

PROJECT MANUAL ERIE COUNTY COMMUNITY COLLEGE EC3

WEST CAMPUS RENOVATIONS HEALTH LAB

**2403 W. 8th Street
Erie, PA 16505**

VOLUME 1 DIVISIONS 00 - 12

CPL Project Number.: R24.15543
Document Date: 4/4/25

ARCHITECT/ENGINEER
CPL ARCHITECTS AND ENGINEERS
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Pittsburgh, PA 15275
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OWNER
ERIE COUNTY COMMUNITY COLLEGE (EC3)
2403 W. 8th Street
Erie, PA 16505
(814) 413-7000
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**SECTION 000105
CERTIFICATIONS PAGE**

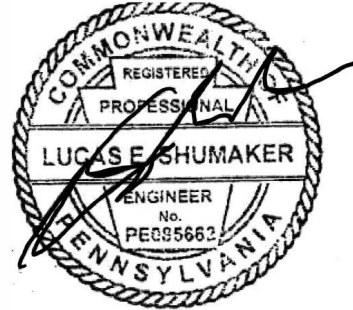
ARCHITECT'S CERTIFICATION:

ENGINEER'S CERTIFICATION:



Date: 04/07/2025

CPL



Date: 04/07/2025

CONSULTANT

000105
CERTIFICATIONS PAGE

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**SECTION 000110
TABLE OF CONTENTS**

PROCUREMENT AND CONTRACTING REQUIREMENTS

VOLUME 1

DIVISION 00 -- PROCUREMENT AND CONTRACTING REQUIREMENTS

- 000100 - PROJECT MANUAL
- 000105 - Certifications Page
- 000110 - Table of Contents
- 002000 - Instructions to Bidders
- 004000 - Form of Proposal
- 004500 - Qualification Statement
- 005100 - A101 2017 Agreement Form
 - 1. Exhibit A - Insurance Requirements
 - 2. Exhibit B - Redevelopment Assistance Capital Program - Key Compliance Guidelines
- 007100 - A201 2017 General Conditions
- 007210 - Sample Performance and Payment Bonds
- 007343 - Wage Rate Requirements (PA)

TECHNICAL SPECIFICATIONS

DIVISION 01 -- GENERAL REQUIREMENTS

- 011000 - Summary
- 012500 - Substitution Procedures
- 012600 - Contract Modification Procedures
- 012900 - Payment Procedures
- 013100 - Project Management and Coordination
- 013200 - Construction Progress Documentation
- 013300 - Submittal Procedures
- 014000 - Quality Requirements
- 014200 - References
- 015000 - Temporary Facilities and Controls
- 016000 - Product Requirements
- 017300 - Execution
- 017700 - Closeout Procedures
- 017823 - Operation and Maintenance Data
- 017839 - Project Record Documents
- 017900 - Demonstration and Training

000110
TABLE OF CONTENTS

DIVISION 02 -- EXISTING CONDITIONS

024100 - Demolition

DIVISION 03 -- CONCRETE

035416 - Cementitious Underlayment

DIVISION 04 -- MASONRY

042000 - Unit Masonry

DIVISION 05 -- METALS

055000 - Metal Fabrications

DIVISION 06 -- WOOD, PLASTICS, AND COMPOSITES

061000 - Rough Carpentry

061053 - Miscellaneous Rough Carpentry

062000 - Finish Carpentry

06 4000 - Architectural Woodwork

064100 - Architectural Wood Casework

DIVISION 07 -- THERMAL AND MOISTURE PROTECTION

076200 - Sheet Metal Flashing and Trim

077100 - Roof Specialties

077200 - Roof Accessories

078400 - Firestopping

079200 - Joint Sealants

DIVISION 08 -- OPENINGS

081113 - Hollow Metal Doors and Frames

081416 - Flush Wood Doors

083100 - Access Doors and Panels

084313 - Aluminum-Framed Storefronts

084435 - Protective Framed Glazing Assemblies

087100 - Door Hardware

088000 - Glazing

DIVISION 09 -- FINISHES

090561 - Common Work Results for Flooring Preparation

092216 - Non-Structural Metal Framing

093000 - Tiling

095100 - Acoustical Ceilings

096500 - Resilient Flooring

096813 - Tile Carpeting

099000 - Painting and Coating

DIVISION 10 -- SPECIALTIES

101423 - Panel Signage

102123 - Cubicle Curtains and Track

000110
TABLE OF CONTENTS

102600 - Wall and Door Protection
102800 - Toilet, Bath, and Laundry Accessories
104400 - Fire Protection Specialties

DIVISION 11 -- EQUIPMENT

DIVISION 12 -- FURNISHINGS

123600 - Countertops

DIVISION 13 -- SPECIAL CONSTRUCTION (NOT USED)

DIVISION 14 -- CONVEYING EQUIPMENT (NOT USED)

VOLUME 2

000102 - Project Manual Volume 2
000110 - Table of Contents

DIVISION 21 -- FIRE SUPPRESSION (NOT USED)

DIVISION 22 -- PLUMBING

220500 - Common Work Results for Plumbing
220517 - Sleeves and Sleeve Seals for Plumbing Piping
220518 - Escutcheons for Plumbing Piping
220519 - Meters and Gauges for Plumbing Piping
220523 - General-Duty Valves for Plumbing Piping
220529 - Hangers and Supports for Plumbing Piping and Equipment
220553 - Identification for Plumbing Piping and Equipment
220719 - Plumbing Piping Insulation
221116 - Domestic Water Piping
221119 - Domestic Water Piping Specialties
221316 - Sanitary Waste and Vent Piping
221319 - Sanitary Waste Piping Specialties
224213 - Commercial Water Closets
224216 - Commercial Lavatories
224217 - Commercial Sinks

DIVISION 23 -- HEATING, VENTILATING, AND AIR-CONDITIONING (HVAC)

230500 - Common Work Results for HVAC
230513 - Common Motor Requirements for HVAC Equipment
230553 - Identification for HVAC Piping and Equipment
230593 - Testing, Adjusting, and Balancing for HVAC
230713 - Duct Insulation
230800 - Commissioning of HVAC
232116 - Hydronic Piping Specialties

000110
TABLE OF CONTENTS

233113 - Ductwork
233300 - Air Duct Accessories
233400 - HVAC Fans
233600 - Air Terminal Units
233713 - Diffusers, Registers and Outlets
237200 - 100% Outdoor Air Energy Recovery Ventilators
237439 - Packaged Outdoor Unitary Air Conditioners
238216 - Air Coils
238249 - Electric Unit Heaters

DIVISION 24 -- RESERVED (NOT USED)

DIVISION 25 -- INTEGRATED AUTOMATION (NOT USED)

DIVISION 26 -- ELECTRICAL

260500 - Common Work Results for Electrical
260519 - Low-Voltage Electrical Power Conductors and Cables
260526 - Grounding and Bonding for Electrical Systems
260529 - Hangers and Supports for Electrical Systems
260533 - Raceway and Boxes for Electrical Systems
260553 - Identification for Electrical Systems
260573 - Electrical System and Protective Device Studies
260923 - Lighting Control Devices
262416 - Panelboards
262726 - Wiring Devices
262913 - Enclosed Controllers
265100 - Lighting Fixtures

DIVISION 27 -- COMMUNICATIONS

270500 - Common Work Results for Communications
271300 - Telecommunications System (Telephone and Data Network)

DIVISION 28 -- ELECTRONIC SAFETY AND SECURITY

283111 - Digital, Addressable Fire-Alarm System

END OF SECTION 000110

**SECTION 002000
INSTRUCTIONS TO BIDDERS**

PART 1 GENERAL

1.01 SUMMARY

- A. Attached is AIA Document A701-2018, Instructions to Bidders.
 - 1. AIA Document A701-2018 defines the conditions affecting award of contract and procedures with which Bidders must comply.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 002000

002000
INSTRUCTIONS TO BIDDERS

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**SECTION 004000
FORM OF PROPOSAL**

DATED: _____

Bid from: Name: _____
Address: _____

Phone No.: _____
Fax No.: _____

Bid to: EC3
2403 W. 8th Street
Erie, PA 16505

Bid for: West Campus Renovations Health Lab
GENERAL CONTRACTOR (GC)

BID

A. BID FOR ALL WORK

1. We have examined and fully understand the requirements and intent of the Bidding and Contract Documents and all subsequent addenda as listed below, and propose to provide all materials, plant, labor, supplies, equipment, transportation and other facilities necessary, or proper for, or incidental to the Work, to complete all Work in strict accord with the Contract Documents and as assigned in the Summary for the base bid lump sum of:

Total Lump Sum Base Bid (in numbers): \$

Total Lump Sum Base Bid (in words):

—

B. BID FOR STAIR WELL B FINISHES:

1. We have examined and fully understand the requirements and intent of the Bidding and Contract Documents and all subsequent addenda as listed below, and propose to provide FINISHES IN STAIRWELL B in strict accord with the Contract Documents and as assigned in the Summary for the lump sum of:

2. Total Lump Sum (in numbers): \$

3. Total Lump Sum (in words):

—

C. BID FOR CORRIDOR C10 FINISHES:

1. We have examined and fully understand the requirements and intent of the Bidding and Contract Documents and all subsequent addenda as listed below, and propose to provide FINISHES IN CORRIDOR C10, C20 and C30 including trim on Display Cabinets, in strict accord with the Contract Documents and as assigned in the Summary for the lump sum of:

004000
FORM OF PROPOSAL

2. Total Lump Sum (in numbers): \$

3. Total Lump Sum (in words):

ADDENDA RECEIVED

Any addenda issued by the Architect, mailed or delivered, to the undersigned prior to the Bid opening date shall become part of the Contract Documents. The Bidder shall enter on this list any addenda issued after this Form of Proposal has been received and shall fill in the addenda number and date.

Addendum No.: _____ Dated: _____

Addendum No.: _____ Dated: _____

Addendum No.: _____ Dated: _____

Addendum No.: _____ Dated: _____

NO SUBSTITUTIONS

Bidder confirms that the bid amount does not include substitutions for materials or products which are listed in the drawings or specifications to be provided without substitution.

BID GUARANTEE

The undersigned Bidder agrees to execute a contract for this Work in the above amount and to furnish surety as specified within ten (10) days after a written Notice of Award, if offered within forty-five (45) days after receipt of bids, and on failure to do so agrees to forfeit to Owner the attached cash, cashier's check, certified check, U.S. money order, or bid bond, as liquidated damages for such failure, in the following amount constituting five percent (5 %) of the Base Bid.

In the event Owner does not offer Notice of Award within the time limits stated above, Owner will return to the undersigned the cash, cashier's check, certified check, U.S. money order, or bid bond.

TIME OF COMPLETION

It is agreed by the undersigned that after receipt of a Notice of Award and a consummation of a Contract Agreement in accord with the terms of the Contract Documents, he or she will start work within ten (10) consecutive calendar days of the notice to proceed and fully complete the work as indicated in the Contract Documents.

BID SECURITY

Bid Security in the form of a Certified or Cashier's Check or a Bid Bond in the form required by the Contract Documents is attached to, and made a part of, this Proposal.

REPRESENTATIONS

By submitting this Proposal, the Bidder represents and certifies to the Owner and the Architect that:

004000
FORM OF PROPOSAL

1. It has examined the Contract Documents, the site of the proposed Work, is familiar with the local conditions at the place where the Work is to be performed and fully comprehends the requirements and intent of the plans and specifications for this Project in accordance with the drawings, specifications and other Contract Documents prepared by CPL, the Owners Consultant, for this Project.
2. It has examined and reviewed, where applicable, all information and data in the Contract Documents related to existing underground facilities at or contiguous to the site. Bidder shall require of the Owner or Architect no further investigations, explorations, tests or reports with respect to such underground facilities in order for the Bidder to perform the Work of the Proposal within the Contract Time and in accordance with the Contract Documents.
3. It has given notice to the Architect, as required by the Contract Documents of any and all discrepancies it has discovered and accepts the resolution of those discrepancies offered by the Architect.
4. The proposal is based upon the materials, equipment and systems required by the Contract Documents, without exception, unless otherwise set forth in this Proposal in detail.

CHANGE ORDERS

We propose and agree that the above lump sum shall be adjusted for changes in the Contract Work not included in unit prices by addition of the following costs:

1. Profit and overhead as permitted in the GENERAL CONDITIONS.

NON-COLLUSIVE BIDDING CERTIFICATION

By submission of this bid, each bidder and each person signing on behalf of any bidder certifies, and in the case of a joint bid each party thereto certifies as to its own organization, under penalty of perjury, that to the best of knowledge and belief:

1. The prices in this bid have been arrived at independently without collusion, consultation, communication, or agreement, for the purpose of restricting competition, as to any matter relating to such prices with any other bidder or with any competitor;
2. Unless otherwise required by law, the prices which have been quoted in this bid have not been knowingly disclosed by the bidder and will not knowingly be disclosed by the bidder prior to opening, directly or indirectly, to any other bidder or to any competitor; and
3. No attempt has been made or will be made by the bidder to induce any other person, partnership or corporation to submit or not to submit a bid for the purpose of restricting competition.

ACCEPTANCE

When this Proposal is accepted, the undersigned agrees to enter into a Contract with the Owner as provided in the Form of Agreement.

AFFIRMS

The undersigned affirms and agrees that this Proposal is a firm one which remains in effect and will be irrevocable for a period of forty-five (45) days after opening of Bids.

TYPE OF BUSINESS

The undersigned hereby represents that it is a [] Corporation, [] Partnership, [] Individual. If a Corporation, then the undersigned further represents that it is duly qualified as a Corporation under the laws of the State of Pennsylvania and it is authorized to do business in this State.

EC3
R24.15543

West Campus Renovations
004000 - 4

004000
FORM OF PROPOSAL

004000
FORM OF PROPOSAL

PLACE OF BUSINESS

The following is the name and address of the person to whom all notices required in connection with this Proposal may be telephoned, mailed, or delivered.

Name of Contact Person:	
Name of Business or Firm:	
Address:	
Address:	
Telephone:	Fax:
Email Address:	
FEIN: Federal Employer Identification No.:	

EXECUTION OF CONTRACT

When written Notice of Acceptance of the Proposal is mailed or delivered to the undersigned within forty-five (45) days after the opening of Bids, or anytime thereafter should the Proposal not be withdrawn, the undersigned, within ten (10) days, will execute the Form of Agreement with the Owner.

ASBESTOS

The bidder certifies that no asbestos or asbestos-containing materials will be incorporated into the Work of this Contract.

AUTHORIZED SIGNATURES FOR PROPOSALS

Signature:	
Name:	
	<i>(Typed or Printed)</i>
Title:	
Firm:	
	<i>(Legal Name of Person, Single Proprietorship, Partnership, or Corporation)</i>
Date:	

(if Corporation, provide seal above)

004000
FORM OF PROPOSAL
PENNSYLVANIA STEEL PRODUCTS PROCUREMENT ACT

By submission of this bid, or by assuming the responsibility of a Contract awarded hereunder, each bidder and each person signing on behalf of any bidders, certifies, and in the case of a joint bid each party thereto certifies as to its own organization, under penalty of perjury, that to the best of its knowledge and belief the requirements of the Pennsylvania Steel Products Procurement Act will be met for this contract. An explanation of these requirements is included in the RACP KEY COMPLIANCE GUIDELINES which are included in this project manual and will be incorporated into the construction contract.

MAILING ADDRESS: _____

CITY/STATE/ZIP CODE: _____

BY: _____

(Signature of Representative of Firm or Corporation)

NAME: _____ TITLE: _____

Please Print

Please Print

DATED: _____

**SECTION 004500
QUALIFICATION STATEMENT**

PART 1 GENERAL

1.01 SUMMARY

A. Fill in information:

Project Number:
Owner's Name:
Name of Bidder:
FEIN (Federal Employer Identification Number)

1.02 STATEMENT OF BIDDER'S QUALIFICATIONS

A. Contract For (Circle or Fill In):

1. GC, MC, EC, and PC ,OTHER _____

B. Notarized & Submitted By 3 Low Bidders Within 72 Hours of Architect Request. All questions must be answered, and the data given must be clear and comprehensive. If necessary, questions may be answered on separate attached sheet.

1. Name of Bidder
2. Permanent main office address
3. When organized
4. If a corporation, where incorporated
5. How many years have you been engaged in the contracting business under your present firm or trade name?
6. Contracts on hand: (Schedule these, showing amount of each contract and the appropriate anticipated dates of completion.)
7. General character of work performed by your company
8. Has any construction contract to which you have been a party been terminated by the OWNER; have you ever terminated work on a project prior to its completion for any reason; has any surety which issued a performance bond on your behalf ever completed the work in its own name or financed such completion on your behalf; has any surety expended any monies in connection with a contract for which they furnished a bond on your behalf? If the answer to any portion of this question is "yes", please furnish details of all such occurrences including name of owner, architect or Architect, and surety, and name and date of project.
9. Has any officer, partner, member or manager of your organization ever been an officer, partner, member or manager of another organization that had any construction contract terminated by the OWNER; terminated work on a project prior to its completion for any reason; had any surety which issued a performance bond complete the work in its own name or financed such completion; or had any surety expend any monies in connection with a contract for which they furnished a bond? If the answer to any portion of this question is "yes", please furnish details of all such occurrences including name of owner, architect or Architect, and surety, and name and date of project.
10. List your experience in work similar to this project.
11. List the background and experience of the principal members of your organization, including officers.
12. List name of project, owner, architect or Architect, contract amount, percent complete and scheduled completion of the major construction projects your organization has in process on this date.
13. List name of project, owner, architect or Architect, contract amount, date of completion and percent of work with own forces of the major projects of the same general nature as this project which your organization has completed in the past five (5) years.
14. Will you, upon request, fill out a detailed financial statement and furnish any other information that may be required by the Owner?

004500

QUALIFICATION STATEMENT

15. List name, address and telephone number of a reference for each project listed under items 12 and 13 above.
16. List names and construction experience of the principal individuals of our organization.
17. List the states and categories of construction in which your organization is legally qualified to do business.
18. List name, address and telephone number of an individual who represents each of the following and whom OWNER may contact for a financial reference:
 - a. One Surety:
 - b. Two banks:
 - c. Three major material suppliers:
19. Attach a financial statement, prepared on an accrual basis, in a form which clearly indicates assets, liabilities and net worth.
 - a. Date of financial Statement:
 - b. Name of firm preparing statement:
20. The undersigned hereby authorizes and requests any person, firm or corporation to furnish any information requested by the Owner in verification of the recitals comprising this Statement of Bidder's Qualifications and that the answers to the foregoing questions and all statements therein contained are true and correct.

Date:
Name of Bidder:
Title:
State of:
County of:
Being duly sworn deposes and says that he is:
Of (Name of Firm or Corporation):
Subscribed and Sworn to before me:
Date:
Notary Public Signature and Stamp:

1.03 BIDDERS STATEMENT

- A. Fill in information:

Name of Bidder:
Name of Firm or Corporation:
Name of Owner and Project Name:

004500

QUALIFICATION STATEMENT

- B. The Bidder making the Bid for Construction of the above named Project, certifies that I or my authorized representative has personally inspected the job site. The Bidder has relied on its own knowledge and review and interpretation of the Bidding Documents and all relevant plans and specifications, boring logs and other data in submitting his bid and not on any representation made by the Owner, Architect, or any other person, with respect to the character, quality or quantities of Work to be performed, or materials or equipment to be furnished. Bidder acknowledges that any quantities are an estimate only so that Bidder agrees not to seek additional compensation or request an adjustment in any unit price as a result of any variation in quantities or unforeseen site conditions encountered for any reason whatsoever. The Bidder represents that it has reviewed and accepts the applicable Project schedule and all revisions thereto. The Bidder agrees and understands that any such project schedule is incorporated by reference in the Contract Documents and further acknowledges that its failure to adhere to any such project schedule will expose Owner to severe financial hardship. Accordingly, Bidder agrees to exonerate, indemnify and hold Owner harmless from and against any and all losses, damages (including claims made by other Contractors performing Work at the Project) and claims arising out of Bidder's failure to adhere to any project schedule or any modifications, updates or revisions thereto. The Bidder's failure to adhere to and maintain the project schedule, including any revisions thereto, shall be grounds for termination.

Print Name of Bidder:

Signature of Bidder:

Title:

Seal if Bidder is a Corporation:

1.04 PERFORMANCE BOND INFORMATION FORM

- A. Fill in information:

City/Town/Village:

School District:

Construction Contract Number:

Name of Contract

Name of Contractor:

Address:

Entity Issuing Security Bond:

EC3
R24.15543

West Campus Renovations
004500 - 4

004500

QUALIFICATION STATEMENT

Address:	
Bonding Agent:	
Address:	
Amount of Bid:	
Duration of Bond: From:	To:
Bond Identification Number:	

END OF SECTION 004500

**SECTION 005100
AGREEMENT FORM**

PART 1 GENERAL

1.01 SUMMARY

- A. The following is a "Standard Form of Agreement Between Owner and Contractor where the Basis of Payment is a Stipulated Sum, "AIA Document A101-2017, along with Exhibit A – Insurance and Bonds, is bound with this Section. AIA Document A101-2017 is a standard form of agreement between Owner and Contractor for use where the basis of payment is a stipulated sum (fixed price). AIA Document A101 adopts by reference, and is designed for use with, AIA Document A201–2017, General Conditions of the Contract for Construction.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION 005100

005100
AGREEMENT FORM

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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)

Erie County Community College
2403 West 8th Street
Erie, PA 16505

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 may have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes 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 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.

ELECTRONIC COPYING of any portion of this AIA® Document to another electronic file is prohibited and constitutes a violation of copyright laws as set forth in the footer of this document.

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. If there is any ambiguity or inconsistency noted in the Contract Documents, it shall be presented timely to the Owner who shall then render a decision as to the controlling document or provision, with no right of appeal, challenge, additional cost or time allowed.

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:

(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 (\$) , 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.)

Per calendar day after , 2025 at \$ per day.

§ 4.6 Other:

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

Not applicable.

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 following consultation with and approval by the Owner, 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 and approved by the Owner not later than thirty (30) days after the approval of the Owner or Owner's Board of Directors as applicable. If an Application for Payment is received by the Architect after the application date fixed above, payment of the amount certified by the Architect following Owner consultation shall be made by the Owner not later than thirty (30) days after the next opportunity for approval.
(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 insured and 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.; and
- .6 Any amounts assessed as Owner back charges, deduct change orders or as liquidated damages.

§ 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:

Retainage shall be a 10% until the Architect certifies the Work to be a 50% completion, whereupon, if the Contractor is on schedule and there are no unresolved claims between Owner and Contractor, and no unresolved claims by or involving any other Prime Contractor on the Project, then Contractor may request the release of half of the retainage in its next application for payment. From and after 50% completion, the retainage shall be at 5% unless there is good cause for the Architect to recommend additional retainage be withheld or if the Owner determines that good cause exists to withhold greater retainage. Any reduction in, or release of retainage by Owner shall then be proportionally released by Contractor to its subcontractors or suppliers within twenty (20) days of receipt by Contractor.

(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.)

§ 5.1.7.1.1 The following items are not subject to retainage: Payment Bond or Performance Bond

(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.)

See 5.1.7.1 above.

§ 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.)

Upon Certification of Substantial completion by the Architect, any retainage shall be released in the next scheduled application for payment, less 1.5 times the reasonable value of the punch list items, incomplete items, deficient items or Owner claims, all as noted in writing to Contractor and valued by the Architect.

§ 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 the below listed conditions precedent have been satisfied.

- .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;
- .2 a final Certificate for Payment has been issued by the Architect.
- .3 the Contractor has submitted a Consent of Surety; and
- .4 the Contractor has submitted an unconditional Final Release and Waiver of all claims and mechanics liens on

behalf of itself and its subcontractors or suppliers in a form suitable to Owner.

§ 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 and satisfaction of the express conditions precedent to final Payment as outlined in Article 5.2.1 above.

§ 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.)

zero % zero

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 Architect's written decision does not resolve the claim or dispute, then the parties shall come to agreement on a neutral Private Mediator who shall upon notification for the parties, schedule and conduct a private mediation to address the claims or disputes at issue. Any resolution achieved through Mediation shall be reduced to a written term sheet executed by the parties in the presence of the Mediator and then added to the Contract Documents as a Change Order to this Agreement. If the Mediation is not successful, or does not resolve all claims or disputes, then the remaining claims and disputes shall be resolved in accordance with Article 6.2 below.

(If the parties mutually agree, insert the name, address and other contact information of the Initial Decision Maker, if other than the Architect.)

§ 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.)

At the election and sole discretion of the Owner, which decision the Owner shall communicate to Contractor and Contractor's Surety within thirty (30) days of the close of the Mediation either

☐ Arbitration pursuant to Section 15.4 of AIA Document A201–2017

☐ Litigation in a court of competent jurisdiction in the County where the Project is located

☐ 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 evaluate the Contractor's termination fee submission with the input of the Architect and issue a change order for the direct costs allowed. There shall be no payment for unearned or unperformed work, or for overhead and profit on unearned work. Any Contractor or subcontractor submissions shall be itemized and in such detail as required by Architect or Owner.

(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)

§ 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 a building information modeling exhibit, if completed, or as otherwise set forth below:

(If other than in accordance with a building information modeling exhibit, 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 **Exhibit B – RACP Key Compliance Document**
- .4 AIA Document A201™–2017, General Conditions of the Contract for Construction

.5 Drawings

Number	Title	Date
--------	-------	------

.6 Specifications

Section	Title	Date	Pages
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.7 Addenda, if any:

Number	Date	Pages
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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.)

[] 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
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[] Supplementary and other Conditions of the Contract:

Document	Title	Date	Pages
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.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)*

(Printed name and title)

CONTRACTOR *(Signature)*

(Printed name and title)

EXHIBIT A

1. Before commencing the Work, the Contractor shall at all times, procure and maintain, at it's own expense, not less than the following insurance coverage and limits which shall be maintained under forms of policies and from companies reasonable satisfactory to the Owner(s). The insurance company must have a financial rating of at least A-VII as defined by A.M. Best Company.

2. WORKERS' COMPENSATION AND EMPLOYERS' LIABILITY INSURANCE in accordance with laws of the Commonwealth of Pennsylvania. Employer's Liability Insurance shall be provided in amounts not less than:

\$1,000,000 each accident for bodily injury by accident

\$1,000,000 policy limit for bodily injury by disease

\$1,000,000 each employee for bodily injury by disease

If there is an exposure of injury to Contractor's employees under the U.S. Longshoremen's and Harbor Workers' Compensation Act, the Jones Act or under laws, regulations or statutes applicable to employees, coverage shall be included for such injuries or claims.

3. COMPREHENSIVE/COMMERCIAL GENERAL LIABILITY INSURANCE APPLICABLE TO THE WORK INCLUDING COMPLETED OPERATIONS, CONTRACTUAL LIABILITY INSURANCE FOR THE LIABILITY ASSUMED HEREINABOVE, and including INDEPENDENT CONTRACTORS LIABILITY INSURANCE if the Contractor sublets to another all or any portion of the Work, Personal Injury Liability, Broad Form Property Damage (including completed operations), and Explosion, Collapse and Underground Hazards and shall be written on ISO occurrence Form CG0001 10 01 or a substitute form providing equal or greater coverage, with the following minimum limits:

\$1,000,000 Each Occurrence

\$1,000,000 Personal & Advertising Injury

\$2,000,000 Products & Completed Operations Aggregate

\$2,000,000 General Aggregate

Per Project Aggregate. The policy must have an endorsement providing that the general aggregate limit applies separately to each project.

4. COMPREHENSIVE/BUSINESS AUTOMOBILE LIABILITY INSURANCE covering all owned, non-owned and hired automobiles including, but not limited to mobile equipment, semi tractors, trailers, tank trucks, buses used in connection with the Work, with the following minimum limits:

Combined Single Limit \$1,000,000

5. UMBRELLA LIABILITY INSURANCE \$5,000,000 each occurrence / annual aggregate.

6. Before commencing the Work, the Contractor shall furnish a certificate, satisfactory to Owner from each insurance company showing that the above insurance is in force, stating policy numbers, dates of expiration, and limits of liability thereunder, and further providing that the insurance will not be canceled or changed until the expiration of at least sixty (60) days after written notice of such cancellation or change has been mailed to and received by Owner.

7. The Owner and other entities as may be reasonably requested shall be named as an additional insured under these policies of insurance using form CG 20 10 and CG 20 37, or their equivalent. It is expressly agreed and understood by and between Owner and Contractors that the insurance afforded the additional insureds shall be primary insurance and that any other insurance carried by Owner shall be excess of all other insurance carried by the Contractor and shall not contribute with the Contractors insurance. Contractor further agrees to provide endorsements on its insurance policies copies of which are to be supplied with applicable certificates which shall state the foregoing.

8. 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, and (2) the Architect, Architect's consultants, separate contractors described herein, 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 covered by property insurance obtained for this project or other property insurance applicable to the Work, except such rights as they have to proceeds of such insurance held by the Owner as fiduciary. The Owner or Contractor, as appropriate, shall require of the Architect, Architect's consultants, separate contractors described herein, if any, and the subcontractors, sub-subcontractors, agents and employees of any of them, by appropriate agreements, written where legally required for validity, 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 damage.

9. Certificates including additional insured endorsement shall be furnished annually and for Three (3) years following completion of the Work.

10. If the Contractor fails to procure and maintain such insurance, Owner shall have the right, but not the obligation, to procure and maintain said insurance for and in the name of the Contractor and the Contractor shall pay the cost thereof and shall furnish all necessary information to make effective and maintain such insurance and at Owner's option, Owner may offset the cost incurred by Owner against amounts otherwise payable to Contractor hereunder.

11. The Contractor shall ensure that all tiers of their subcontractors shall procure and maintain insurance in like form and amounts including naming Owner(s) as Additional Insureds. Copies of certificates must be provided prior to the sub-subcontractors of any tier entering the site.

12. The required insurance shall be subject to the approval of Owner, but any acceptance of insurance certificates by Owner shall in no way limit or relieve Contractor of the contractual or legal duties and responsibilities of said Contractor. If higher limits or other forms of insurance are required in the Contract Documents, Contractor will comply with such requirements.



CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY)

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

IMPORTANT: If the certificate holder is an ADDITIONAL INSURED, the policy(ies) must be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

PRODUCER	CONTACT NAME:		
	PHONE (A/C, No, Ext):	FAX (A/C, No):	
	E-MAIL ADDRESS:		
	INSURER(S) AFFORDING COVERAGE		NAIC #
	INSURER A:		
	INSURER B:		
INSURED ABC Company	INSURER C:		
	INSURER D:		
	INSURER E:		
	INSURER F:		

COVERAGES

CERTIFICATE NUMBER: SAMPLE

REVISION NUMBER:

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	TYPE OF INSURANCE	ADDL INSR	SUBR WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS
	GENERAL LIABILITY						EACH OCCURRENCE \$ 1,000,000
	<input checked="" type="checkbox"/> COMMERCIAL GENERAL LIABILITY						DAMAGE TO RENTED PREMISES (Ea occurrence) \$ 500,000
	<input type="checkbox"/> CLAIMS-MADE <input checked="" type="checkbox"/> OCCUR	X	X				MED EXP (Any one person) \$ 10,000
							PERSONAL & ADV INJURY \$ 1,000,000
							GENERAL AGGREGATE \$ 2,000,000
	GEN'L AGGREGATE LIMIT APPLIES PER:						PRODUCTS - COMP/OP AGG \$ 2,000,000
	<input type="checkbox"/> POLICY <input checked="" type="checkbox"/> PRO-JECT <input type="checkbox"/> LOC						
	AUTOMOBILE LIABILITY						COMBINED SINGLE LIMIT (Per accident) \$ 1,000,000
	<input checked="" type="checkbox"/> ANY AUTO						BODILY INJURY (Per person) \$
	<input type="checkbox"/> ALL OWNED AUTOS						BODILY INJURY (Per accident) \$
	<input type="checkbox"/> HIRED AUTOS						PROPERTY DAMAGE (Per accident) \$
	<input checked="" type="checkbox"/> UMBRELLA LIAB						EACH OCCURRENCE \$ 5,000,000
	<input type="checkbox"/> EXCESS LIAB						AGGREGATE \$ 5,000,000
	<input type="checkbox"/> DED <input type="checkbox"/> RETENTION \$	X	X				
	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY						<input checked="" type="checkbox"/> WC STATUTORY LIMITS <input type="checkbox"/> OTHER
	ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? (Mandatory in NH)	Y/N					E.L. EACH ACCIDENT \$ 1,000,000
	If yes, describe under DESCRIPTION OF OPERATIONS below	N/A					E.L. DISEASE - EA EMPLOYEE \$ 1,000,000
							E.L. DISEASE - POLICY LIMIT \$ 1,000,000
	Contractor's Pollution Liability						Per Claim \$2,000,000 Aggregate \$2,000,000

CERTIFICATE HOLDER**CANCELLATION**

Erie County Community College
2403 West 8th Street
Erie, PA 16505

SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.

60 Days Notice of Cancellation

AUTHORIZED REPRESENTATIVE

Redevelopment Assistance Capital Program (RACP)

Key Compliance Guidelines



November 2024

KEY COMPLIANCE GUIDELINES

It is suggested that a copy of this complete document be given to your Project, Construction Manager, and/or Architect so that they are fully aware of the RACP requirements related to each. This document should be included in your bid packages and should be made an addendum to any and all construction contracts, plans and specifications related to the RACP project.

Compliance with all RACP requirements, including the key items in these guidelines will be monitored frequently throughout the construction phase of your project and will be reviewed once more during the legislatively mandated close-out audit.

COMPETITIVE BIDDING REQUIREMENTS

The sole and exclusive bidding requirement for RACP projects is in the Capital Facilities Debt Enabling Act (Act 67 of 2004), which states "Notwithstanding any other provision of law, the solicitation of a minimum of three written bids for all contracted construction work on redevelopment assistance capital projects shall be the sole requirement for the composition, solicitation, opening and award of bids on such projects." Unless the terms of the law change, the Office of the Budget cannot grant waivers for bidding requirements to Grantees.

RACP projects are not subject to separation of trades. You are REQUIRED to solicit a minimum of three (3) bids for "all generally contracted work" being performed within the RACP defined scope of work. You are not required to receive three (3) bid responses. However, you should provide documentation to prove that at least three bids were solicited by providing copies of the solicitation letters (preferably on letterhead of the bidding entity) used in the bidding process. You are not required to select the lowest bidder, but if you do not, you will have to provide a brief written justification for your selection. Note: there is NO threshold level under the RACP program regardless of the size or dollar amount associated with the work to be performed. You need to show that you solicited a minimum of three (3) bids for any contract to be eligible for RACP.

Bidding is acceptable at either the general contractor level (described in option a. below) or at the sub-contractor level (described in option b. below):

- **General Contractor (GC) Level** - If you chose to bid at the GC level, please note that the bid should encompass the entire RACP scope of work to be performed including all associated construction work. The dollar amount bid on the project must include 100% of the work to be performed by the GC and the sub-contractors. Bidding at the GC level will require submission of bidding and construction related documents at the GC level only (see Sub-Contractor level below for a distinction)
- **Sub-Contractor Level** - If you choose not to solicit three bids for a General Contractor, then you are required to solicit a minimum of three bids for EACH Sub-Contractor covering all trades involved in the project. Note that any self-performed work by a non-bid GC is NOT an eligible cost for reimbursement OR match purposes. Bidding at the Sub-Contractor level will require submission of bidding and construction related documents at the sub level...meaning proof of

bidding, construction contracts, payment and performance bonds, insurance etc. will need to be provided for every sub-contractor in the RACP scope.

Professional Services: Professional services associated with the project are not required to be bid as these associated costs are only eligible as match.

Change Orders: Grantees and/or Sub-Grantees are not required to competitively bid out change orders as long as the work was within the RACP scope of the original bid and is less than 20% of the total contract. If a change order is for work beyond the RACP scope of work originally bid, the Grantee will be required to competitively bid out the new scope of work in order to be considered RACP eligible.

PENNSYLVANIA STEEL PRODUCTS PROCUREMENT ACT

The Office of the Budget (OB) cannot grant waivers to the Pennsylvania Steel Products Procurement Act (SPPA) unless the terms of the law change. All RACP Grantees must comply with the SPPA. If a Grantee/RACP project fails to abide by the SPPA, it does so at its own risk.

[A full explanation on the RACP steel requirements is available as a PDF download.](#)

Up to 2011, OB only accepted the ST-4 Form (justification for the use of foreign steel) that the Department of General Services (DGS) had exclusively devised to address exceptions linked to the requirements of the SPPA, when it was necessary. Since 2011, OB has approved the acceptability of two more DGS ST Forms (ST-2, ST-3) with some caveats, providing that the forms are properly filled out. The ST-1 Form will not be accepted by OB. It is not necessary for the ST-2, ST-3, and ST-4 Forms to be notarized.

Since 2013, OB has utilized the DGS Exempt Machinery and Equipment Steel Products listings as part of the RACP steel policy. DGS published a Statement of Policy - Steel Products Procurement in the Pennsylvania Bulletin Volume 43, Number 6 dated February 9, 2013 (See PA Bulletin #43, pages 85-86) that discussed their production of an annual list, based on their analysis of submitted ST-4 forms, which exempts certain steel products not produced domestically in sufficient quantity. DGS publishes an updated "Exemption List" annually.

Please be aware that ST forms are acceptable only in cases where nonstructural steel needs to be addressed. The DGS ST forms do not replace the steel certification forms associated with structural steel. OB will continue to require the submission of steel mill certifications to demonstrate compliance with the steel requirements for structural steel.

The PDF copies of the three acceptable ST Forms for RACP listed below can be obtained from the RACP website:

- [ST-2 Steel Origin Certification: Non-Identifiable, Non-Structural Steel](#)
- [ST-3 75% U.S. Manufacture Certification](#)
- [ST-4 Not Domestically Manufactured: Prime Contractor](#) (only to be used when requesting items to be exempted that are not found on the current year's List of Exempt Machinery and Equipment Steel Products)

It is suggested that the certifications be collected at the time any steel for the project is purchased and delivered to ease the collection process.

Be advised that OB DOES NOT need to approve the ST forms prior to the start of the construction period. The ST forms need to be submitted to demonstrate that compliance, when and where necessary, has been met.

We shall deem as ineligible all contracts that are unable to demonstrate compliance via the submission of steel certifications for Structural Steel and for Non-structural Steel the submission of steel certifications and/or ST forms and/or DGS Exempt Machinery and Equipment Steel Products List. Therefore, the value of construction contracts associated with non-compliant steel will be removed (both materials and labor costs) from the scope of the project, which may in turn affect the project's ability to leverage their full grant amount (project may not receive its full grant).

Recycled products, melted from previously used steel, are acceptable, providing that adequate documentation from the supplier has been furnished. The supplier shall certify that the recycled steel product was produced in the USA.

TRADE PRACTICES ACT

In accordance with the Trade Practices Act of July 23, 1968, P.L. 686 (71 P.S. § 773.101 et seq.), the Grantee cannot and shall not use or permit to be used in the work any aluminum or steel products made in a foreign country which is listed below as a foreign country which discriminates against aluminum or steel products manufactured in Pennsylvania. The countries of Argentina, Brazil, South Korea, and Spain have been found to discriminate against certain products manufactured in Pennsylvania. Therefore, the purchase or use of those countries' products, as listed below, is not permitted:

- **Argentina:** carbon steel wire rod and cold-rolled carbon steel sheet.
- **Brazil:** welded carbon steel pipes and tubes; carbon steel wire rod; tool steel; certain stainless steel products, including hot-rolled stainless steel bar; stainless steel wire rod and cold-formed stainless steel bar; pre-stressed concrete steel wire strand; hot-rolled carbon steel plate in coil; hot-rolled carbon steel sheet; and cold-rolled carbon steel sheet.
- **South Korea:** welded carbon steel pipes and tubes; hot-rolled carbon steel plate; hot-rolled carbon steel sheet; and galvanized steel sheet.
- **Spain:** certain stainless steel products, including stainless steel wire rod, hot-rolled stainless steel bars; and cold-formed stainless steel bars; pre-stressed concrete steel wire strand; and certain steel products, including hot-rolled steel plate, cold-rolled carbon steel plate, carbon steel structural shapes; galvanized carbon steel sheet, hot-rolled carbon steel bars, and cold-formed carbon steel bars.

Penalties for violation of the above paragraphs may be found in the Trade Practices Act, which penalties include becoming ineligible for public works contracts for a period of three years.

This provision in no way relieves the Grantee of responsibility to comply with those provisions which prohibit the use of foreign-made steel and cast iron products.

PUBLIC WORKS CONTRACTORS' BOND LAW (PAYMENT & PERFORMANCE BONDS)

The requirement for 100% payment and performance (P&P) bonds is a state law; the Office of the Budget cannot waive this requirement.

A performance bond must be obtained at 100% of the contract amount, conditioned upon the faithful performance of the contract in accordance with the plans, specifications, and conditions of the contract. Such bond shall be solely for the protection of the contracting body which awarded said contract.

A payment bond must be obtained at 100% of the contract amount. Such bond shall be solely for the protection of claimants supplying labor or materials to the Grantee, its contractor or to any of its subcontractors, in the prosecution of the work provided for in such contract, and shall be conditioned for the prompt payment of all such material furnished or labor supplied or performed in the prosecution of the work. "Labor or materials" shall include public utility services and reasonable rentals of equipment, but only for periods when the equipment rented is actually used at the site.

PA PREVAILING WAGE ACT (PWA)

The Office of the Budget cannot grant waivers for the PA Prevailing Wage Act. All Grantees must comply with the act. Grantees that fail to abide by the Prevailing Wage Act do so at their own risk. Please do not assume that PA Prevailing Wage is always consistent with your local union wages.

All projects should apply for a wage determination letter prior to the start of construction by registering the project with the PA Department of Labor and Industry to obtain the prevailing wage rates relevant to your project. This determination sheet will provide the necessary trade classifications for the project, along with their corresponding hourly wage and hourly fringe rates that are required for the certified payrolls required as part of RACP. The wage determination should be obtained within 120 days of the award of construction contracts. If necessary, the Department of Labor and Industry can issue determinations letters after construction has begun.

The prevailing wage information and forms can be found on the [PA Department of Labor & Industry website](#).

AMERICANS WITH DISABILITIES ACT (ADA)

Typically your architect should provide a letter stating the plans and specs are in compliance with ADA regulations. Additionally, the Grantee agrees to comply with the General Prohibitions Against Discrimination, 28 C.F.R. § 35.130, and all other regulations promulgated under Title II of The Americans with Disabilities Act which are applicable to all benefits, services, programs, and activities provided by the commonwealth through contracts.

FIDELITY BONDS

The Grantee shall procure and furnish evidence to OB, of fidelity bonds with coverage to be maintained under the administrative title of the position, in amounts and for such positions as are reasonably determined by OB. Fidelity Bonding is also commonly known as "Employee Dishonesty Insurance."

Grantees should submit certificates of insurance to support fidelity bond coverage is in effect and the coverage amount meets or exceeds the RACP grant amount, or the coverage amount meets or exceeds the monthly project funding schedule contained in Appendix C of the grant agreement. For Grantees with multiple projects and/or grants larger than \$5,000,000 the coverage amount can be the lesser of either \$1,000,000 or 20% of the RACP grant amount(s).

INSURANCE REQUIREMENTS

- Worker's Compensation Insurance - The Grantee shall provide Worker's Compensation Insurance where required, and shall accept full responsibility for the payment of premiums for Worker's Compensation Insurance and Social Security, as well as income tax withholding and any other taxes or payroll deductions required by law for its employees who are performing services related to the project.
- General Liability & Property Damage Insurance - The Grantee will provide and maintain comprehensive general liability and property damage insurance in the minimum amount of \$250,000.00 per person for injury and death in a single occurrence; \$1,000,000.00 per occurrence for injury or death of more than one (1) person in a single occurrence; and \$500,000.00 for a single occurrence of property damage, and which shall be endorsed to protect the commonwealth.
- Flood Insurance – If the project is wholly or partially within a floodplain, proof of sufficient flood insurance coverage must be provided. In any case, a project is required to provide a copy of a floodplain map of the project area, with the project site being delineated thereon.

Identify Commonwealth as Additional Insured: The commonwealth shall be listed on the above insurance policies as an additional insured. Upon request, the Grantee shall furnish proof of insurance as required by this section to OB.

RESTRICTIONS ON GOVERNMENTAL ENTITIES SELLING RACP PROJECTS

Article 8 of the RACP Grant Agreement spells out sale price restrictions for a governmental entity that sells property that was acquired and/or improved with RACP funds. The restrictions are required to insure that the Grantees CANNOT sell the property for a net gain or even recoup the value of the grant in the sale price. [A PDF download is available that contains more information on Article 8.](#)

Redevelopment Assistance Capital Program (RACP)



Steel Guidance

November 2024

GUIDANCE ON STEEL CERTIFICATION

The following guidance is a clarification from the Office of the Budget (OB) regarding the requirements associated with the Pennsylvania Steel Products Procurement Act (SPPA) relative to the RACP program whose statutes are regulated under Act 1 of 1999, as amended. In the past, many grantees have inquired about specific cases and we were able to provide each individual project with specific directions. Additionally, we had only accepted the ST-4 form that the Department of General Services (DGS) had exclusively devised to address exceptions linked to the requirements of the SPPA in the handling of special cases or exceptions. Please note that cost consideration (or convenience) is not an acceptable justification that the ST-4 form can address. Filled out ST-4 forms premised on cost consideration will not be accepted by OB.

OB accepts two DGS ST forms (ST-2 and ST-3) with some caveats, providing that the forms are properly filled out. The ST-1 form is NOT a valid option and shall NOT be accepted by OB. It is not necessary for the ST-2, ST-3, and ST-4 forms to be notarized. Please, be advised that this guidance is specifically tailored to suit the published and programmatic needs of OB as the overseer of RACP program. This is not a commonwealth-wide policy. Any attempt to impose this guidance on other state agencies is strongly discouraged.

Please, be aware that the aforementioned ST forms are acceptable only in cases where non-structural steel needs to be addressed. The DGS ST forms do not replace the steel certification forms associated with structural steel. It remains the responsibility of the project representatives to provide documented evidence that a non-structural steel product is not domestically produced in sufficient quantities.

OB shall continue to require that steel mill certifications be submitted to demonstrate compliance with the steel requirements. Please, be further advised that OB DOES NOT need to approve the ST forms prior to the start of the construction period. The ST forms need to be submitted to demonstrate that compliance, when and where necessary, has been met. The ST forms exceptions are displayed below. Please submit questions to RA-OB-RACP-Steel-Cost@pa.gov.

It is suggested that the certifications be collected at the time any steel for the project is purchased and delivered to ease the collection process.

Since 2013, OB has utilized the DGS Exempt Machinery and Equipment Steel Products listings as part of the RACP steel policy. DGS published a Statement of Policy - Steel Products Procurement in the Pennsylvania Bulletin Volume 43, Number 6 dated February 9, 2013 (See PA Bulletin #43, pages 85-86) that discussed their production of an annual list, based on their analysis of submitted ST-4 forms, which exempts certain steel products not produced domestically in sufficient quantity.

No other changes in RACP steel policy resulted from this new adjustment; consequently, the use of steel certificates for structural steel will still be required. Please note that the use of ST 2, 3, and 4, as requested for other steel products, will still be utilized unless an exemption based on the list has been formulated and forwarded to OB.

OB's guidance is to make sure the Grantee/Subgrantee's are aware that it's their responsibility to certify all applicable steel components incorporated within RACP projects. In some

instances, OB/RACP staff and/or the state assigned consultant may limit their compliance analysis to significant steel components. The projects' architect/engineers are responsible for preparing/providing a significant steel component listing, not the RACP assigned consultant.

Two distinct approaches are presented below for steel products that are structural and/or have a significant building component.

Structural Steel Products

Pursuant to the SPPA, OB will require a mill certificate containing the statement "milled, melted, and manufactured in the USA" for all structural steel products used on RACP projects. We shall deem as ineligible all contracts that are unable to demonstrate compliance via the submission of steel certifications. Therefore, the value of construction contracts associated with non-compliant steel will be removed (both materials and labor costs) from the scope of the project.

Non-Structural Steel Products

Pursuant to the SPPA, OB will require, either a mill certificate containing the statement "milled, melted, and manufactured in the USA" or the appropriate ST form or an **Exemption Request** to utilize the DGS current years' Final List of Exempt Machinery and Equipment Steel Products to demonstrate compliance associated with the non-structural steel products used on RACP projects. OB shall deem as ineligible all contracts that are unable to demonstrate compliance via the submission of **steel certifications /ST forms/Exemption Request** based on the DGS Exempt Machinery and Equipment Steel Products listing. Therefore, the value of construction contracts associated with non-compliant steel will be removed (both materials and labor costs) from the scope of the project.

Recycled products, melted from previously used steel, are acceptable, providing that adequate documentation from the supplier has been furnished. The supplier shall certify that the recycled steel product was produced in the USA.

Furthermore, the burden of proof for all non-structural steel products not produced domestically in sufficient quantities is still the project's responsibility to provide.

Please be aware that the acceptance of ST forms is contingent upon the form being fully filled-in and compliant with the submission guidelines for steel certifications for DGS projects with the following exceptions:

- A. It is not necessary for the forms to be notarized; however, all ST forms must be signed. Original signatures or electronic signatures through Adobe fill/sign, DocuSign, or Nuance (program which allows electronic signature similar to Adobe fill/sign) are acceptable.
- B. Any questions regarding steel certification submissions and/or compliance with the Act shall be submitted to the OB Steel Resource Account (RA-OBRACP-Steel-Cost@pa.gov).
- C. The Steel certification forms do NOT need to be submitted and approved by OB before the steel product arrives on site so as not to interfere with the project construction schedule.
- D. OB assumes responsibility for acceptance of the DGS ST forms in accordance with this policy.

Completion of the ST-2, ST-3, and ST-4 forms shall follow the DGS directions attached to the form with the following exceptions:

- ST forms do NOT need to be submitted and approved by OB before the steel product arrives on site so as not to interfere with the construction schedule.
- RACP ME# assigned to the project shall be inserted in all areas requiring the DGS contract number (Line#5).
- RACP official project name shall be inserted in all areas requiring the contract title (Line #6).

Note:

Acceptance of each ST form shall be determined by OB at its sole discretion. All documents and other information to be delivered in order to demonstrate compliance with the steel requirements shall be and are, in form, content and substance, subject to the approval of OB, which approval may be withheld or delayed at OB's discretion. OB reserves the right to reject all improperly filled out or unsupported ST forms.

Below are links to PDF copies of the three acceptable ST Forms that can be obtained from the RACP website:

- [ST-2 Steel Origin Certification: Non-Identifiable, Non-Structural Steel](#)
- [ST-3 75% U.S. Manufacture Certification](#)
- [ST-4 Not Domestically Manufactured: Prime Contractor](#) (only to be used when the items requested to be exempted are not found on the appropriate year's List of Exempt Machinery and Equipment Steel Products [see section below entitled "Year of DGS Exemption Listing to Use"])

To implement the RACP policy on Non-structural Steel Exemption Request utilizing the DGS's current years' Final List of Exempt Machinery and Equipment Steel Products, referred to as the "Exemption List", please follow the below requirements:

1. The Project must be under "active" construction (workers on site) on or AFTER 1/01/2013 (RACP effective date) to use the "Exemption List".
2. "Active" construction does not include performance of just "punch list" items.
3. Effective date is based on the "active" construction date and not the date the machinery and equipment were purchased.
4. There is no retroactive application of utilization of the "Exemption List".
5. No ST-4 form is required for a RACP Exemption Request based on the "Exemption List".
6. RACP Exemption Request (to utilize the "Exemption List") must come from a contractor involved in the construction of the project and be:
 - On Construction Company Letterhead.
 - Dated and signed by appropriate company official (does not need to be notarized).
 - Should be addressed to Office of Budget
 - Should contain RACP project name and/or ME #
 - Lists any/all machinery and equipment that the Company is requesting to have exempted from ST-4 documentation.
 - All items listed on RACP Exemption Request letter must clearly match-up to an item

on the appropriate year's "Exemption List" and the Exemption List year should be notated for each item.

- There can/may be multiple construction company RACP Exemption Request letters utilized for various machinery and equipment, as applicable, per project.
- Exemption Request can be submitted directly by the project to OB or through the State Assigned Consultant for their project.
- Any questions regarding the exemption request submission and/or compliance with the Act shall also be submitted to OB (RA-OB-RACP-Steel-Cost@pa.gov)

Year of DGS Exemption Listing to Use:

A project should be using the exemption listing for when they are in active construction. For example, if construction was active (and complete) in 2021 they would use the 2021 listing. If a project overlaps a calendar year, they should use the latest listing in which construction is active. For example, if construction is active in 2021 and 2022, they would use the 2022 listing.

If a project is phased, they should use the listing for the year they are in active construction for each phase. For example, if the first phase starts and ends in 2021 whereas the second phase starts and ends in 2022, the first phase would use the 2021 listing while the second phase would use the 2022 listing. If a phase overlaps a calendar year, follow the 1st paragraph above.

Among other items, the DGS web page for Steel Products Procurement Act information includes links for a copy of the Act; the current year's Final List of Exempt Machinery and Equipment Steel Products; the PA Bulletin's Steel Products Procurement Act Statement of Policy; and Frequently Asked Questions. Certain prior years DGS Exemption Lists are downloadable from the RACP website.

Please be aware that all other steel items not specifically exempted or that may require any type of interpretation would be discretionary to OB's policy. Be reminded that this exemption listing is not effective for structural steel.

Note:

Acceptance of each Exemption Request shall be determined by OB at its sole discretion. All documents and other information to demonstrate compliance with the steel requirements shall be in form, content, and substance, subject to the approval of OB, which approval may be withheld or delayed at OB's discretion. OB reserves the right to reject all improperly filled out or unsupported Exemption Request.

2024 List of Exempt Machinery and Equipment Steel Products

The Department of General Services (DGS) has reviewed all comments and supporting documentation received prior to the end of the thirty-day (30) comment period and presents here its annual list of exempt machinery and equipment steel products. Contractors, subcontractors, suppliers, bidders, offerors and public agencies may rely on the list of exempt steel products in preparing bids and contracts for any project that is subject to the Steel Products Procurement Act.

Pursuant to the department's Statement of Policy and the Steel Products Procurement Act, DGS will not make any changes to this list during the calendar year for which it was created. In early 2025 DGS will identify, from ST-4 waivers approved in calendar year 2024, specific machinery and equipment steel products that have been recognized as not being produced in the United States in sufficient quantities to meet the 2024 contract requirements. Those items will be added to the list presented below and the resultant list will be published in the Pennsylvania Bulletin for a thirty-day (30) public comment period at that time.

Exempt Machinery and Equipment Steel Products

Air Conditioning Units
Air Duct Housing w/Sample Tubes
Air Handling Units
Anchor Bolt
Audio RA Station
Annunciator Panel
AV Rack Kit
Back Box
Backflow Preventer
Battery Cabinet
Blank Filler Plate for Fiber
Blank Metal Door
Blank Plate for Outer Door
Bottom Dead Front Panel
Bridge for Cameras
Cabinet
Cardcage
Cast Steel Gate Valve
CCTV Power Supply
Ceiling Exhaust Fan
Ceiling Flange
Central Control Unit
Centrifugal pumps

Channel Video
Circulating Pump
Closers
Color Monitor
Combination Round Head Steel Zinc-Plated Toggle Bolts
Condensing Boilers
Conduit Fittings
Control Module Plate
Control Panel
Control Valve
Data Converter Unit
Deck Inserts
Deck and Rub Rail Fasteners
Dielectric Nipples
Digital Communicators
Digital Record
Door Protection
Door Trim/Handles
Drinking Fountain
Drip Pan ELL
Drop-In Anchors
Dry Tape Transformer
Drywall Screws
Dual Interface Module
Duct Detector w/Relay
Duct Housing
Ductless Split System
DVR Rack
Electric Traction Elevators
Electric Water Cooler
Elevator Controller
Elevator Hoistway
Encl. for Annunciator
Exit Devices
Exp Cage
Fence System Nuts and Bolts
Fire Alarm NAC Extender
Fire Alarm Peripherals
Fixed Door Station
Flexible Drops
Full Blank Plate
Galvanized Carriage Bolts

Garage Door Tracking
Gas Furnace
Gas Piping Butt Weld Tees
Gauges
Generator
Globe Valve (Steam)
Hand Dryer
Hanger Mounting Plates
Hangermates
Hangers Supports
Horn/Strobe
Inclined Platform Wheelchair Lifts
Inner & Outer Door
Inner Door Blank Plate
Interface Module
Lag Bolts
Large Remote Cab
Lighting Fixtures, Interior/Recessed
Lighting Fixtures, Surface Wrap
Lighting Fixtures, Track Head
Lock Cylinders
Locknuts
Locksets
Low Temp. Detection Thermostats
Lubrication Unit
Machine Screws
Main Control Board
Mega Press Fittings, Mega Press XL and G Fittings
Metal Lockers
Manual Pull Station
Med. Enclosure
Middle Dead Front
Mini-Interface Module
Monitor Mount
Monitor Wall Brk
Mounting Plate
Network Fiber Switch
Overhead Door
Overhead Stops
Patient Wandering Alarm
Pellet Storage Bin
Pipe Clamps
Pivots

Power Supply
Pull Station Box
RA Annunciator Pnl
Rack Mount Card Cage
Rack Mount Kit
Radiant Panels
Reader Interface
Relay Module
Remote Chiller
Round Head Machine Screw
Safety Relief Valve
Sampling Tube
Screw Air Compressor
Security Panel
Security Unit
Security/CCTV Camera Housing
Self-Turn / Self Tapping Screw
Shower/eye Washers
Signal Extender Module
Single Blank
Smoke Detector Wire
Speaker
Speaker/Strobe
Split HVAC System
Split Ring Hangers
Split Rings
Split System Air Conditioning
SSD-C Remote Display w/Control
SSD-C-REM Rem Display
Stainless Flat Bars
Stainless Steel Cable
Strobe
Submersible pump
Sump Pump
Surface Mount Speaker
Surface Station Box
Surge Arrester
Surge Protector
T8 Light Troffer
Tamper Proof Screws & Nuts
Thermometers

Threaded Rod Hanger
Tie Wire 21 gauge
Tie Wire Anchor
Toggle Wing
Transformer
Turbine Pumps
Uninterruptible Power Supply
VRV Fan Coils/Cond. Units
Wall Mounted Boiler
Wall Mounted Fountain
Water Coolers
Water Fountain Mounting Frame
Water Heater
Wing Toggle

ST-2

This form must be filled out for non-identifiable, non-structural steel products.

SECTION A

To be filled out by the Purchaser, the firm that pays the Fabricator

Line #1 This is the name of the firm that is dealing directly with the Fabricator

Line #2 This is the purchaser's mailing address.

Line #3 This is the purchaser's business phone.

Line #4 This is the date the ST-2 form is sent to the fabricator.

Line #5 This is the ~~DGS contract number or~~ **RACP ME#** for the project.

Line #6 This is the ~~DGS project description~~ **RACP Project Name.**

Line #7 This is the "steel product" being certified, such as a chiller, condenser, hollow metal doors. The prime contractor may not fill in the line with a description like "structural steel", "heating unit" or "air conditioning Unit". The model number, if any, of the steel product must be listed as indicated.

**LINE #7 IS THE MOST CRITICAL PART OF THE FORM.
FAILURE TO PROPERLY FILL OUT LINE #7 ON EACH ST FORM
MAKES THE ENTIRE FORM INVALID AND A NEW FORM MUST BE
SUBMITTED.**

SECTION B

To be filled out by the Fabricator, the firm that assembles the product listed on Line #7.

Line #1 This is the Fabricator's name.

Line #2 This is the Fabricator's mailing address.

Line #3 This is the Fabricator's business phone.

Line #4 This is the date the Fabricator receives the ST-2 from the Purchaser.

Line #5 This is the Fabricator's Federal I.D. number.

SECTION C

1. Language – **No modifications, cross-outs or alterations of any type may be made to the language of this certification paragraph.**
2. Signature – Two signatures are required on the ST-1 form. The Prime Contractor's President/Vice President must sign on one line and the Secretary or Treasurer must sign as a witness. The names should be typed or printed beneath the signature lines. Failure to type in the names **does not** invalidate the ST form.

ST-2 STEEL ORIGIN CERTIFICATION:
NON-IDENTIFIABLE, NON-STRUCTURAL STEEL

This form must be executed by the Purchaser and the Fabricator of any item containing steel that is not structural steel. This form must be submitted to the APM within 30 days from the date the Professional approved a submittal listing a "steel product". No steel product may be delivered on-site unless DGS has received the ST form. Structural steel is defined as steel products used as a basic structural element or a project (i.e. steel beams, columns, decking stairways, reinforcing bars, pipes, etc.). Purchasers of structural steel products (contractors or subcontractors) **must** provide bills of lading, invoices **and** mill certifications that the steel was manufactured in the United States instead of this form. The Fabricator shall be herein defined as the firm that assembles the component parts of the product to be purchased. The Department of General Services will accept the certification of firms that are earlier in the chain of purchase (i.e. manufacturers of components, steel suppliers) in lieu of the Fabricator.

A. TO BE COMPLETED BY THE PURCHASER:

1. Name of purchasing firm: _____
 2. Firm's address: _____
 3. Firm's phone number: _____ 4. Date submitted to Fabricator: _____
 5. Contract No. DGS _____ 6. Contract Title: _____
 7. Steel Product Certified: _____
- Model: _____

B. TO BE COMPLETED BY THE FABRICATOR/MANUFACTURER:

1. Name of firm: _____
2. Address of firm: _____
3. Firms phone number: _____ 4. Date Received: _____
5. Federal Employer ID. No: _____

CERTIFICATION: I, the undersigned officer of the Fabricator/Manufacturer, do certify that our firm assembled/fabricated the components to the steel products listed in Section A, Item 7, and that all steel components therein are comprised of steel that is melted and/or fabricated in the United States. I understand that, by signing this document, I certify that I have received assurances from the suppliers/manufacturers of the components that said components do not contain foreign manufactured steel. I further understand that this document is subject to the provisions of the Unsworn Falsification to Authorities Act (18 P.S. § 4904). I also understand that I am subject to the provisions of the Steel Products Procurement Act (73 P.S. § 1881, et. seq.) which provides penalties including, but not limited to, debarment from supplying any products for Commonwealth of Pennsylvania Public works projects for a period of five (5) years for violations therein. I agree to provide documentation supporting these facts if requested by the Commonwealth. The Commonwealth reserves the right to pursue any action deemed necessary to protect the Commonwealth's interest and ensure compliance with the laws of the Commonwealth.

WITNESS:

Name:
Secretary or Treasurer

Name: _____ (Seal)
President or Vice President

ST-3

2-STEP ELIGIBILITY ANALYSIS:

BEFORE A PRIME CONTRACTOR CAN SUBMIT AN ST-3, THE FOLLOWING ANALYSIS MUST BE SATISFIED

STEP #1: The contractor must establish that the “product” **contains BOTH:**

- Steel melted in the USA

AND

- Foreign Steel

Note: Step #1 focuses upon the **content** of the “product”.

Note: The % need not be close; it can be 99-1, so long as there is both foreign and domestic steel in the “product”.

STEP #2: The contractor must establish that 75% of the **cost** of the “product” has been mined, produced or manufactured in the USA.

Note: Step #2 focuses upon the cost of the entire “product”, not just the steel within it.

SECTION A

Line #1 This is the Prime Contractor’s name.

Line #2 This is the Prime Contractor’s business address.

Line #3 This is the Prime Contractor’s phone number.

Line #4 This is the date the ST-3 is submitted to the fabricator.

Line #5 This is ~~DCS contract number or~~ **RACP ME#** for the project for the project.

Line #6 This is the ~~DCS project description~~ **RACP Project Name.**

Line #7 This is the “steel product” being certified, such as a chiller, condenser, hollow metal doors. The prime contractor **may not** fill in the line with a description like “structural steel”, “heating unit” or “air conditioning unit”. The model number, if any, or the steel product must be listed as indicated.

<p>LINE #7 IS THE MOST CRITICAL PART OF THE FORM. FAILURE TO PROPERLY FILL OUT LINE #7 ON EACH ST FORM MAKES THE ENTIRE FORM INVALID AND A NEW FORM MUST BE SUBMITTED.</p>

SECTION B **To be filled out by the Fabricator/Manufacturer, the firm that fabricates the product listed on Line A7.**

Line #1 This is the Fabricator's name.

Line #2 This is the Fabricator's business address.

Line #3 This is the Fabricator's business phone.

Line #4 This is the date the Fabricator receives the ST-3 from the purchaser.

Line #5 This is the Fabricator's Federal I.D. Number.

Line #6 The Fabricator must insert the percentage of the cost of the articles, materials and supplies which have been mined, produced or manufactured in the U.S. for the product listed on Line #7.

SECTION C

1. Language – **No modifications, cross-outs or alterations of any type may be made to the language of this certification paragraph.**
2. Signature – Two signatures are required on the ST-3 form. The Fabricator's President/Vice President must sign on one line **and** the Secretary or Treasurer must sign as a witness. The names should be typed or printed beneath the signature lines. Failure to type in the names does not validate the ST form.

NOTES on ST-3 Forms:

- It is not necessary to submit an ST-1 with the ST-3.
- **DGS reserves the right to request additional documentation to support the percentage specified on Line 14. If the Fabricator/manufacturer refuses to produce such documentation and/or DGS deems it to be in the Commonwealth's best interests, DGS may request the Office of Inspector General to investigate the submission of the ST-3 form.**

ST-3
75% U.S. MANUFACTURE CERTIFICATION

The Steel Products Procurement Act (73 P.S. § 1881, et. seq.) allows the use of steel products with **both** foreign and domestic steel **if at least 75 percent of the cost** of the materials (including steel, rubber, wood, plastics, etc.) in the product are manufactured or produced, as the case may be, in the United States.

This form must be executed by a Fabricator of any item containing BOTH U.S. AND FOREIGN STEEL. The fabricator shall hereby be defined as the firm that assembles the component parts of the product to be purchased. The Department of General Services will accept the certification of firms that are **earlier** in the chain of purchase (i.e., manufacturers of components, steel suppliers) in lieu of the Fabricator.

This form must be submitted to the APM within 30 days from the date the Professional approves a submittal listing a "steel product". No steel product may be delivered on-site unless DGS has received an ST form.

A. TO BE COMPLETED BY THE PRIME CONTRACTOR (PURCHASER):

1. Name of Contractor: _____
2. Address of Contractor: _____
3. Phone Number: _____ 4. Date submitted to Fabricator: _____
5. Contract No. DGS: _____ 6. Contract Title: _____
7. Steel Product Certified: _____
Model: _____

B. TO BE COMPLETED BY THE FABRICATOR/MANUFACTURER:

1. Name of Firm: _____
2. Address of Firm: _____
3. Firm's Phone number: _____ 4. Date Received: _____
5. Federal Employer ID No. _____

6. Percentage of the cost of the articles, materials and supplies which have been mined, produced or manufactured in the U.S. for the product listed above on line 7: _____

CERTIFICATION: I, the undersigned Officer of the Fabricator/Manufacturer, do certify that our firm assembled/manufactured the components to the steel product listed in Section 7, that the steel in said product is both foreign and domestically manufactured, and that all the facts contained in this document are true. I agree to provide documentation supporting these facts if requested by the Commonwealth. I further understand that this document is subject to the provisions of the unsworn Falsification to Authorities Act (18 P.S. § 4904) and the Steel products Procurement Act (73 P.S. § 1881, et seq.) which provide penalties including, but not limited to, debarment from supplying any products for Commonwealth of Pennsylvania public works projects for a period of five (5) years for violations therein. The Commonwealth reserves the right to pursue any action deemed necessary to protect the Commonwealth's interest and ensure compliance with the laws of the Commonwealth.

WITNESS:

Name:
Secretary or Treasurer

Name: (Seal)
President or Vice President

ST-4

This form may be submitted in circumstances where the Prime contractor believes that the “product” on Line #7 is not made in sufficient quantities to satisfy the requirements of the contract.

The information submitted by a Prime contractor is subject to verification by the Department. Any Prime contractor who executes a Purchase Order or other type of purchase agreement encompassing a “steel product” prior to receiving the Department’s written determination that the “steel product” listed on Line #7 of the ST-4 form is not manufactured in sufficient quantity to meet the requirements of the project does so at its own risk and faces penalties including, but not limited to, non-payment for the product; removal and replacement of the product at its own costs; and/or an Office of Inspector General investigation which may lead to debarment.

**Domestic availability will be determined as of the date
the ST-4 form is submitted to DGS for approval**

Line #1 this is the Prime Contractor’s formal business name.

Line #2 This is the Prime Contractor’s business address.

Line #3 This is the Prime Contractor’s business phone.

Line #4 This is the date the ST-4 form is submitted to ~~DGS~~. Office of the Budget.

Line #5 This is the ~~DGS contract number or~~ RACP ME# for the project.

Line #6 This is the ~~DGS project description~~ RACP Project Name.

Line #7 This is the “steel product” being certified, such as a chiller, condenser, hollow metal doors. The prime contractor may not fill in the line with a description like “structural steel”, “heating unit” or air conditioning unit”.

**LINE #7 IS THE MOST CRITICAL PART OF THE FORM.
FAILURE TO PROPERLY FILL OUT LINE #7 ON EACH ST FORM
MAKES THE ENTIRE FORM INVALID AND A NEW FORM MUST BE
SUBMITTED FOR APPROVAL.**

Line #8 These four lines, (a) through (d), are to be filled out completely by the Prime Contractor. At least four suppliers/manufacturers must be contacted by the Prime Contractor to ascertain if the “product” on Line #7 is manufactured with domestic steel.

CERTIFICATION

1. Language – **No modifications, cross-outs or alterations of any type may be made to the language of this certification paragraph.**
2. Signature – Two signatures are required on the ST-4 form. The Prime Contractor’s President/Vice President must sign on one line **and** the Secretary or Treasurer must sign as a witness. The names should be typed or printed beneath the signature line. Failure to type in the names **does not** invalidate the ST form.

NOTE ON ST-4 FORMS:

- It is not necessary to submit an ST-1 form with an ST-4 form.

ST-4 NOT DOMESTICALLY MANUFACTURED: PRIME CONTRACTOR

This form must be executed by the Prime Contractor and submitted to the APM within 30 days from the date the Professional approves a submittal listing a “steel product”. No steel product may be delivered on-site unless DGS has received, reviewed and provided written approval of the ST-4 form. An ST-4 form can only be submitted for approval when a steel product is not domestically produced in sufficient quantities. DGS will verify the accuracy of the information on the ST-4 form and will contact additional suppliers/manufacturers to ascertain the availability of a domestic steel product.

1. Prime Contractor:_____ 2. Address:_____
3. Phone Number:_____ 4. Date Submitted:_____ 5. Contract No. DGS:_____
6. Contract Title:_____ 7. Steel Product:_____
8. Suppliers/manufacturers contacted by the Prime Contractor that claimed that the above product is not produced/manufactured with U.S. manufactured steel. At least four Suppliers/Manufacturers are needed. Manufacturers listed in specifications must be contacted.
 - a. Firm Name:_____ Phone Number:_____
Address:_____
Person Contacted:_____ Date Contacted:_____
 - b. Firm Name:_____ Phone Number:_____
Address:_____
Person Contacted:_____ Date Contacted:_____
 - c. Firm Name:_____ Phone Number:_____
Address:_____
Person Contacted:_____ Date Contacted:_____
 - d. Firm Name:_____ Phone Number:_____
Address:_____
Person Contacted:_____ Date Contacted:_____

CERTIFICATION: I, the undersigned Officer of the Contractor, do certify that I have contacted the firms listed in Section 9, and was informed that said firms do not produce/manufacture the steel product listed on Line 7 with U.S. Steel in sufficient quantities to complete the above-referenced project. I understand that this document is subject to the provisions of the Unsworn Falsifications to Authorities Act (18 P.S. § 4904) and the Steel Products Procurement Act, which provide penalties including, but not limited to, debarment from bidding on any Commonwealth of Pennsylvania public works project for a period of five years. The Commonwealth reserves the right to pursue any action deemed necessary to protect the Commonwealth’s interest and ensure compliance with the laws of the Commonwealth.

WITNESS:


Name:
Secretary or Treasurer

_____(SEAL)
Name:
President or Vice President

WEEKLY PAYROLL CERTIFICATION FOR PUBLIC WORKS PROJECTS

☐ Contractor or
 ☐ Subcontractor (Please check one)

ALL INFORMATION MUST BE COMPLETED

CONTRACTOR ADDRESS		SUBCONTRACTOR ADDRESS		 DEPARTMENT OF LABOR & INDUSTRY <small>COMMONWEALTH OF PENNSYLVANIA</small> BUREAU OF LABOR LAW COMPLIANCE PREVAILING WAGE DIVISION 7TH & FORSTER STREETS HARRISBURG, PA 17120 1-800-932-0665
PAYROLL NUMBER	WEEK ENDING DATE	PROJECT AND LOCATION		
		PROJECT SERIAL #	PROJECT #	

EMPLOYEE NAME	APPR. RATE (%)	WORK CLASSIFICATION	DAY AND DATE							S- TIME 0- TIME	BASE HOURLY RATE	TOTAL FRINGE BENEFITS (C=Cash) (FB=Contributions)*	TOTAL DEDUCTIONS	GROSS PAY FOR PREVAILING RATE JOB(S)	CHECK #
			HOURS WORKED EACH DAY												
											C:				
											FB:				
											C:				
											FB:				
											C:				
											FB:				
											C:				
											FB:				
											C:				
											FB:				

*SEE REVERSE SIDE

PAGE NUMBER _____ OF _____

THE NOTARIZATION MUST BE COMPLETED ON FIRST AND LAST SUBMISSIONS ONLY. ALL OTHER INFORMATION MUST BE COMPLETED WEEKLY.

*FRINGE BENEFITS EXPLANATION (FB): Bona fide benefits contribution, except those required by Federal or State Law (unemployment tax, workers' compensation, income taxes, etc.)

Please specify the type of benefits provided and contributions per hour:

- 1) Medical or hospital care _____
- 2) Pension or retirement _____
- 3) Life insurance _____
- 4) Disability _____
- 5) Vacation, holiday _____
- 6) Other (please specify) _____

CERTIFIED STATEMENT OF COMPLIANCE

1. The undersigned, having executed a contract with _____
(AWARDING AGENCY, CONTRACTOR OR SUBCONTRACTOR)
_____ for the construction of the above-identified project, acknowledges that:
 - (a) The prevailing wage requirements and the predetermined rates are included in the aforesaid contract.
 - (b) Correction of any infractions of the aforesaid conditions is the contractor's or subcontractor's responsibility.
 - (c) It is the contractor's responsibility to include the Prevailing Wage requirements and the predetermined rates in any subcontract or lower tier subcontract for this project.
2. The undersigned certifies that:
 - (a) Neither he nor his firm, nor any firm, corporation or partnership in which he or his firm has an interest is debarred by the Secretary of Labor and Industry pursuant to Section 11(e) of the PA Prevailing Wage Act, Act of August 15, 1961, P.L. 987 as amended, 43 P.S. § 165-11(e).
 - (b) No part of this contract has been or will be subcontracted to any subcontractor if such subcontractor or any firm, corporation or partnership in which such subcontractor has an interest is debarred pursuant to the aforementioned statute.
3. The undersigned certifies that:
 - (a) the legal name and the business address of the contractor or subcontractor are: _____

 - (b) The undersigned is: ☐ a single proprietorship ☐ a corporation organized in the state of _____
☐ a partnership ☐ other organization (describe) _____
 - (c) The name, title and address of the owner, partners or officers of the contractor/subcontractor are:

NAME	TITLE	ADDRESS

The willful falsification of any of the above statements may subject the contractor to civil or criminal prosecution, provided in the PA Prevailing Wage Act of August 15, 1961, P.L. 987, as amended, August 9, 1963, 43 P.S. § 165.1 through 165.17.

(DATE)

(SIGNATURE)

(TITLE)

SEAL

Taken, sworn and subscribed before me this _____ Day
of _____ A.D., _____

**SECTION 007100
GENERAL CONDITIONS COVER**

PART 1 GENERAL

1.01 SUMMARY

- A. The following are the "General Conditions of the Contract for Construction," AIA Document A201-2017, is bound with this Section. AIA Document A201-2017 sets forth the rights, responsibilities, and relationships of the Owner, Contractor, and Architect.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION 007100

007100
GENERAL CONDITIONS COVER

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AIA® Document A201® – 2017

General Conditions of the Contract for Construction

for the following PROJECT:

(Name and location or address)

Erie County Community College
2403 West 8th Street
Erie, PA 16505

THE OWNER:

(Name, legal status and address)



THE ARCHITECT:

(Name, legal status and address)



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

ADDITIONS AND DELETIONS:

The author of this document may have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes 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 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.

For guidance in modifying this document to include supplementary conditions, see AIA Document A503™–2017, Guide for Supplementary Conditions.

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14 TERMINATION OR SUSPENSION OF THE CONTRACT

15 CLAIMS AND DISPUTES

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

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

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**

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

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

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

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

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. If there is any ambiguity or inconsistency noted in the Contract Documents, it shall be presented timely to the Owner who shall then render a decision as to the controlling document or provision, with no right of appeal, challenge, additional cost or time allowed.

§ 1.1.3 The Work

The term "Work" means the construction and services required or reasonably inferable from 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 and provide the Owner with an integrated and complete Project. 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, in which event Contractor shall cooperate, coordinate, schedule, phase and sequence its work with that of the other contractors without additional cost to Owner..

§ 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.

§ 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 written protocols governing the transmission and use of, and reliance on, Instruments of Service or any other information or documentation in digital form.

§ 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 written protocols governing the use of, and reliance on, the information contained in the model 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. Where the Owner acts through a Board, it shall be Board approved alone that can bind the Owner under this Agreement. No statement, whether oral or in writing, from a representative or agent of the Owner can bind the Owner.

§ 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 notify the Owner that if reasonable assurances of financial ability to pay are not provided within an additional thirty (30) days, Contractor may stop the Work. If the Work is stopped under this Section 2.2.2, the Contract Time shall be extended appropriately and the Contract Sum may be increased by the proven amount of the Contractor's reasonable costs of shutdown, delay and start-up.

§ 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.

§ 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 fails to carry out Work in accordance with the Contract Documents, fails to comply with the Project Schedule or fails to furnish sufficient craftsmen or materials or equipment needed for the Project, then 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. The Owner may also notify Contractor's surety who shall then timely address the Owner's concerns in writing and meet with the Owner and Contractor if requested by Owner.

§ 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 or the Owner's Solicitor made necessary by such default, neglect, or failure. If current and future payments are not sufficient to cover such amounts, the Contractor or the Owner's surety 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 and the Project Schedule, as amended and approved by the Owner.

§ 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, sequencing, phasing 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, scheduling, coordination and phasing with all other construction and construction 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. Any damage to work or finishes previously performed that are caused by Contractor or its subcontractors shall be repaired by Contractor without delay or cost to the Owner.

§ 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, staging, hoisting, trash containment and removal and other facilities and services necessary for proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.

§ 3.4.2 Except in the case of minor changes in the Work 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 without impact to the Project Schedule.

§ 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, and Owner and Architect may issue a Construction Charge Directive if necessary. Notwithstanding anything to the contrary in the Contract Documents, all excavation or earthwork shall be unclassified and Contractor shall be fully responsible for its excavation work and shall perform all advance notices with utilities or others having underground liens or utilities in the vicinity of the Work, without additional cost to the Owner..

§ 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 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.

§ 3.10.3 The Contractor shall perform the Work in general accordance with the most recent schedules submitted to the Owner and Architect. Where there is objection by the Owner or the Architect, Contractor shall revise or modify the project scheduled to reflect completion within the time allotted for the Project without additional costs to the Owner. Where, in the determination of the Owner or the Architect, the Contractor has negative float, or is behind schedule, or is impacting or delaying other contractors or is delaying the Owner, then the Contractor shall immediately accelerate to regain the schedule without additional cost to the Owner.

§ 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.

§ 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 and shall periodically remove accumulated waste, trash or construction materials and dumpsters. 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 and shall repair or recondition any portions of Owner's premises damaged.

§ 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.

§ 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, whether or not 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. Where or as appropriate, the Owner may engage a Clerk of the Works or a Construction Manager or a specialty consultant.

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

§ 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.

§ 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. Contractor shall identify all Subcontractors and Sub-subcontractors to Contractor as they are engaged. If requested by Owners, copies of all agreements between Contractor and its Subcontractors and Sub-subcontractors shall timely be provided to Owner. If deemed necessary to confirm payments are timely flowing to Subcontractors and Sub-subcontractors, or if amounts are due or if claims exist. Owner may communicate with Subcontractors and Sub-subcontractors for these purposes.

§ 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 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 may upon submission of itemized supporting documents be equitably adjusted for increases in cost resulting from the suspension, which added costs shall be charged to Contractor or its surety.

§ 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, subject to paragraph 5.4.2.

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. If the Contractor claims that delay or additional cost is involved because of such action by the Owner, the Contractor shall make such Claim as provided in Article 15. No such claim shall excuse Contractor's obligation to perform the Work in a timely manner or to not comply with the Project Schedule or any interim milestone date, or any construction change directive.

§ 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 Unless provided otherwise, in the Contract Documents, the Owner may 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 each other. The Contractor shall participate with any Separate Contractors and the Owner in reviewing their construction schedules, sequencing of the overall work, durations of scheduled activities, phasing of each other's respective work items and overall coordination. 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. If there is any disagreement between the Contractor and any other separate contractor or the Owner, then the Owner shall make the decision that shall be binding on all parties, each of whom shall perform its work as indicated in the adjusted construction schedule without additional cost or delay to the Owner. Any float in the construction schedule shall belong to the Owner.

§ 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 hoisting, staging and performance of their activities, and shall connect and coordinate the Contractor's construction and operations with theirs as required by the Contract Documents and the construction schedule. If there is any disagreement between Contractor and any other separate contractor or the Owner, then the Owner shall make the decision that shall be binding on all parties, each of whom shall perform its work as indicated in the adjusted construction schedule without additional cost or delay to the Owner.

§ 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 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, failure to coordinate or cooperate or defective construction. The Owner shall evaluate and render a decision on any itemized and documented claim or change order requests submitted by the Contractor for costs the Contractor incurs because of a separate contractor's delays, improperly timed activities, failure to coordinate or cooperate, 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 without impact to the construction schedule.

§ 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 (“CCD”) 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. Upon receipt of a Construction Change Directive, the Contractor shall immediately proceed with the Work as set forth in the Directive without delay.

§ 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;
- .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.
- .5 Contractor shall maintain accurate contemporaneous records on a daily basis with copies to the Owner no less frequently than weekly, or as required by the Owner.

§ 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 contemporaneous 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 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.

§ 7.3.6 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.

§ 7.3.7 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.

§ 7.3.8 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, in writing within three (3) days of receiving the CCD.

§ 7.3.9 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.

§ 7.3.10 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.

§ 7.3.11 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, upon acceptance and approval of the Owner, 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.

§ 7.3.12 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 change without prior written 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. Any float in the Project Schedule shall belong to the Owner.

§ 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 on the critical path of the Project

Schedule solely 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, not within Contractor's control, 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 or the Contractor's ability to mitigate; (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 to an activity on the critical path of the project schedule having zero float, then the Contract Time shall be extended for such reasonable time as the Architect may determine the Project Schedule was actually impacted as shown on the CPM analysis for the Project.

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

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 may be equitably adjusted upon the Architect and the Owner's evaluation of Contractor's documented submission.

§ 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. The lack of objection to the value of any line item in the schedule of values is not an acceptance of the line item and may not be the basis for establishing the value of any subsequently submitted claim or change order request

§ 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. Each application shall contain a Waiver of Claims and Mechanic Liens in such form as tendered to Contractor by Owner and executed by Contractor and all Subcontractors/Suppliers.

§ 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 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.
- .8 failure to maintain the Project Schedule or to regain the Project Schedule.

§ 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 timely 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 and without prejudice, 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 following consultation with and approval by the Owner, the Owner shall make payment in the manner and within the time provided in the Contract Documents, and shall so notify 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.

§ 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, as well as the dates and amounts actually paid by Contractor. 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. Architect or Owner may provide subcontractors or suppliers with a copy of Contractor's payment bond upon request, with a copy also to Contractor.

§ 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.

§ 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 fourteen (14) days after receipt of the Contractor's Application for Payment, or if the Owner does not pay the Contractor within twenty-one (21) 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 unless stopping the Work fails to mitigate damages as Contractor is obligated to do so. The Contract Time shall be equitably extended and the Contract Sum may be equitably increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up.

§ 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 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 and/or latent defects;
- .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 solely 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 solely 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.

§ 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 may be extended appropriately and the Contract Sum may be increased by the amount of the Contractor's reasonable and unavoidable additional costs of shutdown, delay, and start-up if so determined upon the submission of itemized documentation by the Architect and then approved by the Owner.

§ 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 cooperate with Contractor and where the cause of the remediation is due to an act or omission of the Owner, then Contractor may request reimbursement for all direct 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 and its subcontractors 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 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 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.

§ 11.3.3 The Owner shall have the right to require the Contractor to furnish bonds on an AIA or other form acceptable to the Owner covering faithful performance of the Contract and payment of obligations arising thereunder as stipulated in bidding requirements or specifically required in the Contract Documents on the date of execution of the Contract.

§ 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.

§ 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 with the exception of latent defects that may not be discoverable, if during the one-year period for correction of Work, 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 of patent defects 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. However, any corrected Work shall either have the remainder of the original warranty period or no less than six (6) months of warranty, whichever is longer.

§ 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 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. Neither party to this Agreement shall be entitled to assert as a defense or as an affirmative defense that its failure to strictly comply with Article 13.3, or any other timing provision in this Agreement, has been waived by allegations that the other had actual notice.

§ 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.

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 in excess of 30 days beyond the time to do so as provided in Section 9.4.1, or because the Owner has not made payment on a Certificate for Payment in excess of 30 days beyond the time to do so as 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 twenty-one 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 accepted by the Architect and, the direct and itemized 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 not otherwise attributable to a force majeure event beyond the Owner's sole control, the

Contractor may, upon twenty-one 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 maintain or regain the project schedule or prevents other contractors from performing their work items in accordance with the project schedule;**
- .3 fails to make payment to Subcontractors or suppliers in accordance with the respective agreements between the Contractor and the Subcontractors or suppliers;
- .4 repeatedly disregards applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of a public authority; or
- .5 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, 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 mitigation of damages; 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 and approved by the Architect; direct costs incurred by reason of the termination, including the proven direct 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 and deduct 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. For Claims by the Owner, the twenty-one days shall commence following approval by the Board.

§ 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 in amounts approved by the Architect.

§ 15.1.4.2 The Contract Sum and Contract Time may 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 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 participate in mediation. If such a demand is made and the party receiving the demand fails to agree to participate in mediation within 30 days after receipt thereof, then both parties waive their rights to mediate 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 active assistance and participation in resolving the controversy, which request the surety shall honor without objection.

§ 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 not be administered by the American Arbitration Association in accordance with its Construction Industry Mediation Procedures in effect on the date of the Agreement. Any mediation will be administered by a private Mediator selected by agreement of the parties. 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, if known. The request may identify the names of three potential mediator candidates. 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 sixty 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 ninety 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 the claimant waives its rights to binding dispute resolution proceedings with respect to the initial decision.

§ 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 Owner has 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 sixty days following 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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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)

« »
« »

BOND

Date:

(Not earlier than Construction Contract Date)

« »

Amount: \$ « »

Modifications to this Bond: ☐ None ☐ See Section 18

CONTRACTOR AS PRINCIPAL

Company: (Corporate Seal)

SURETY

Company: (Corporate Seal)

Signature:

Name and « »

Title:

(Any additional signatures appear on the last page of this Payment Bond.)

Signature:

Name and « »

Title:

(FOR INFORMATION ONLY — Name, address and telephone)

AGENT or BROKER:

« »
« »
« »

OWNER'S REPRESENTATIVE:

(Architect, Engineer or other party:)

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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.

Any singular reference to Contractor, Surety, Owner or other party shall be considered plural where applicable.

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§ 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.

§ 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.

§ 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

Company:

(Corporate Seal)

SURETY

Company:

(Corporate Seal)

Signature:

Name and Title:

Address:

« »« »

« »

Signature:

Name and Title:

Address:

« »« »

« »

DRAFT AIA® Document A312® – 2010

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)

« »
« »

BOND

Date:

(Not earlier than Construction Contract Date)

« »

Amount: \$ « »

Modifications to this Bond: ☐ None ☐ See Section 16

CONTRACTOR AS PRINCIPAL

Company: (Corporate Seal)

Signature:

Name and « »

Title:

(Any additional signatures appear on the last page of this Performance Bond.)

SURETY

Company: (Corporate Seal)

Signature:

Name and « »

Title:

(FOR INFORMATION ONLY — Name, address and telephone)

AGENT or BROKER:

« »
« »
« »

OWNER'S REPRESENTATIVE:

(Architect, Engineer or other party:)

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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.

Any singular reference to Contractor, Surety, Owner or other party shall be considered plural where applicable.

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§ 1 The Contractor and 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 when applicable to participate in a conference as provided in Section 3.

§ 3 If there is no Owner Default under the Construction Contract, the Surety's obligation under this Bond shall arise after

- .1 the Owner first provides notice to the Contractor and the Surety that the Owner is considering declaring a Contractor Default. Such notice shall indicate whether the Owner is requesting a conference among the Owner, Contractor and Surety to discuss the Contractor's performance. If the Owner does not request a conference, the Surety may, within five (5) business days after receipt of the Owner's notice, request such a conference. If the Surety timely requests a conference, the Owner shall attend. Unless the Owner agrees otherwise, any conference requested under this Section 3.1 shall be held within ten (10) business days of the Surety's receipt of the Owner's notice. 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;
- .2 the Owner declares a Contractor Default, terminates the Construction Contract and notifies the Surety; and
- .3 the Owner has agreed to pay the Balance of the Contract Price in accordance with the terms of the Construction Contract to the Surety or to a contractor selected to perform the Construction Contract.

§ 4 Failure on the part of the Owner to comply with the notice requirement in Section 3.1 shall not constitute a failure to comply with a condition precedent to the Surety's obligations, or release the Surety from its obligations, except to the extent the Surety demonstrates actual prejudice.

§ 5 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:

§ 5.1 Arrange for the Contractor, with the consent of the Owner, to perform and complete the Construction Contract;

§ 5.2 Undertake to perform and complete the Construction Contract itself, through its agents or independent contractors;

§ 5.3 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 a 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 7 in excess of the Balance of the Contract Price incurred by the Owner as a result of the Contractor Default; or

§ 5.4 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, make payment to the Owner; or
- .2 Deny liability in whole or in part and notify the Owner, citing the reasons for denial.

§ 6 If the Surety does not proceed as provided in Section 5 with reasonable promptness, the Surety shall be deemed to be in default on this Bond seven 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 5.4, and the Owner refuses the payment 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.

§ 7 If the Surety elects to act under Section 5.1, 5.2 or 5.3, 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. Subject to the commitment by the Owner to pay the Balance of the Contract Price, the Surety is obligated, without duplication, for

- .1 the responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;
- .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 5; and
- .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.

§ 8 If the Surety elects to act under Section 5.1, 5.3 or 5.4, the Surety's liability is limited to the amount of this Bond.

§ 9 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, successors and assigns.

§ 10 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.

§ 11 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 a declaration of 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.

§ 12 Notice 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.

§ 13 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.

§ 14 Definitions

§ 14.1 **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.

§ 14.2 **Construction Contract.** The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and changes made to the agreement and the Contract Documents.

§ 14.3 **Contractor Default.** Failure of the Contractor, which has not been remedied or waived, to perform or otherwise to comply with a material term of the Construction Contract.

§ 14.4 **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.

§ 14.5 **Contract Documents.** All the documents that comprise the agreement between the Owner and Contractor.

§ 16 Modifications to this bond are as follows:

**SECTION 011000
SUMMARY**

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Project Information.
 - 2. Definitions.
 - 3. Work Covered by Contract Documents.
 - 4. Phased Construction.
 - 5. Access to Site.
 - 6. Work Restrictions.
 - 7. Coordination with Occupants.
 - 8. Specification and Drawing Conventions.
- B. Related Sections:
 - 1. Division 01 Section "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.02 PROJECT INFORMATION

- A. Project Identification:
 - 1. EC3 - West Campus Renovations Health Lab.
- B. Project Location:
 - 2403 W. 8th Street
 - Erie PA 16505
- C. Owner: EC3
 - 2403 W. 8th Street
 - Erie PA 16505
- D. Architect:
 - CPL Architects and Engineers, Inc.
 - 125 Enterprise Drive
 - Pittsburgh, PA 15275
 - PH: (800) 274-9000

 - Contact Person(s):
 - Project Manager: Melanie Panutsos, AIA, MBA, WELL AP, NCARB, LEED Green Associate
 - PH: (412) 489 - 3112
- E. Architect's Consultants: The Architect has retained the following design professionals who have prepared designated portions of the Contract Documents:
 - 1. Mechanical, Electrical and Plumbing Consultant:
 - H F Lenz
 - 1051 Brinton Road, Ste 100
 - Pittsburgh, PA 15221
 - (412) 371 - 9073

011000
SUMMARY

1.03 DEFINITIONS

- A. Work Package: A group of specifications, drawings, and schedules prepared by the design team to describe a portion of the Project Work for pricing, permitting, and construction.

1.04 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of the Project is defined by the Contract Documents and consists of the following:
 - 1. Renovations to create classrooms for healthcare lab simulations, classroom shell space and toilet rooms, including partitions, doors, finishes, millwork, mechanical, electrical and plumbing work.
- B. Type of Contract:
 - 1. Project will be constructed under a single prime contract.

1.05 PHASED CONSTRUCTION

- A. The Work shall be conducted in (2) two phases, with each phase substantially complete as indicated:
 - 1. Phase One: All work in the medical training area (All new work in rooms served by Corridor H100) Work shall be substantially complete and ready for occupancy at time of Substantial Completion for the Work.
 - 2. Phase Two: Toilet Rooms C11, C12, C21, C22, C32 and C33: Work of this phase shall commence when all materials are on site and be substantially complete and ready for occupancy after commencement of construction of this phase by 60 days
 - 3. Phase Three: All new work in Corridors C10, C20 and C30. Work of this phase shall commence when all materials are on site and be substantially complete and ready for occupancy after commencement of construction of this phase by 60 days.
 - 4. Phase Four A: All new work in Stairwell B or C. Work of this phase shall commence when all materials are on site and be substantially complete and ready for occupancy before commencement of work in the second Stairwell.
 - 5. Phase Four B: All new work in Stairwell B or C. Work of this phase shall commence when all materials are on site and be substantially complete and ready for occupancy at the time of Substantial Completion for the Work.
 - 6. Refer to Division 00 Section "Preliminary Schedules" for additional information regarding phased construction.
- B. Before commencing Work of each phase, submit an updated copy of the Contractor's Construction Schedule showing the sequence, commencement and completion dates, (and move-out and -in dates of Owner's personnel) for all phases of the Work.
- C. All materials for the Toilet Rooms must be available and ready for installation, before construction begins.

1.06 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 and Section 015000 Temporary Facilities and Controls
- B. Use of Site: Limit use of Project site to work areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
 - 1. Limits: Confine construction operations to designated staging areas, storage trailers and dumpster location.
 - 2. Driveways, Walkways and Entrances: Keep driveways and loading areas and entrances serving premises clear and available to Owner, Students, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.

011000
SUMMARY

- a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
- C. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.

1.07 WORK RESTRICTIONS

- A. General Work Restrictions: Comply with restrictions on construction operations.
 - 1. Comply with limitations on use of public streets and other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: Limit work in the existing building and/or the existing site to normal business working hours of 7:00 to 4:30, Monday through Friday, except as otherwise indicated.
 - 1. School Vacations and Holidays: Work may occur at any times, as approved.
 - 2. Weekend Hours: Work may occur on Saturdays, as approved.
 - 3. Hours for Utility Shutdowns: Only on weekends, holidays, and school vacations as approved.
 - 4. Work during the winter holiday break, December 24 to January 1, must be approved.
 - 5. Special Events: The Owner will provide dates and times of special events that will restrict construction operations.
- 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 (2) 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 (2) two days in advance of proposed disruptive operations.
 - 2. Obtain Owner's written permission before proceeding with disruptive operations.
- E. Nonsmoking Building: Smoking is not permitted within the building or on the building grounds.

1.08 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. Maintain access to existing exit stairs, walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and approval of authorities having jurisdiction.
 - 2. Notify the Owner not less than (72) seventy-two hours in advance of activities that will affect Owner's operations.

1.09 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.

011000
SUMMARY

2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
3. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
4. Drawing Coordination: Requirements for materials and products identified on the Drawings are described in detail in the Specifications. One or more of the following are used on the Drawings to identify materials and products:
 - B. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
 1. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings.
 2. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION 011000

SECTION 012500 SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.01 GENERAL

- A. Should the Contractor desire to substitute other articles, materials, apparatus, products or processes than those specified or approved as equal, the Contractor shall apply to the Architect in writing for approval of such substitution. It should be noted that the bid shall not be based on a substituted article, material, apparatus, product or process. With the application shall be furnished such information as required by the Architect to demonstrate that the article, material, apparatus, product or process he wishes to use is the equivalent of that specified in quality, finish, design, efficiency and durability and has been elsewhere demonstrated to be equally serviceable for the purpose for which it is intended. The Contractor shall set forth the reasons for desiring to make the substitution and shall further state what difference, if any, will be made in the construction schedule and the contract price for such substitution should it be accepted; it being the intent hereunder that any savings shall accrue to the benefit of the Owner.
- B. The Architect shall reject any such desired substitution as not being specifically named in the contract, or if he shall determine that the adjustment in price in favor of the Owner is insufficient, the Contractor shall immediately proceed to furnish the designated article, material, apparatus, product or process.
- C. Request for substitutes shall conform to the requirements of this Article.
- D. Requests for substitutions shall, include full information concerning differences in cost, and any savings in cost resulting from such substitutions shall be passed on to the Owner.
- E. Requests for utilization of substitutes will be reviewed during the course of the project. The impact on the project and the timeliness of submission will be of key consideration.
- F. The approval of utilization of a substitute is subject to the sole and final discretion of the Architect.

1.02 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Sections:
 - 1. Division 01 Section "Alternates" for products selected under an alternate.
 - 2. Division 01 Section "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.
 - 3. Division 01 Section "Submittals" for submittal procedures.
 - 4. Divisions 02 through 49 Sections for specific requirements and limitations for substitutions.

1.03 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
 - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
- B. Substitute Items (Or Equal): If in Architect/Engineer's sole discretion, an item of material or equipment proposed by Contractor does not qualify as an "or-equal" item it will be considered a proposed substitute item.

012500
SUBSTITUTION PROCEDURES

1.04 ACTION SUBMITTALS

- A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
1. Documentation: Show compliance with requirements for substitutions and the following, as applicable: Substitution Request Form: Use the Substitution Request Form bound into section 006000 of this Project Manual.
 - a. Statement indicating why specified product or fabrication, or installation cannot be provided, if applicable.
 - b. Coordination information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
 - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. Certificates and qualification data, where applicable or requested.
 - g. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
 - h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
 - i. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
 - j. Cost information, including a proposal of change, if any, in the Contract Sum.
 - k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
 - l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
 - m. See additional requirements in Article 2.3 DETAILED SUBSTITUTION REVIEW PROCEDURES.
 2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within (5) five working days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within (10) ten working days of receipt of request, or (5) five working days of receipt of additional information or documentation, whichever is later.
 - a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
 - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

012500
SUBSTITUTION PROCEDURES

1.05 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage qualified testing agency to perform compatibility tests recommended by manufacturers.

PART 2 PRODUCTS

2.01 SUBSTITUTION PROCEDURES (GENERAL)

- A. Conditions: After the "Notice of Award" and prior to the Contractor entering into a Formal Contract with the Owner, the Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 - 1. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - 2. Substitution results in substantial cost savings to the Owner or substantial performance improvements.
 - 3. Substitution request is fully documented and properly submitted.
 - 4. Requested substitution will not adversely affect Contractor's construction schedule.
 - 5. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - 6. Requested substitution is compatible with other portions of the Work.
 - 7. Requested substitution has been coordinated with other portions of the Work.
 - 8. Requested substitution provides specified warranty.
 - 9. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
 - 10. The substitution is submitted in compliance with Article 2.3 DETAILED SUBSTITUTION REVIEW PROCEDURES.
- B. If the Contractor does not present "Substitutions" in the time frame noted above any future requests to substitute products will not be considered, unless the substitution is for cause.
- C. Coordination: Modify or adjust affected work as necessary to integrate work of the approved substitutions.

2.02 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately upon discovery of need for change, but not later than (20) twenty days prior to time required for preparation and review of related submittals.
 - 1. Architect will consider Contractor's request for substitution when the following conditions are present.
 - a. The specified product is not available
 - b. The specified product cannot be delivered in the time frame required under the Project Schedule.
 - 2. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 - a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - b. Substitution request is fully documented and properly submitted.
 - c. Requested substitution will not adversely affect Contractor's construction schedule.

012500

SUBSTITUTION PROCEDURES

- d. Requested substitution has received necessary approvals of authorities having jurisdiction.
- e. Requested substitution is compatible with other portions of the Work.
- f. Requested substitution has been coordinated with other portions of the Work.
- g. Requested substitution provides specified warranty.
- h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

2.03 DETAILED SUBSTITUTION REVIEW PROCEDURES

- A. The Architect in addition to the requirements listed above will require compliance with the following requirements and procedures.
 - 1. Requests for approval of substitutions will be received and considered from Prime Contractors only and not from manufacturers, suppliers, Subcontractors, or other third parties.
 - 2. If the materials and equipment submitted are offered as substitutions to the Contract Documents or approved equal, the Contractor shall advise the Owner and the Architect of the requested substitutions and comply with the requirements hereinafter specified in this Article.
 - 3. Where the acceptability of substitution is conditioned upon a record of and the proposed substitution does not fulfill this requirement, the Architect, at the Architect's sole discretion, may accept the substitution if the Contractor provides a bond or cash deposit which guarantees replacement at no cost to the Owner for any failure occurring within a specified time. The substitution item must meet all other technical requirements contained in the Specification.
 - 4. The Contractor shall furnish such information as required by the Architect to demonstrate that the equal article, material, apparatus, product or process is the equivalent of that specified in quality, finish, design, efficiency and durability and has been elsewhere demonstrated to be equally serviceable for the purpose for which it is intended and/or that it offers substantial benefits to the Owner in saving of time and/or cost. The Contractor shall set forth the reasons for desiring to make this substitution.
 - 5. Contractor shall submit:
 - a. For each proposed request for approved substitute sufficient details, complete descriptive literature and performance data together with samples of the materials, where feasible, to enable the Architect to determine if the proposed request for approval should be granted, including manufacturer's brand or trade names, model numbers, description of specification of item, performance data, test reports, samples, history of service, and other data as applicable.
 - b. Certified tests, where applicable, by an independent laboratory attesting to the performance of the substitute.
 - c. A list of installations where the proposed substitute equipment or materials is performing under similar conditions as specified.
 - d. A list of installations where the proposed substitute equipment or materials is performing under similar conditions as specified.
 - 6. Where the approval of a substitute requires revision or redesign of any part of Work, including that of other Contracts, all such revision and redesign, and all new drawings and details required therefore, shall be provided by the Contractor at its own cost and expense, and shall be subject to the approval of the Architect.
 - 7. In the event that the Architect is required to provide additional services, then the Architect's charges for such additional services shall be paid by the Contractor to the Owner.

012500

SUBSTITUTION PROCEDURES

8. Any modifications in the Work required under other contracts to accommodate the changed design will be incorporated in the appropriate contracts and any resulting increases in contract prices will be charged to the Contractor by the Owner who initiated the changed design.
9. In all cases, the Architect shall be the judge as to whether a proposed substitute is to be approved. The Contractor shall be bound by the Architect's decision. No substitute items shall be used in the Work without written approval of the Architect.
10. In making request for approval of substitute, Contractor represents that:
 - a. Contractor has investigated proposed substitute and determined that it is equal to or superior in all respects to the product, manufacturer or method specified or offers other specified advantages to the Owner.
 - b. Contractor will provide the same or better warranties or bonds for proposed substitute as for product, manufacturer or method specified.
 - c. Contractor waives all claims for additional costs or extension of time related to proposed substitute that subsequently may become apparent.
 - d. Contractor shall have and make no claim for an extension of time or for damages by reason of the time taken by the Architect in considering a substitute proposed by the Contractor or by reason of failure of the Architect to approve a substitute proposed by the Contractor. Any delays arising out of consideration, approval, or utilization of a substitute shall be the sole responsibility of the Contractor requesting the substitute and it shall arrange its operations to make up the time lost.
11. Proposed substitute will not be accepted if:
 - a. Acceptance will require substantial revision of Contract Documents.
 - b. Acceptance will substantially change design concepts or Technical Specifications.
 - c. Acceptance will delay completion of the Work, or the Work of other Contractors.
 - d. If the Substitute item is not accompanied by formal request for approval of substitute from Contractor.
12. The Architect reserves the right to disapprove, for aesthetic reasons, any material or equipment on the basis of design or color considerations alone, without prejudice to the quality of the material or equipment, if the manufacturer cannot meet the required colors or design.
13. All requests for approval of substitutes of materials or other changes from the contract requirements shall be accompanied by an itemized list of all other items affected by such substitution or change. The Architect shall have the right, if such is not done, to rescind any approvals for substitutions and to order such Work removed and replaced with Work conforming to the specified requirements of the contract, all at the Contractor's expense, or to assess all additional costs resulting from the substitution to the Contractor.
14. Approval of a substitute will not relieve Contractor from the requirement to submit Shop Drawings or any of the provisions of the Contract Documents.
15. In the event that the Architect is required to provide additional services as a result of a request for approval of a substitute results in changes by the Contractor in dimension, weight, power requirements, etc., of the equipment and accessories furnished, or as a result of Contractor's errors, omissions or failure to conform to the requirements of the Contract Documents or if the Architect is required to examine and evaluate any changes proposed by the Contractor solely for the convenience of the Contractor, or for evaluation of deviations from Contract Documents, then the Architect's charges in connection with such additional services shall be paid by the Contractor.
16. Structural design shown on the Drawings is based upon the configuration of and maximum loading for major items of equipment as indicated on the Drawings and as specified. If the substituted equipment furnished differs from said features, the Contractor shall pay to the Owner all costs of redesign and for any construction changes required to accommodate the equipment furnished, including the Architect's charges in connection therewith.

012500

SUBSTITUTION PROCEDURES

- B. The Contractor shall respond to required submittals with complete information and with a degree of accuracy to achieve approvals within two (2) submissions. All costs to the Architect involved with subsequent submissions of Shop Drawings, Samples or other items requiring approval, will be paid by the Contractor to the Owner, by deducting such costs from payments due for Work completed. In the event an approved item is requested by the Contractor to be changed or substituted for, all costs involved in the reviewing and approval process will likewise be back charged to the Contractor unless determined by the Architect that the need for such substitution and/or deviation from Contract Documents is beyond the control of the Contractor.

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION 012500

**SECTION 012600
CONTRACT MODIFICATION PROCEDURES**

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Sections:
 - 1. Division 01 Section "Product Requirements" for administrative procedures for handling requests for substitutions made after Contract award.

1.02 NO COST CHANGES IN THE WORK

- A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on the Information Bulletin form bound in section 006000 of this Project Manual.

1.03 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within time specified in Proposal Request or (10) ten working days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.
 - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship.
- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.
 - 1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
 - 2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - 3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - 4. Include costs of labor and supervision directly attributable to the change.
 - 5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times.
 - 6. Comply with requirements in Division 01 Section "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.

012600
CONTRACT MODIFICATION
PROCEDURES

1.04 ALLOWANCES

- A. Allowance Adjustment: To adjust allowance amounts, base each Change Order proposal on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.
 - 1. Include installation costs in purchase amount only where indicated as part of the allowance.
 - 2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other margins claimed.
 - 3. Submit substantiation of a change in scope of work, if any, claimed in Change Orders related to unit-cost allowances.
 - 4. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.
- B. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the Purchase Order amount or Contractor's handling, labor, installation, overhead, and profit. Submit claims within (5) five days of receipt of the Change Order or Construction Change Directive authorizing work to proceed. Owner will reject claims submitted later than (5) five days after such authorization.
 - 1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of work has changed from what could have been foreseen from information in the Contract Documents.
 - 2. No change to Contractor's indirect expense is permitted for selection of higher- or lower-priced materials or systems of the same scope and nature as originally indicated.

1.05 ADMINISTRATIVE CHANGE ORDERS

- A. Adjustment from Allowances: Refer to Division 01 Section "Allowances" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of allowances.
- B. Adjustments from Unit Prices: Refer to Division 01 Section "Unit Prices" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect measured scope of unit price work.

1.06 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on the Information Bulletin form bound in section 006000 of this Project Manual.

1.07 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect may issue a Construction Change Directive on the Information Bulletin form bound in section 006000 of this Project Manual.
 - 1. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
 - a. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

012600
CONTRACT MODIFICATION
PROCEDURES

2. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
 - a. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION 012600

**012600
CONTRACT MODIFICATION
PROCEDURES**

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**SECTION 012900
PAYMENT PROCEDURES**

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Sections:
 - 1. Division 01 Section "Contract Modification Procedures" for procedures for handling changes to the Contract.
 - 2. Division 01 Section "Submittal Procedures" for requirements governing the preparation and submittal of the submittal schedule.

1.02 SCHEDULE OF VALUES

- A. Schedule of Values: 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.
- B. Coordination: Correlate line items in the schedule of values with other required administrative forms and schedules, including the following:
 - 1. Application for Payment forms AIA G702 and G703 with continuation sheets.
 - 2. Submittal schedule.
 - 3. Submit the schedule of values to Architect at earliest possible date but no later than (7) seven days before the date scheduled for submittal of initial Applications for Payment.
- C. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the schedule of values.
 - 1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Name of Architect.
 - c. Architect's project number.
 - d. Contractor's name and address.
 - e. Date of submittal.
 - 2. 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. Change Orders (numbers) that affect value.
 - d. 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.
 - 3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports.
 - 4. The following line items must be included on the continuation sheet.
 - a. Project Bonds and Insurances.
 - b. Mobilization.
 - c. Shop Drawings.
 - d. Project Meetings.
 - e. Temporary Heat (where applicable).
 - f. Progress Cleaning.
 - g. Lawn and Tree Watering (where applicable to establish new lawns and trees).
 - h. Punch List.

012900
PAYMENT PROCEDURES

- i. Final Cleaning.
- j. Close Out documents and Warranties.
- 5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
- 6. Submit draft of AIA Document G703 Continuation Sheets.
- 7. 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.
- 8. Purchase Contracts: Provide a separate line item in the schedule of values for each purchase contract. Show line-item value of purchase contract. Indicate owner payments or deposits, if any, and balance to be paid by Contractor.
- 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.

1.03 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect 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 is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- C. Application for Payment Forms: Use AIA Documents G702 and 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. Architect 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.
 - 4. The OWNER shall retain (5%) five percent of the amount due on each Application for both the work completed and materials stored. The OWNER reserves the right to retain a greater percentage in the event the CONTRACTOR fails to make satisfactory progress or in the event there is other specific cause for greater withholding.
- 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.

012900

PAYMENT PROCEDURES

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.
- F. Transmittal: Submit (4) four signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt. One copy shall include waivers of lien and similar attachments if required.
- 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. Waiver Forms: Submit waivers of lien on forms, executed in a manner acceptable to Owner.
- H. Initial Application for Payment: Administrative actions and submittals that must precede submittal of first Application for Payment include the following:
 1. List of Substitutions
 2. Contract or Notice to Proceed.
 3. Performance and Payment bonds.
 4. Liability, Auto, and Umbrella Insurance
 5. Worker Compensation certificates
 6. Proposed schedule of values for approval.
- I. Initial Application for Payment: Administrative actions and submittals that must coincide with submittal of first Application for Payment include the following:
 1. Approved Schedule of values.
 2. List of subcontractors.
 3. Contractors Safety Program.
 4. Proof of completion of the OSHA 10 Safety Training Course by all Contractor's and Subcontractor's employees present on the job site.
 - a. Attach copy of this proof of completion for each employee.
 - b. Attach copy of this proof of completion on each succeeding payroll where each new or additional employee is first listed.
 5. Submittal schedule (preliminary if not final).
 - a. First Payment WILL NOT be processed without a Submittal Schedule.
 6. Emergency Contacts List.
 7. Certified Payroll.
 8. Schedule of unit prices.
 9. List of Contractor's staff assignments.
 10. List of Contractor's principal consultants.
 11. Copies of building permits.
 12. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 13. Minutes or report of preconstruction conference.
- J. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
 1. Administrative actions and submittals that shall precede or coincide with this application include:
 - a. Occupancy permits and similar approvals.

012900

PAYMENT PROCEDURES

- b. List of incomplete Work, recognized as exceptions to Architect's Certificate of Substantial Completion.
- c. Record Drawings and Specifications.
- d. Operations and Maintenance Manuals.
- e. Maintenance Instructions and Training.
- f. Start-up performance reports.
- g. Test/adjust/balance records.
- h. Warranties (guarantees) and maintenance agreements.
- i. Final cleaning.
- j. Change-over information related to Owner's occupancy, use, operation and maintenance.
- k. Application for reduction of retainage and consent of surety.
- l. Advice on shifting insurance coverages.
- 2. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
- 3. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- K. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
 - 1. Ensure that incomplete Work is not accepted and will be completed without undue delay.
 - 2. 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.
 - 3. Evidence of completion of Project closeout requirements.
 - 4. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 - 5. Updated final statement, accounting for final changes to the Contract Sum.
 - 6. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
 - 7. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
 - 8. AIA Document G707, "Consent of Surety to Final Payment."
 - 9. Evidence that all claims have been settled.
 - 10. Removal of temporary facilities and services.
 - 11. Removal of surplus materials, rubbish, and similar elements.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION 012900

**SECTION 013100
PROJECT MANAGEMENT AND COORDINATION**

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. General project coordination procedures.
 - 2. Administrative and supervisory personnel.
 - 3. Coordination drawings.
 - 4. Requests for Information (RFIs).
 - 5. Project meetings.
- B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.
- C. Related Sections:
 - 1. Division 01 Section "Summary" for Project Information and phasing requirements
 - 2. Division 01 Section "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
 - 3. Division 01 Section "Closeout Procedures" for coordinating closeout of the Contract.

1.02 DEFINITIONS

- A. RFI: Request from Owner, Architect, or Contractor seeking information from each other during construction.

1.03 INFORMATIONAL SUBMITTALS

- A. Use the Architects Newforma Info Exchange when uploading Submittals.
- B. Subcontractor list is required by AIA Document A201 to be submitted as soon as practical prior to award of the Contract. Coordinate with submittal requirements for subcontractor list in Procurement Requirements and Contracting Requirements if any.
- C. Subcontractor 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. Use Subcontractor List form bound into 006000 of this Project Manual. 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.
- D. Key Personnel Names: Within (15) fifteen 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, 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. Each Contractor to furnish a 24hr. emergency contact person and cellular phone number.
 - 2. Post copies of listing in project meeting room, or field office, [on Project Web site,] and by each field telephone. Keep list current...

013100
PROJECT MANAGEMENT AND
COORDINATION

1.04 COORDINATION

- 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. Coordination: Each contractor shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its operations with 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 with other contractors to ensure maximum performance and accessibility for required maintenance, service, and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.
- C. 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.
- D. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors 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.
 - 9. Project closeout activities.
- E. 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.

013100
PROJECT MANAGEMENT AND
COORDINATION

1.05 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings in accordance with requirements in individual Sections, 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 architectural, 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 Architect 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 architectural elements, 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. Provide required information for work sequence to interface with the installation work.
 - 2. Plenum Space: Indicate sub framing 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.

013100
PROJECT MANAGEMENT AND
COORDINATION

- 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 inch 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 areas for required access and indicate the need for access doors for access to shutoffs electrical boxes Etc.
 - 10. Prepare coordination wiring diagrams and any drawings necessary to illustrate the complete installation of door hardware and access control to provide fully operational system. General Contractor to provide individual wiring diagrams for hardware for each door. Provide drawings to Electrical Contractor for completion.
 - 11. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are the Contractor's responsibility. If the Architect determines that the coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, the Architect will so inform the Contractor, who shall make changes as directed and resubmit.
 - a. Failure to provide the required coordination drawings as required by this specification section may result in withholding a portion of the Contractor payment requests until such coordination drawings are received.
 - 12. Coordination Drawing Prints: Prepare and submit coordination drawing prints in accordance with requirements of Division 01 Section "Submittal Procedures."
- C. Architect's Digital Data Files:
 - 1. The Architect will provide digital PDF's of Contract Drawings for the purpose of producing coordination drawings for a Handling Fee of \$ 50 per drawing file.
 - a. Contract documents are graphic representations of approximate locations of materials. Therefore, information contained within these files should not be assumed to be accurate and users of the Files accept full responsibility for verifying the accuracy and completeness of the Files with field conditions and the contract documents.
 - 2. Document Transfer Agreement - For Projects where Architect's work files are not a deliverable: The Contractor shall execute an Electronic Document Transfer Agreement for all electronic transfers of files, other than PDFs. The contractor must provide acknowledgement, accept the information regarding drawings, ownership and Limitations of Liability. Electronic Document Transfer Agreement form is bound in section 006000 of this Project Manual.
 - a. The following CAD files will be furnished for each appropriate discipline:
 - 1) Floor plans.
 - 2) Reflected ceiling plans.

013100
PROJECT MANAGEMENT AND
COORDINATION

1.06 KEY PERSONNEL

- A. Key Personnel Names: Within (5) five 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 email addresses. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.
 - 1. Post copies of list in project meeting room, or temporary office, and by field telephone.

1.07 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. Do not submit an RFI if information is readily available in the contract documents. Verify by contacting and questioning the Architect prior to submitting an RFI.
 - a. Architect will return with no response, any RFI where information is available to the contractor and is indicated in the Contract Documents.
 - 2. Architect will return RFI's submitted to Architect by other entities controlled by Contractor with no response.
 - 3. Coordinate and submit RFI's 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 and the following:
 - 1. Project name.
 - 2. Project number.
 - 3. Name of Contractor.
 - 4. Name of Architect.
 - 5. RFI number, numbered sequentially.
 - 6. RFI subject.
 - 7. Specification Section number and title and related paragraphs, as appropriate.
 - 8. Drawing number and detail references, as appropriate.
 - 9. Field dimensions and conditions, as appropriate.
 - 10. Contractor's suggested resolution. If Contractor's solution(s) impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 - 11. Contractor's signature.
 - 12. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
 - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI's sent without the required content information will not be considered a formal RFI and will be returned to the Contractor without comment or response.
- D. RFI Forms: Use Request For Information form bound in section 006000 of this Project Manual.
- E. Architect's Action: Architect will review each RFI, determine action required, and respond .. Allow (7) seven working days for Architect's response for each RFI. RFI's received by Architect after 1:00 p.m. will be considered as received the following working day.
 - 1. The following RFI's will be refused without action:
 - a. Requests for approval of submittals.

013100
PROJECT MANAGEMENT AND
COORDINATION

- b. Requests for approval of substitutions.
 - c. Requests for information already indicated in the Contract Documents.
 - d. Requests for adjustments in the Contract Time or the Contract Sum.
 - e. Requests for interpretation of Architect's actions on submittals.
 - f. Incomplete RFI's or inaccurately prepared RFI's.
- 2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
- 3. Architect's action on RFI's that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit a Change Proposal according to Division 01 Section "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within (10) ten days of receipt of the RFI response.
- F. RFI Log: Prepare, maintain, and submit a tabular log of RFI's organized by the RFI number. Submit log weekly. Use CSI Log Form 13.2B. Include the following:
 - 1. Project name.
 - 2. Name and address of Contractor.
 - 3. Name and address of Architect.
 - 4. RFI number including RFI's that were dropped and not submitted.
 - 5. RFI description.
 - 6. Date the RFI was submitted.
 - 7. Date Architect's response was received.
 - 8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
 - 9. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.
- G. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within (7) seven days if Contractor disagrees with response.
 - 1. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
 - 2. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

1.08 ARCHITECTS WEBSITE

- A. The contractor will use Newforma Info Exchange for Submittals, Shop Drawings and RFI's. Project Web site shall include the following functions:
 - 1. Project directory.
 - 2. Project correspondence.
 - 3. Meeting minutes.
 - 4. Contract modifications forms and logs.
 - 5. RFI forms and logs.
 - 6. Task and issue management.
 - 7. Photo documentation.
 - 8. Schedule and calendar management.
 - 9. Submittals forms and logs.
 - 10. Payment application forms.
 - 11. Drawing and specification document hosting, viewing, and updating.
 - 12. Online document collaboration.

013100
PROJECT MANAGEMENT AND
COORDINATION

- 13. Reminder and tracking functions.
- 14. Archiving functions.
- B. Provide up to (7) seven Project Web site user licenses for use by the Architect. Provide (8) eight hours of software training at Architect's office for Project Web site users.
- C. Upon completion of Project, provide (1) one complete archive copy(ies) of Project Web site files to Owner and to Architect in a digital storage format acceptable to Architect.
- D. Contractor, subcontractors, and other parties granted access by Contractor to Project Web site shall execute a data licensing agreement in the form of AIA Document C106.

1.09 PROJECT MEETINGS

- A. General: Architect will schedule and conduct meetings and conferences at Project site, unless otherwise indicated.
- B. Preconstruction Conference: Architect will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than (15) fifteen days after execution of the Agreement.
 - 1. Conduct the conference to review responsibilities and personnel assignments.
 - 2. Attendees: Authorized representatives of Owner, Architect, and Architect's Consultants; Contractors and their superintendents; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to decide 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. Procedures for project communications.
 - f. Procedures for processing field decisions and Change Orders.
 - g. Procedures for RFI's.
 - h. Testing and inspecting requirements.
 - i. Procedures for processing Applications for Payment.
 - j. Distribution of the Contract Documents.
 - k. Submittal procedures using Newforma Info Exchange.
 - l. Preparation and updating of record documents.
 - m. Use of the premises.
 - n. Work restrictions.
 - o. Working hours.
 - p. Owner's occupancy requirements and restrictions.
 - 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.

013100
PROJECT MANAGEMENT AND
COORDINATION

- C. Preinstallation Conferences: Architect shall conduct a preinstallation conference at Project site, unless otherwise indicated, before each construction activity that requires coordination with other construction.
1. Attendees: Installer and representatives of manufacturers and fabricators involved in, or affected by, the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise all parties involved of scheduled meeting dates.
 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. Contract Documents.
 - b. Options.
 - c. Related RFI's.
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Review of mockups.
 - i. Possible conflicts.
 - j. Compatibility problems.
 - k. Time schedules.
 - l. Weather limitations.
 - m. Manufacturer's written recommendations.
 - n. Warranty requirements.
 - o. Compatibility of materials.
 - p. Acceptability of substrates.
 - q. Temporary facilities and controls.
 - r. Space and access limitations.
 - s. Regulations of authorities having jurisdiction.
 - t. Testing and inspecting requirements.
 - u. Installation procedures.
 - v. Coordination with other work.
 - w. Required performance results.
 - x. Protection of adjacent work.
 - y. Protection of construction and personnel.
 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 4. Reporting: The entity recording meeting minutes shall distribute them to each party present and to other parties requiring information.
 5. 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. Progress Meetings: Architect will conduct progress meetings at regular intervals.
1. Coordinate dates of meetings with preparation of payment requests.
 2. Required Attendees: In addition to representatives of Owner and Architect, each Prime contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to decide matters relating to the Work.

013100
PROJECT MANAGEMENT AND
COORDINATION

3. 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) Status of submittals.
 - 4) Deliveries.
 - 5) Off-site fabrication.
 - 6) Access.
 - 7) Site utilization.
 - 8) Temporary facilities and controls.
 - 9) Progress cleaning.
 - 10) Status of correction of deficient items.
 - 11) Field observations.
 - 12) Status of RFI's.
 - 13) Status of proposal requests.
 - 14) Pending changes.
 - 15) Status of Change Orders.
4. 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.
- E. Coordination Meetings: Architect will conduct Project coordination meetings at regular intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
 1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined 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.

013100
PROJECT MANAGEMENT AND
COORDINATION

- b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
 - c. Review present and future needs of each contractor present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Status of submittals.
 - 4) Deliveries.
 - 5) Off-site fabrication.
 - 6) Access.
 - 7) Site utilization.
 - 8) Temporary facilities and controls.
 - 9) Work hours.
 - 10) Hazards and risks.
 - 11) Progress cleaning.
 - 12) Quality and work standards.
 - 13) Change Orders.
 - 3. Reporting: Entity recording meeting minutes shall distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.
- F. Project Closeout Meeting: Architect will schedule and conduct a Project Closeout Meeting, at a time convenient to Owner and Architect, but no later than (30) thirty days prior to the scheduled date of Substantial Completion.
- 1. Conduct the conference to review requirements and responsibilities related to Project closeout.
 - 2. Required Attendees: Authorized representatives of Owner and Architect; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
 - a. Preparation and completion of Contractor's punch list.
 - b. Responsibility for removing temporary facilities and controls.
 - c. Owner's partial occupancy requirements.
 - d. Coordination of separate contracts for owner related work prior to occupancy.
 - e. Installation of Owner's furniture, fixtures, and equipment.
 - f. Requirements for preparing operations and maintenance data.
 - g. Requirements for the Submittal of written warranties.
 - h. Requirements for demonstration and training.
 - i. Requirements for submission of record documents, record specifications and record submittals.
 - j. Responsibility and schedule for final cleaning
 - k. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
 - 4. Minutes: Entity conducting meeting will record and distribute meeting minutes.

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West Campus Renovations
013100 - 11

**013100
PROJECT MANAGEMENT AND
COORDINATION**

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION 013100

**013100
PROJECT MANAGEMENT AND
COORDINATION**

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**SECTION 013200
CONSTRUCTION PROGRESS DOCUMENTATION**

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Start-up construction schedule.
 - 2. Contractor's construction schedule.
 - 3. Daily construction reports.
 - 4. Field condition reports.
 - 5. Special reports.
- B. Related Sections:
 - 1. Division 01 Section "Submittal Procedures" for submitting schedules and reports.
 - 2. Division 01 Section "Quality Requirements" for submitting a schedule of tests and inspections.

1.02 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format(s):
 - 1. Electronic PDF files.
- B. Start-up construction schedule.
- C. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
- D. Daily Construction Reports: Submit at weekly intervals.
- E. Field Condition Reports: Submit at time of discovery of differing conditions.
- F. Special Reports: Submit at time of unusual event.

1.03 QUALITY ASSURANCE

- A. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination". Review methods and procedures related to the preliminary construction schedule and Contractor's construction schedule, including, but not limited to, the following:
 - 1. Review software limitations and content and format for reports.
 - 2. Verify availability of qualified personnel needed to develop and update schedule.
 - 3. Review delivery dates for Owner-furnished products.
 - 4. Review schedule for work of Owner's separate contracts.
 - 5. Review time required for review of submittals and resubmittals.
 - 6. Review requirements for tests and inspections by independent testing and inspecting agencies.
 - 7. Review time required for completion and startup procedures.
 - 8. Review and finalize list of construction activities to be included in schedule.
 - 9. Review submittal requirements and procedures.
 - 10. Review procedures for updating schedule.

1.04 COORDINATION

- A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.

013200
CONSTRUCTION PROGRESS
DOCUMENTATION

1. Secure time commitments for performing critical elements of the Work from entities involved.
2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 PRODUCTS

2.01 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Time Frame: Extend schedule from date established for commencement of the Work to date of Substantial Completion.
 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- B. Activities: Treat each story or separate area as a separate numbered activity for each principal element of the Work. Comply with the following:
 1. Activity Duration: Define activities and days
 2. Procurement Activities: Include procurement process activities for long lead items and major items, requiring a cycle of more than (60) sixty days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 3. Submittal Review Time: Include review and resubmittal times indicated in Division 01 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
 4. Startup and Testing Time: Include not less than (15) fifteen days for startup and testing.
 5. Punch List and Final Completion: Include not more than (30) thirty days for punch list and final completion.
- C. Schedule Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule and show how the sequence of the Work is affected.
 1. Phasing: Arrange list of activities on schedule by phase.
 2. Work under More Than One Contract: Include a separate activity for each contract.
 3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
 4. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Division 01 Section "Summary". Delivery dates indicated stipulate the earliest possible delivery date.
 5. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Division 01 Section "Summary". Delivery dates indicated stipulate the earliest possible delivery date.
 6. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Coordination with existing construction.
 - b. Limitations of continued occupancies.
 - c. Uninterruptible services.
 - d. Partial occupancy before Substantial Completion.
 - e. Use of premises restrictions.
 - f. Provisions for future construction.
 - g. Seasonal variations.
 - h. Environmental control.
 7. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
 - a. Submittals.
 - b. Purchases.
 - c. Mockups.

013200
CONSTRUCTION PROGRESS
DOCUMENTATION

- d. Sample testing.
- e. Deliveries.
- f. Installation.
- g. Tests and inspections.
- h. Adjusting.
- i. Startup and placement into final use and operation.
- 8. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
 - a. Structural completion.
 - b. Permanent space enclosure.
 - c. Completion of mechanical installation.
 - d. Completion of electrical installation.
 - e. Substantial Completion.
- D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed and Substantial Completion.
- E. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
 - 1. Unresolved issues.
 - 2. Unanswered RFI's.
 - 3. Rejected or unreturned submittals.
 - 4. Notations on returned submittals.
- F. Recovery Schedule: When periodic update indicates the Work is (14) fourteen or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.
- G. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

2.02 START-UP CONSTRUCTION SCHEDULE

- A. Bar-Chart Schedule: Submit start-up horizontal bar-chart-type construction schedule within (7) seven days of date established for approval. Schedule to start from the Notice of Award.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first (90) ninety days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

2.03 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

- A. Gantt-Chart Schedule: From the approved Bar Chart Schedule submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's construction schedule within (30) thirty days Base schedule on the approved startup construction schedule and additional information received since the start of Project.

2.04 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

013200
CONSTRUCTION PROGRESS
DOCUMENTATION

1. List of Prime contractors at Project site.
 2. List of subcontractors at Project site.
 3. Approximate count of personnel at Project site.
 4. Equipment at Project site.
 5. Material deliveries.
 6. High and low temperatures and general weather conditions, including presence of rain or snow.
 7. Accidents.
 8. Meetings and significant decisions.
 9. Unusual events (refer to special reports).
 10. Stoppages, delays, shortages, and losses.
 11. Meter readings and similar recordings.
 12. Emergency procedures.
 13. Orders and requests of authorities having jurisdiction.
 14. Change Orders received and implemented.
 15. Construction Change Directives received and implemented.
 16. Services connected and disconnected.
 17. Equipment or system tests and startups.
 18. Partial completions and occupancies.
 19. Substantial Completions authorized.
- B. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.05 SPECIAL REPORTS

- A. General: Submit special reports directly to Owner within (1) one day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.
- B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

PART 3 EXECUTION

3.01 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 3. As the Work progresses, indicate final completion percentage for each activity.
- B. Distribution: Distribute copies of approved schedule to Owner, Architect, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
1. Post copies in Project meeting rooms and temporary field offices.

013200
CONSTRUCTION PROGRESS
DOCUMENTATION

2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 013200

**013200
CONSTRUCTION PROGRESS
DOCUMENTATION**

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**SECTION 013200
CONSTRUCTION PROGRESS DOCUMENTATION**

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Start-up construction schedule.
 - 2. Contractor's construction schedule.
 - 3. Daily construction reports.
 - 4. Field condition reports.
 - 5. Special reports.
- B. Related Sections:
 - 1. Division 01 Section "Submittal Procedures" for submitting schedules and reports.
 - 2. Division 01 Section "Quality Requirements" for submitting a schedule of tests and inspections.

1.02 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format(s):
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- B. Start-up construction schedule.
- C. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
- D. Daily Construction Reports: Submit at weekly intervals.
- E. Field Condition Reports: Submit at time of discovery of differing conditions.
- F. Special Reports: Submit at time of unusual event.

1.03 QUALITY ASSURANCE

- A. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination". Review methods and procedures related to the preliminary construction schedule and Contractor's construction schedule, including, but not limited to, the following:
 - 1. Review software limitations and content and format for reports.
 - 2. Verify availability of qualified personnel needed to develop and update schedule.
 - 3. Review delivery dates for Owner-furnished products.
 - 4. Review schedule for work of Owner's separate contracts.
 - 5. Review time required for review of submittals and resubmittals.
 - 6. Review requirements for tests and inspections by independent testing and inspecting agencies.
 - 7. Review time required for completion and startup procedures.
 - 8. Review and finalize list of construction activities to be included in schedule.
 - 9. Review submittal requirements and procedures.
 - 10. Review procedures for updating schedule.

1.04 COORDINATION

- A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.

013200
CONSTRUCTION PROGRESS
DOCUMENTATION

1. Secure time commitments for performing critical elements of the Work from entities involved.
2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 PRODUCTS

2.01 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Time Frame: Extend schedule from date established for commencement of the Work to date of Substantial Completion.
 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
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 1. Activity Duration: Define activities and days
 2. Procurement Activities: Include procurement process activities for long lead items and major items, requiring a cycle of more than (60) sixty days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 3. Submittal Review Time: Include review and resubmittal times indicated in Division 01 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
 4. Startup and Testing Time: Include not less than (15) fifteen days for startup and testing.
 5. Punch List and Final Completion: Include not more than (30) thirty days for punch list and final completion.
- C. Schedule Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule and show how the sequence of the Work is affected.
 1. Phasing: Arrange list of activities on schedule by phase.
 2. Work under More Than One Contract: Include a separate activity for each contract.
 3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
 4. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Division 01 Section "Summary". Delivery dates indicated stipulate the earliest possible delivery date.
 5. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Division 01 Section "Summary". Delivery dates indicated stipulate the earliest possible delivery date.
 6. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Coordination with existing construction.
 - b. Limitations of continued occupancies.
 - c. Uninterruptible services.
 - d. Partial occupancy before Substantial Completion.
 - e. Use of premises restrictions.
 - f. Provisions for future construction.
 - g. Seasonal variations.
 - h. Environmental control.
 7. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
 - a. Submittals.
 - b. Purchases.
 - c. Mockups.

013200
CONSTRUCTION PROGRESS
DOCUMENTATION

- d. Sample testing.
- e. Deliveries.
- f. Installation.
- g. Tests and inspections.
- h. Adjusting.
- i. Startup and placement into final use and operation.
- 8. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
 - a. Structural completion.
 - b. Permanent space enclosure.
 - c. Completion of mechanical installation.
 - d. Completion of electrical installation.
 - e. Substantial Completion.
- D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed and Substantial Completion.
- E. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
 - 1. Unresolved issues.
 - 2. Unanswered RFI's.
 - 3. Rejected or unreturned submittals.
 - 4. Notations on returned submittals.
- F. Recovery Schedule: When periodic update indicates the Work is (14) fourteen or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.
- G. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

2.02 START-UP CONSTRUCTION SCHEDULE

- A. Bar-Chart Schedule: Submit start-up horizontal bar-chart-type construction schedule within (7) seven days of date established for approval. Schedule to start from the Notice of Award.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first (90) ninety days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

2.03 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

- A. Gantt-Chart Schedule: From the approved Bar Chart Schedule submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's construction schedule within (30) thirty days Base schedule on the approved startup construction schedule and additional information received since the start of Project.

2.04 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

013200
CONSTRUCTION PROGRESS
DOCUMENTATION

1. List of Prime contractors at Project site.
 2. List of subcontractors at Project site.
 3. Approximate count of personnel at Project site.
 4. Equipment at Project site.
 5. Material deliveries.
 6. High and low temperatures and general weather conditions, including presence of rain or snow.
 7. Accidents.
 8. Meetings and significant decisions.
 9. Unusual events (refer to special reports).
 10. Stoppages, delays, shortages, and losses.
 11. Meter readings and similar recordings.
 12. Emergency procedures.
 13. Orders and requests of authorities having jurisdiction.
 14. Change Orders received and implemented.
 15. Construction Change Directives received and implemented.
 16. Services connected and disconnected.
 17. Equipment or system tests and startups.
 18. Partial completions and occupancies.
 19. Substantial Completions authorized.
- B. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.05 SPECIAL REPORTS

- A. General: Submit special reports directly to Owner within (1) one day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.
- B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

PART 3 EXECUTION

3.01 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 3. As the Work progresses, indicate final completion percentage for each activity.
- B. Distribution: Distribute copies of approved schedule to Owner, Architect, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
1. Post copies in Project meeting rooms and temporary field offices.

013200
CONSTRUCTION PROGRESS
DOCUMENTATION

2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 013200

**013200
CONSTRUCTION PROGRESS
DOCUMENTATION**

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SECTION 013300 SUBMITTAL PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.
- B. This specification describes the procedures for submission of submittals and shop drawings using Newforma Info Exchange.
 - 1. The Contractor will be required to use the Newforma Info Exchange for the transfer of Submittals, Shop Drawings and RFI's. There will be **no exceptions** to this requirement. The contractor will be given a login and password free of charge. For more information follow the procedure below.
 - a. Information and instructions for use are available for review by the Contractor by contacting CPL. The Contractor is to provide an email address for the file to be sent. A PDF file will be emailed to the requesting contractor.
- C. Related Requirements:
 - 1. Section 012900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
 - 2. Section 013100 "Project Management and Coordination" for submitting coordination drawings and subcontract list.
 - 3. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
 - 4. Section 014000 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
 - 5. Section 017700 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
 - 6. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
 - 7. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
 - 8. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.02 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect'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 Architect'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".
- C. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.03 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.

013300

SUBMITTAL PROCEDURES

1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Architect.
 2. Delegated Design must be done by qualified professional, licensed to practice in the State of Pennsylvania.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file of certificate, signed and sealed by the responsible design professional, licensed to practice in the State of Pennsylvania, 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.

1.04 SUBMITTAL GENERAL ADMINISTRATIVE REQUIREMENTS

- A. The Contractor shall prepare a Submittal Log containing the information required to be submitted under the Submittal article from each respective Specification Section. With each item listed the Contractor shall provide anticipated dates for submission to the Architect. The Architect will review and accept or request that corrections be made for subsequent acceptance. This acceptance will constitute an approval for the submittal, shop drawings and sample submissions to commence. **No Submittals or Shop Drawings will be reviewed by the Architect until an approved Submittal Schedule is in place.**
- B. The contractor shall prepare expected submittals in Newforma that correspond to all submittals listed on the submittal schedule at the time of submission of the submittal log. These expected submittals are to follow the naming conventions laid out in section "1.5 Submittal Schedule" and "1.6 Submittal Identification".
- C. The Contractor is responsible for all costs for creating electronic files for the submittal process. The Architect will not provide this service.
1. The Submittal Cover Sheet located in Specification Section 006000 Project Forms shall be used for all Submittals.
 - a. An electronic form of the submittal cover is available upon request from the Architect.
 2. The Submittal Cover sheet when scanned to a PDF shall be the first page viewed in the individual file.
 - a. Each product submitted within a specification section shall have a Submittal Cover sheet attached. Combined submittals with one cover page will not be accepted
 - b. Each Submittal Cover sheet shall be filled in completely. **Files that are sent with the Submittal Cover Sheet missing or not filled in correctly will not be reviewed.** The Architect will send a notice that the submittal is missing information. If the Contractor fails to correct or provide the proper submittal within (15) fifteen days, notice will be provided, and the submittal will be REJECTED.
 3. The Contractor(s) will be provided with a link to upload files to the Newforma Info Exchange. The site address and a "log in" will be provided to the Contractor(s) free of charge.
 4. A read-only Record Submittal Log and RFI Log will be available from the Newforma Info Exchange for the Contractor's reference in checking the status of the submittals and shop drawings.
- D. 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.

013300

SUBMITTAL PROCEDURES

3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
4. Coordinate transmittals of different types of submittals from related sections for parts of the work so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until all related submittals are received. Delays associated with the above are not the Architects responsibility and rests solely with the Contractor.
- E. Architect's Digital Data Files:
 1. Architect will not furnish Contractor with digital drawings for the preparation of shop drawings.

1.05 SUBMITTAL SCHEDULE

- A. Submittal Schedule: Submit, as an action submittal, a list 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 Architect and additional time for handling and reviewing submittals required by those corrections.
 1. Submit a preliminary, if not final, Submittal Schedule for approval a minimum of (15) fifteen days after award of contract. Failure to submit a submittal schedule within the required time frame will result in the refusal by the Architect to review any submittals. Delays associated with failure to receive the Submittal Schedule are not the Architect's responsibly and rest solely with the Contractor.
- B. The information is required to be submitted under the Submittal article from each respective Specification Section. With each item listed, the Contractor shall provide anticipated dates for submission to the Architect. The Architect will review and accept or request that corrections be made for subsequent acceptance. This acceptance will constitute a review for the submittal, shop drawings and sample submissions may commence. No Submittals or Shop Drawings will be reviewed by the Architect until an approved Submittal Schedule is in place.
 1. The Submittal Schedule shall be coordinated with the overall Project Schedule to ensure that submittals are submitted and reviewed so as not to delay the Project Schedule.
 2. The Architect will not be responsible for ensuring that all required Shop Drawings, Product Data, Samples or similar submittals that are required to be submitted and reviewed under the Contract Documents are submitted by the Contractor. Submissions of Shop Drawings, Product Data, Samples or similar submittals are the Contractor's sole responsibility. Delays associated with the Contractor's failure to provide the required submittals are the Contractor's responsibility.
 3. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
 4. Initial Submittal Schedule: Submit concurrently with startup construction schedule. Include submittals required during the first (30) thirty days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
 5. Final Submittal Schedule: Submit concurrently with the first complete submittal of Contractor's construction schedule.
 - a. Submit revised submittal schedule as required to reflect changes in current status and timing for submittals.
 6. Format: Arrange the following information in a tabular format:
 - a. Scheduled date for first submittal.
 - b. Specification Section number and title.
 - c. Submittal Category: Action; informational.
 - d. Name of subcontractor.

013300
SUBMITTAL PROCEDURES

- e. Description of the Work covered.
- f. Scheduled date for Architect's final release or approval.
- g. Scheduled dates for purchasing.
- h. Scheduled date of fabrication.
- i. Scheduled dates for installation.

1.06 SUBMITTAL IDENTIFICATION

- A. Submittal Cover Sheet: Attach one cover sheet for each product, shop drawing or sample.
DO NOT combine submittals together with one cover sheet for multiple items. They will not be reviewed.
- B. Submittal Information: Include the following information in each submittal. Use the submittal cover form found in specification section 006000 Project Forms. An electronic form can be sent to the contractor upon request.
 - 1. Contractor, Address, Phone/fax and or Email
 - 2. Contractors Submittal Number.
 - 3. Architects Project Number (if not filled in by the Architect).
 - 4. Project Name (if not filled in by the Architect).
 - 5. Type of submittal being sent (select box).
 - 6. Product Identification including the following: Provide one submittal cover sheet for each product within a specification section.
 - a. Specification Section Number.
 - b. Contract Drawing Number.
 - c. Product Name.
 - d. Specification Reference: Part/Paragraph.
 - e. Detail Reference.
 - f. Manufacturer.
 - 7. Contractors Approval: The contractor must acknowledge that they have reviewed the submittal for conformance with the Contract Documents and must sign and date the approval.
 - 8. Deviation from the Contract Documents: Where the submittal may not meet all of the requirements of the specified item. The contractor must indicate how the submitted item differs from the specified item.
 - 9. Contractor Comments: Any additional comments by the contractor should be indicated in this space. (Provide an attachment sheet for any other information required that will not fit on the cover sheet).
- C. Deviations and Additional Information: On each individual submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information, revisions, line by line comparison and other information requested by Architect. Indicate by highlighting on each submittal or noting on attached separate sheet. Identify options requiring selection by Architect.
- D. File Naming (for uploading to Newforma Info Exchange): Each submittal or shop drawing file uploaded to the project on the Newforma Info Exchange, shall have in the file name, the specification section number followed by the submittal number, the submittal abbreviation and the specification section name. For re-submissions an R1 would be added following submittal number. The file name must include the following information:

Example:

081416	001	PD	Flush Wood Doors
Spec Section	Submittal No.	Submittal Abbr	Specification Name

File to Read: 081416-001 PD - Flush Wood Doors

013300
SUBMITTAL PROCEDURES

Re-submission to Read: 081416-001-R1 PD - Flush Wood Doors

Submittal Abbreviations required to be used in the file name on submittals are as follows:

CD - Coordination Drawings
CERT - Certification(s)
CLC - Calculations
DD - Design Data
EJ - Engineer's Judgement
O&M - Operations and Maintenance Manuals
PD - Product Data
PHOTO - Photo
QD - Qualification Data
RPT - Report
SAMP - Sample
SCH - Schedule
SEL - Make A Selection
SD - Shop Drawing(s)
STDY - Study
TR - Test Results
WAR - Warranty

- E. When uploading submittals or RFI's to the Newforma Info Exchange, complete the online transmittal. The information required is derived from the Contractor's submittal cover sheet or RFI. Instructions for using the Newforma Info Exchange are available from CPL. These instructions can be emailed to the contractor.

1.07 SUBMITTAL DATA AND TESTING REQUIREMENTS

- A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment. Each product within a specification section shall have a separate submittal cover.
1. If information must be specially prepared for submittal because standard published data are unsuitable 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. Send full submittals for each product. Partial submittals will not be reviewed until all required submittal information is received. The Architect will not be responsible for project delays due to the Contractor's failure to submit the required submittal information in a complete package.
 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.

013300
SUBMITTAL PROCEDURES

- 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 that show 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 Shop Drawings, and before or concurrently with Samples.
- B. Shop Drawings: Prepare project-specific information for each shop drawing. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal based on Architect's digital data drawing files is otherwise permitted.
 - 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. Description any conflicts with other trades.
 - h. Seal and signature of professional engineer if specified.
- C. Samples: Submit Samples for review of type, color, pattern, and texture for a check of these characteristics with other materials.
 - 1. Transmit Samples that contain multiple, related components, such as accessories together in one submittal package. If samples are delivered with product data, only the samples will be reviewed. The Product Data must be uploaded to the Newforma Info Exchange. A duplicate submittal cover sheet is to be uploaded to the Newforma Info Exchange as a record of sample delivery.
 - a. The Product Data is to be loaded concurrent with the delivery of samples. Samples may be delivered/given to the Architect. In the remarks column of the transmittal place "given to the Architect".
 - 2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
 - a. Project name and submittal number.
 - b. Generic description of Sample.
 - c. Product name and name of manufacturer.
 - d. Sample source.
 - e. Number and title of applicable Specification Section.
 - f. Specification paragraph number and generic name of each item.
 - g. In addition to all hard copy and physical samples submitted, duplicate digital submittal is to be produced for review, record and tracking purposes through Newforma Info Exchange. Include same information as above as well as a high resolution, color, digital image of all samples with labeled information clearly visible for each physical sample.
 - 3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.

013300

SUBMITTAL PROCEDURES

- b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
- 4. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units, showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit (1) one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
- 5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit (3) three sets of Samples. Architect will retain (2) two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record Sample.
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least (3) three sets of paired units that show approximate limits of variations.
- D. Information requirements for each submittal: Where submittal is requiring Schedules, Product Data, Qualification Data, Design Data, Certificates and Tests use the following protocol.
 - 1. Schedules: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
 - 2. Product Data: Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
 - a. Manufacturer and product name, and model number if applicable.
 - b. Number and name of room or space.
 - c. Location within room or space.
 - 3. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
 - 4. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.
 - 5. Certificates:
 - a. Certificates and Certifications Submittals: Submit 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. Provide a notarized signature where indicated.
 - b. Insert definition of Contractor certificates here if required by individual Specification Sections. See the Evaluations.
 - c. Installer Certificates: Submit written statements on manufacturer's letterhead, certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

013300

SUBMITTAL PROCEDURES

- d. Manufacturer Certificates: Submit written statements on manufacturer's letterhead, certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- e. Material Certificates: Submit written statements on manufacturer's letterhead, certifying that material complies with requirements in the Contract Documents.
- f. Product Certificates: Submit written statements on manufacturer's letterhead, certifying that product complies with requirements in the Contract Documents.
- g. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of AWS B2.1/B2.1M on AWS forms. Include names of firms and personnel certified.
- h. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
- i. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- j. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- k. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- 6. Test and Research Reports:
 - a. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate preparation and primers required.
 - b. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
 - c. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
 - d. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
 - e. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
 - f. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - 1) Name of evaluation organization.
 - 2) Date of evaluation.
 - 3) Time period when report is in effect.
 - 4) Product and manufacturers' names.
 - 5) Description of product.
 - 6) Test procedures and results.
 - 7) Limitations of use.
- E. Submit the following submittals: Within (15) fifteen days of contract award.
 - 1. Submittal Schedule including dates of anticipated review and approval.
 - a. No submittals will be reviewed without an approved Submittal Schedule in place.

013300

SUBMITTAL PROCEDURES

2. Subcontractor 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:
 - a. Name, address, telephone number and email address of entities performing subcontract or supplying products.
 - b. Number and title of related Specification Section(s) covered by subcontract.
 3. Contractor's Construction Schedule: Comply with requirements specified in Section 013200 "Construction Progress Documentation".
 4. Schedule of Values: Comply with requirements specified in Section 012900 "Payment Procedures".
- F. Submit with in the first (30) thirty days after Contract Award
1. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 014329 "Special Inspections".
 2. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
 3. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- G. Submit Field Test Reports during construction within (15) fifteen days of the testing date and as follows:
1. Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- H. Submit a minimum (30) thirty days prior to Project Closeout:
1. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 017700 "Closeout Procedures".
 2. Maintenance Data: Comply with requirements specified in Division 01 Section 017823 "Operation and Maintenance Data".

1.08 SUBMITTAL PROCESSING

- A. Processing Time: Allow time for submittal review, including time for re-submittals, as follows. Time for review shall commence on Architect'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 re-submittals.
- B. The architect will not be responsible for project delays due to the contractor's failure to submit the required submittal information in time to allow for review based on the stipulated review time and to meet the project schedule.
- C. Initial Review: Allow (10) ten Business days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
- D. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
- E. Re-submittal Review: Allow (10) ten business days for review of each re-submittal.
- F. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow (15) fifteen Business days for initial review of each submittal.

013300
SUBMITTAL PROCEDURES

- G. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow (10) tenBusiness days for review of each submittal. Submittal will be returned to Architect before being returned to Contractor.
- H. Where submittal are required to be approved that are part of an assembly or for items such as finishes where color selections are required. The submittal will be retained until all of the information related to these systems and color selections is provided and accepted.
- I. Products with multiple submittals may be held until all necessary information has been submitted for architect to make a complete review. Submittals dependent on coordinating information from related or dependent products; or products with critical interface with other products may be held until all information is submitted for architect to make a complete review and coordinate all required information. EXAMPLE: door frames will not be reviewed without door hardware.
- J. 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 reviewed notation from Architect's action stamp.
- K. 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 Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.

1.09 SUBMITTAL PROCEDURES

- A. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- B. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.
- C. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
- D. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- E. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- F. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- G. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

013300
SUBMITTAL PROCEDURES

- H. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- I. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - 1. Name of evaluation organization.
 - 2. Date of evaluation.
 - 3. Time period when report is in effect.
 - 4. Product and manufacturers' names.
 - 5. Description of product.
 - 6. Test procedures and results.
 - 7. Limitations of use.
- J. Schedule of Tests and Inspections: Comply with requirements specified in Division 01 Section "Quality Requirements".
- K. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- L. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- M. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- N. Maintenance Data: Comply with requirements specified in Division 01 Section "Operation and Maintenance Data".
- O. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

1.10 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 Architect.
- B. Contractors Approval: Provide Contractor's approval signature and date on the Submittal Cover sheet certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

1.11 ARCHITECT'S ACTION

- A. Submittals: Architect will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect will respond to each submittal indicating one of the following actions required:

013300

SUBMITTAL PROCEDURES

1. NO EXCEPTIONS TAKEN (NET): Architect takes no exception to the submittal. This part of the Work covered by the submittal may proceed provided it complies with requirements of the Contract Documents; final acceptance will depend upon that compliance.
 2. FURNISH AS CORRECTED (FAC): No exceptions taken except what is identified by the Architect. The part of the Work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and requirements of the Contract Documents; final acceptance will depend on that compliance. Furnish any additional related information as requested.
 3. REVISE AND RESUBMIT (RAR): Revise the submittal based on the Architects comments and resubmit the submittal. Do not proceed with that part of the Work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal in accordance with the notations; resubmit without delay. Repeat if necessary to obtain a different action mark.
 - a. Do not permit submittals marked "Revise and Resubmit" to be used at the Project Site, or elsewhere where Work is in progress.
 4. REJECTED (REJ): The submittal is rejected. See Architects comments on why submittal was rejected.
 - a. Submittal has not been reviewed by the Contractor and so noted.
 - b. Submittal has been prepared without due regard for information called for or logically implied by the Contract Documents.
 - c. Information is not sufficiently complete or accurate to verify that work represented is in accordance with the Contract Documents.
 - d. Do not permit submittals marked "Rejected" to be used at the Project Site, or elsewhere where Work is in progress.
 5. NO ACTION TAKEN (NAT): The submittal is not required and will not be reviewed.
- B. Submittals by Newforma Info Exchange: Architect will indicate, on Newforma Info Exchange, the appropriate action.
- C. Informational Submittals: Architect will review each submittal and will not return it or will return it if it does not comply with requirements. The Architect's action will be noted in the Newforma Info Exchange.
- D. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect. The Architect's action will be noted in the Newforma Info Exchange and noted as a partial review until a full submittal can be received.
- E. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for re-submittal without review.
- F. Submittals not required by the Contract Documents will not be reviewed and will receive no action.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 013300

SECTION 014000 QUALITY REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-assurance and -control services required by Architect and Owner or authorities having jurisdiction are not limited by provisions of this Section.
- C. Related Sections:
 - 1. Divisions 02 through 49 Sections for specific test and inspection requirements.

1.02 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.
- C. Mockups: Full size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
 - 1. Integrated Exterior Mockups: Mockups of the exterior envelope erected separately from the building but on Project site, consisting of multiple products, assemblies, and subassemblies.
 - 2. Room Mockups: Mockups of typical interior spaces complete with wall, floor, and ceiling finishes, doors, windows, millwork, casework, specialties, furnishings and equipment, and lighting.
- D. Preconstruction Testing: Tests and inspections performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.
- E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- F. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.

014000
QUALITY REQUIREMENTS

- G. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- I. Installer/Applicator/Erector: 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.
 - 1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade or trades.
- J. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of (5) five Projects similar in nature, size, and extent of this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.03 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 Architect.
- B. Delegated-Design Services Statement: Submit a statement 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, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.
 - 1. The design professional shall be licensed to perform professional design services in the jurisdiction of the project location.

1.04 CONFLICTING REQUIREMENTS

- A. Referenced Standards: 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 conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.
- B. 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 Architect for a decision before proceeding.

1.05 ACTION SUBMITTALS

- A. Shop Drawings: For integrated exterior mockups, provide plans, sections, and elevations, indicating materials and size of mockup construction.
 - 1. Indicate manufacturer and model number of individual components.
 - 2. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

014000
QUALITY REQUIREMENTS

1.06 INFORMATIONAL SUBMITTALS

- A. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems.
 - 1. Seismic-force resisting system, designated seismic system, or component listed in the designated seismic system quality assurance plan prepared by the Architect.
 - 2. Main wind-force resisting system or a wind-resisting component listed in the wind-force-resisting system quality assurance plan prepared by the Architect.
- B. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- C. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
 - 1. Specification Section number and title.
 - 2. Entity responsible for performing tests and inspections.
 - 3. Description of test and inspection.
 - 4. Identification of applicable standards.
 - 5. Identification of test and inspection methods.
 - 6. Number of tests and inspections required.
 - 7. Time schedule or time span for tests and inspections.
 - 8. Requirements for obtaining samples.
 - 9. Unique characteristics of each quality-control service.

1.07 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
 - 1. Date of issue.
 - 2. Project title and number.
 - 3. Name, address, and telephone number of testing agency.
 - 4. Dates and locations of samples and tests or inspections.
 - 5. Names of individuals making tests and inspections.
 - 6. Description of the Work and test and inspection method.
 - 7. Identification of product and Specification Section.
 - 8. Complete test or inspection data.
 - 9. Test and inspection results and an interpretation of test results.
 - 10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
 - 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 - 12. Name and signature of laboratory inspector.
 - 13. Recommendations on retesting and re-inspecting.
- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
 - 1. Name, address, and telephone number of technical representative making report.
 - 2. Statement on condition of substrates and their acceptability for installation of product.
 - 3. Statement that products at Project site comply with requirements.
 - 4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.

014000

QUALITY REQUIREMENTS

5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 6. Statement whether conditions, products, and installation will affect warranty.
 7. Other required items indicated in individual Specification Sections.
- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of factory-authorized service representative making report.
 2. Statement that equipment complies with requirements.
 3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 4. Statement whether conditions, products, and installation will affect warranty.
 5. Other required items indicated in individual Specification Sections.
- D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.08 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm with (5) five years' experience in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- C. Fabricator Qualifications: A firm with (5) five years' experience in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual with (5) five years' experience in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.
- F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.
- G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.
1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

014000
QUALITY REQUIREMENTS

- H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
 - 1. Contractor responsibilities include the following:
 - a. Provide test specimens representative of proposed products and construction.
 - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
 - c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
 - d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
 - e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
 - f. When testing is complete, remove test specimens, assemblies, mockups; do not reuse products on Project.
 - 2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
- K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
 - 1. Build mockups in location indicated or, if not indicated, as directed by Architect.
 - 2. Notify Architect (7) seven days in advance of dates and times when mockups will be constructed.
 - 3. Employ supervisory personnel who will oversee mockup construction. Employ workers who will be employed to perform same tasks during the construction at Project.
 - 4. Demonstrate the proposed range of aesthetic effects and workmanship.
 - 5. Obtain Architect's approval of mockups before starting corresponding Work, fabrication, or construction.
 - a. Allow (7) seven days for initial review and each re-review of each mockup.
 - 6. Promptly correct unsatisfactory conditions noted by Architect's preliminary review, to the satisfaction of the Architect, before completion of final mockup.
 - 7. Approval of mockups by the Architect does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 8. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - 9. Demolish and remove mockups when directed unless otherwise indicated.

014000
QUALITY REQUIREMENTS

- L. Integrated Exterior Mockups: Construct integrated exterior mockup as indicated on Drawings. Coordinate installation of exterior envelope materials and products for which mockups are required in individual Specification Sections, along with supporting materials. Comply with requirements in "Mockups" Paragraph.
 - 1. Coordinate construction of the mockup to allow observation of air barrier installation, flashings, air barrier integration with fenestration systems, and other portions of the building air/moisture barrier and drainage assemblies, prior to installation of veneer, cladding elements, and other components that will obscure the work.
- M. Room Mockups: Construct room mockups as indicated on Drawings, incorporating required materials and assemblies, finished according to requirements. Provide required lighting and additional lighting where required to enable Architect to evaluate quality of the Work. Comply with requirements in "Mockups" Paragraph.

1.09 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
 - 1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
 - 2. Costs for retesting and re-inspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.
 - 1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
 - 2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
 - 3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 - 4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 - 5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
 - 6. Notify testing agencies at least (24) twenty four hours in advance of time when Work that requires testing or inspecting will be performed.
- C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 01 Section "Submittal Procedures".
- D. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- E. Retesting/Re-inspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and re-inspecting, for construction that replaced Work that failed to comply with the Contract Documents.

014000
QUALITY REQUIREMENTS

- F. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
 - 1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 - 2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
 - 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 - 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 - 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 - 6. Do not perform any duties of Contractor.
- G. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
 - 1. Access to the Work.
 - 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 - 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 - 4. Facilities for storage and field curing of test samples.
 - 5. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 - 6. Security and protection for samples and for testing and inspecting equipment at Project site.
- H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
 - 1. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.10 QUALITY-CONTROL PLAN

- A. Contractor's Quality-Control Plan, The Contractor shall submit quality-control plan within (10) ten days of Notice of Award, and not less than (5) five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities and to coordinate Owner's quality-assurance and quality-control activities. Coordinate with Contractor's Construction Schedule.
- B. Quality-Control Personnel Qualifications: Engage qualified personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.
 - 1. Project quality-control manager may also serve as Project Superintendent.
- C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.
- D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:

014000

QUALITY REQUIREMENTS

1. Contractor-performed tests and inspections, including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections. Distinguish source quality-control tests and inspections from field quality-control tests and inspections.
 2. Special inspections required by authorities having jurisdiction and indicated on the Statement of Special Inspections.
 3. Owner-performed tests and inspections indicated in the Contract Documents.
- E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring the Work into compliance with standards of workmanship established by Contract requirements and approved mockups.
- F. Monitoring and Documentation: Maintain testing and inspection reports, including log of approved and rejected results. Include Work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming Work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.11 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Owner will engage a qualified testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of the Owner and as follows:
1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviews the completeness and adequacy of those procedures to perform the Work.
 2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
 3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect, with a copy to Contractor, and to Authorities having Jurisdiction.
 4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
 5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
 6. Retesting and re-inspecting corrected work.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.01 TEST AND INSPECTION LOG

- A. Prepare a record of tests and inspections. Include the following:
1. Date test or inspection was conducted.
 2. Description of the Work tested or inspected.
 3. Date test or inspection results were transmitted to Architect.
 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and modifications as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.02 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

014000

QUALITY REQUIREMENTS

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Division 01 Section "Execution".
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

014000
QUALITY REQUIREMENTS

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SECTION 014200 REFERENCES

PART 1 GENERAL

1.01 KEY 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": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- 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.

1.02 DEFINITIONS

- A. Air Handling Unit: A blower or fan used for the purpose of distributing supply air to a room, space or area.
- B. Approved Agency: An established and recognized agency regularly engaged in conducting tests or furnishing inspection services, when such agency has been approved according to the requirements established in this Section and as required by the Code Official having jurisdiction over this project.
- C. Architect: Other terms including "Architect/Engineer" and "Engineer" have the same meaning as "Architect".
- D. Company Field Adviser: An employee of the Company which lists and markets the primary components of the system under the name who is certified in writing by the Company to be technically qualified in design, installation, and servicing of the required products or an employee of an organization certified by the foregoing Company to be technically qualified in design, installation, and serving of the required products. Personnel involved solely in sales do not qualify.
- E. Concealed Location: A location that cannot be accessed without damaging permanent parts of the building structure or finish surface. Spaces above, below or behind readily removable panels or doors shall not be considered as concealed.
- F. Concealed Piping: Piping that is located in a concealed location. (See "concealed location".)

014200
REFERENCES

- G. Connect: A term contraction and unless otherwise specifically noted is to mean "The labor and materials necessary to join or attach equipment, materials or systems to perform the functions intended".
- H. Construction Manager: Construction Manager's Name.
- I. Drain: Any pipe that carries wastewater or water-borne wastes in a building drainage system.
- J. Drainage Fittings: Type of fitting or fittings utilized in the drainage system. Drainage fittings are similar to cast-iron fittings, except that instead of having a bell and spigot, drainage fittings are recessed and tapped to eliminate ridges on the inside of the installed pipe.
- K. Drainage System: Piping within a public or private premise that conveys sewage, rainwater or other liquid wastes to a point of disposal. A drainage system does not include the mains of a public sewer system or a private or public sewage treatment or disposal plant.
 - 1. Building Gravity: A drainage system that drains by gravity into the building sewer.
 - 2. Sanitary: A drainage system that carries sewage and excludes storm, surface and ground water.
 - 3. Storm: A drainage system that carries rainwater, surface water, condensate, cooling water or similar liquid wastes.
- L. Duct: A tube or conduit utilized for conveying air. The air passages of self-contained systems are not to be construed as air ducts.
- M. Duct System: A continuous passageway for the transmission of air that, in addition to ducts, includes duct fittings, dampers, plenums, fans and accessory air-handling equipment and appliances.
- N. Experienced: When used with an entity, "experienced" 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.
- O. Headroom: Minimum clearance between the floor and the underside of the point of lowest installed mechanical construction above. In case of stairways and walkways, the minimum clearance between the step or surface of the walkway and the lowest installed mechanical construction above the stairway or the walkway.
- P. Include: When used in any form other than "inclusive", is non-limiting and is not intended to mean "all-inclusive."
- Q. 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."
- R. Inspection Certificate: Identification applied on a product by an approved agency containing the name of the manufacturer, the function and performance characteristics, and the name and identification of an approved agency that indicates that the product or material has been inspected and evaluated by an approved agency.
- S. Installer: An installer is the Contractor or another entity engaged by the Contractor, either as an employee, subcontractor, or contractor of lower tier, to perform a particular construction activity, including installation, erection, application, or similar operations. Installers are required to be experienced in the operations they are engaged to perform.
 - 1. Trades: Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespersons of the corresponding generic name.

014200
REFERENCES

2. Assigning Specialists: Certain Sections of the Specifications require that specific construction activities shall be performed by specialists who are recognized experts in those operations. The specialists must be engaged for those activities, and their assignments are requirements over which the Contractor has no option. However, the ultimate responsibility for fulfilling contract requirements remains with the Contractor.
 3. This requirement shall not be interpreted to conflict with enforcing building codes and similar regulations governing the Work. It is also not intended to interfere with local trade-union jurisdictional settlements and similar conventions.
- T. Label: An identification applied on a product by the manufacturer that contains the name of the manufacturer, the function and performance characteristics of the product or material, and the name and identification of an approved agency and that indicates that the representative sample of the product or material has been tested and evaluated by an approved agency.
- U. Location:
1. Damp Location: Partially protected locations under canopies, marquees, roofed open porches and like locations, and interior locations subject to moderate degrees of moisture, such as some basements, some barns and some cold-storage warehouses.
 2. Dry Location: A location not normally subject to dampness or wetness. A location classified as dry may be temporarily subject to dampness or wetness, as in the case of a building under construction.
 3. Wet Location: Installations underground or in concrete slabs or masonry in direct contact with the earth and locations subject to saturation with water or other liquids, such as vehicle-washing areas, and locations exposed to weather and unprotected.
- V. Manufacturer's Designation: Identification applied on a product by the manufacturer indicating that a product or material complies with a specified standard or set of rules (see also "Inspection Certificate," "Label" and "Mark").
- W. Mark: An identification applied on a product by the manufacturer indicating the name of the manufacturer and the function of a product or material (see also "Inspection Certificate," "Label" and "Manufacturer's Designation").
- X. Mechanical: Other terms including "HVAC", "Plumbing", "Sprinkler", "Laboratory Equipment", "Food Service Equipment", "Laundry Equipment", and "Refrigeration" have the same meaning as "Mechanical".
- Y. Owner: EC3.
- Z. Piping: This term includes pipe, tube and appurtenant fittings, flanges, valves, traps, hangers and supports.
- AA. Piping, Concealed: Piping built into construction and not accessible without removal of construction Work such as masonry, plaster or other finish material, and piping installed in floors, furred spaces, suspended ceilings, non-walk-in tunnels, conduits, and behind removable panels and cabinet doors.
- BB. Piping, Distribution: Domestic water supply piping, starting with a connection to service piping, and continuing throughout the building to point of connection to equipment and fixture supply piping.
- CC. Piping, Exposed: Piping directly accessible by normal accesses without removal of any construction Work or material.
- DD. Piping, Service: Underground domestic water supply piping with a connection to a water main or supply as noted, and continuing to and into a building and terminating with the exposed fitting inside the building.
- EE. Piping, Tunnel: Piping installed in walk-in or non-walk-in tunnels or conduits up to first shut-off valve inside building.

014200
REFERENCES

- FF. Plumbing System: Includes the water supply and distribution pipes; plumbing fixtures and traps; water-treating or water-using equipment; soil, waste and vent pipes; and sanitary and storm sewers and building drains, in addition to their respective connections, devices and appurtenances within a structure or premises.
- GG. Product: As used includes materials, systems and equipment.
- HH. Registered Design Professional: An individual who is a registered architect (RA) in accordance with Article 147 of the New York State Education Law or a licensed professional engineer (PE) in accordance with Article 145 of the New York State Education Law.
- II. Space, Finished: A space which has a finishing material applied to walls or ceilings, such as paint, plaster, ceramic tile, enamel glazing, face brick, vinyl wall covering, etc. to provide a finished appearance or which will have such finishes applied under a related Contract.
- JJ. Space, Unfinished: A space which does not meet the definition of a finished space.
- KK. Special Inspection: Inspection as herein required of the materials, installation, fabrication, erection, or placement of components and connections requiring special expertise to ensure compliance with approved construction documents and referenced standards.
- LL. Steam-Heating Boiler: A boiler operated at pressures not exceeding 15 psi for steam.
- MM. Supplier: Any person or organization who supplies materials or equipment for the work, including that fabricated to a special design.
- NN. Utility: Any gas, steam, water, sanitary sewer, storm sewer, electrical or other such service.
- OO. Water Supply System: The water service pipe, water distribution pipes, and the necessary connecting pipes, fittings, control valves and all appurtenances in or adjacent to the structure or premises.
1. Chilled: Water-cooled by refrigeration.
 2. Cold: Water with at temperature between 33 degrees F and 80 degrees F and which is neither cooled nor heated mechanically.
 3. Domestic: Water for use in buildings, except water used in connection with space heating and space cooling.
 4. High Temperature: Water with a supply water temperature above 350 degrees.
 5. Hot: Water at a temperature greater than or equal to 110°F.

1.03 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 Architect 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 Architect for a decision before proceeding.

014200
REFERENCES

- 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.

1.04 ABBREVIATIONS AND ACRONYMS

AA	Aluminum Association, Inc. (The)
AABC	Associated Air Balance Council
AAALAC	Association for Assessment and Accreditation of Laboratory Animal Care
AAMA	American Architectural Manufacturers Association
AASHTO	American Association of State Highway and Transportation Officials
ACI	ACI International (American Concrete Institute)
ACPA	American Concrete Pipe Association
AF&PA	American Forest & Paper Association
AGA	American Gas Association
AGC	Associated General Contractors of America (The)
AHA	American Hardboard Association (part of CPA)
AI	Asphalt Institute
AIA	American Institute of Architects (The)
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ALSC	American Lumber Standard Committee, Incorporated
AMCA	Air Movement and Control Association International, Inc.
ANSI	American National Standards Institute
AOSA	Association of Official Seed Analysts, Inc.

014200
REFERENCES

APA	Architectural Precast Association
APA	APA - The Engineered Wood Association
ARI	Air-Conditioning & Refrigeration Institute
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASME	ASME International
ASSE	American Society of Sanitary Engineering
ASTM	ASTM International
AWCMA	American Window Covering Manufacturers Association (WCSC)
AWI	Architectural Woodwork Institute
AWPA	American Wood-Preservers' Association
AWS	American Welding Society
AWWA	American Water Works Association
BHMA	Builders Hardware Manufacturers Association
BIA	Brick Industry Association (The)
CBM	Certified Ballast Manufacturers
CCC	Carpet Cushion Council
CDA	Copper Development Association
CISCA	Ceilings & Interior Systems Construction Association
CISPI	Cast Iron Soil Pipe Institute
CLFMI	Chain Link Fence Manufacturers Institute
CPA	Composite Panel Association
CRI	Carpet & Rug Institute (The)

014200
REFERENCES

CRSI	Concrete Reinforcing Steel Institute
CSI	Cast Stone Institute
CSI	Construction Specifications Institute (The)
CTI	Cooling Technology Institute
DHI	Door and Hardware Institute
EIA	Electronic Industries Alliance
EIMA	EIFS Industry Members Association
EJCDC	Engineers Joint Contract Documents Committee
EJMA	Expansion Joint Manufacturers Association, Inc.
ESD	ESD Association
FM Approvals	Factory Mutual Approvals
FSA	Fluid Sealing Association
GA	Gypsum Association
GANA	Glass Association of North America
GSI	Geosynthetic Institute
HI	Hydraulic Institute
HI	Hydronics Institute
HMMA	Hollow Metal Manufacturers Association
HPVA	Hardwood Plywood & Veneer Association
ICEA	Insulated Cable Engineers Association, Inc
ICRI	International Concrete Repair Institute, Inc.
IEC	International Electrotechnical Commission

014200
REFERENCES

IEEE	Institute of Electrical and Electronics Engineers, Inc. (The)
IESNA	Illuminating Engineering Society of North America
IENT	Institute of Environmental Sciences and Technology
IGCC	Insulating Glass Certification Council
IGMA	Insulating Glass Manufacturers Alliance
ILI	Indiana Limestone Institute of America, Inc.
IPCEA	Insulated Power Cable Engineer Associates
ISO	International Organization for Standardization
ISSFA	International Solid Surface Fabricators Association
ITU	International Telecommunication Union
KCMA	Kitchen Cabinet Manufacturers Association
LEED	Leadership in Energy and Environmental Design
MBMA	Metal Building Manufacturers Association
MFMA	Maple Flooring Manufacturers Association, Inc.
MFMA	Metal Framing Manufacturers Association, Inc.
MIA	Marble Institute of America
MPI	Master Painters Institute
MSS	Manufacturers Standardization Society of The Valve and Fittings Industry Inc.
NAAMM	National Association of Architectural Metal Manufacturers
NACE	NACE International
NADCA	National Air Duct Cleaners Association
NAIMA	North American Insulation Manufacturers Association

014200
REFERENCES

NCMA	National Concrete Masonry Association
NCPI	National Clay Pipe Institute
NCTA	National Cable & Telecommunications Association
NEBB	National Environmental Balancing Bureau
NECA	National Electrical Contractors Association
NeLMA	Northeastern Lumber Manufacturers' Association
NEMA	National Electrical Manufacturers Association
NETA	National Electrical Testing Association
NFHS	National Federation of State High School Associations
NFPA	National Fire Protection Association
NFRC	National Fenestration Rating Council
NGA	National Glass Association
NHLA	National Hardwood Lumber Association
NLGA	National Lumber Grades Authority
NOFMA	NOFMA: The Wood Flooring Manufacturers Association
NRCA	National Roofing Contractors Association
NRMCA	National Ready Mixed Concrete Association
NSF	NSF International (National Sanitation Foundation International)
NSSGA	National Stone, Sand & Gravel Association
NTMA	National Terrazzo & Mosaic Association, Inc. (The)
NWWDA	National Wood Window and Door Association (WDMA)
PCI	Precast/Prestressed Concrete Institute

014200
REFERENCES

PDCA	Painting & Decorating Contractors of America
PDI	Plumbing & Drainage Institute
PGI	PVC Geomembrane Institute
PTI	Post-Tensioning Institute
RCSC	Research Council on Structural Connections
RFCI	Resilient Floor Covering Institute
SAE	SAE International
SDI	Steel Deck Institute
SDI	Steel Door Institute
SEFA	Scientific Equipment and Furniture Association
SEI/ASCE	Structural Engineering Institute/American Society of Civil Engineers
SGCC	Safety Glazing Certification Council
SIA	Security Industry Association
SIGMA	Sealed Insulating Glass Manufacturers Association
SJI	Steel Joist Institute
SMA	Screen Manufacturers Association
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
SPIB	Southern Pine Inspection Bureau (The)
SPRI	Single Ply Roofing Industry
SSINA	Specialty Steel Industry of North America
SSPC	SSPC: The Society for Protective Coatings
STI	Steel Tank Institute
SWRI	Sealant, Waterproofing, & Restoration Institute

014200
REFERENCES

TCA	Tile Council of America, Inc.

1.05 FEDERAL GOVERNMENT AGENCIES:

- A. 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. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

CE	Army Corps of Engineers
CPSC	Consumer Product Safety Commission
DOC	Department of Commerce
DOD	Department of Defense
DOE	Department of Energy
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FCC	Federal Communications Commission
FDA	Food and Drug Administration
GSA	General Services Administration
HUD	Department of Housing and Urban Development
NIST	National Institute of Standards and Technology
OSHA	Occupational Safety & Health Administration
PHS	Office of Public Health and Science
SD	State Department
TRB	Transportation Research Board
USDA	Department of Agriculture

014200
REFERENCES

USPS	Postal Service
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- B. Codes, 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.

ADAAG	Americans with Disabilities Act (ADA) Accessibility Guidelines
BCNYS	Building Code of New York State
CFR	Code of Federal Regulations
DOD	Department of Defense Military Specifications and Standards
FS	Federal Specification
MILSPEC	Military Specification and Standards

1.06 OTHER TERMS OR ACRONYMS:

- A. Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name in the following list.
1. Asbestos Containing Materials
 2. Acoustical Tile
 3. Infection Control Risk Assessment
 4. Resilient Vinyl Tile
 5. Suspended Acoustical Tile
 6. Spray on Fire Resistive Materials
 7. Thermal Systems Insulation
 8. Vinyl Asbestos Tile
 9. Vinyl Composition Tile

1.07 OTHER TERMS OR ACRONYMS:

- A. Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name in the following list.
- a. Asbestos Containing Materials
 - b. Acoustical Tile
 - c. Infection Control Risk Assessment
 - d. Resilient Vinyl Tile
 - e. Suspended Acoustical Tile
 - f. Spray on Fire Resistive Materials
 - g. Thermal Systems Insulation
 - h. Vinyl Asbestos Tile
 - i. Vinyl Composition Tile

EC3
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West Campus Renovations
014200 - 13

**014200
REFERENCES**

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION 014200

014200
REFERENCES

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**SECTION 015000
TEMPORARY FACILITIES AND CONTROLS**

PART 1 GENERAL

1.01 SUMMARY

- A. This Section includes requirements for temporary facilities and controls, including temporary utilities, support facilities, and security and protection.
- B. Temporary utilities may include, but are not limited to, the following:
 - 1. Water service and distribution.
 - 2. Temporary electric power and light.
 - 3. Temporary heat.
 - 4. Ventilation and Humidity Control
 - 5. Sanitary facilities, including drinking water.
- C. Support facilities may include, but are not limited to, the following:
 - 1. Field offices and storage containers.
 - 2. Temporary partitions and enclosures.
 - 3. Hoists and temporary elevator use.
 - 4. Temporary project identification sign and project signage.
 - 5. Waste disposal services and dumpsters.
 - 6. Construction aids and miscellaneous services and facilities.
- D. Security and protection facilities include, but are not limited to, the following:
 - 1. Temporary fire protection.
 - 2. Barricades, warning signs, and lights.
 - 3. Tree and plant protection.
 - 4. Security enclosure and lockup.
 - 5. Temporary enclosures.
 - 6. Temporary partitions.
- E. Related Sections:
 - 1. Division 01 Section "Summary" for work restrictions and limitations on utility interruptions.

1.02 INFORMATIONAL SUBMITTALS

- A. Temporary Utilities: The contractor shall submit reports of tests, inspections, meter readings, and similar procedures performed on temporary utilities.
- B. Implementation and Termination Schedule: Within 15 days of the date established for submittal of the Contractor's Construction Schedule, the contractor shall submit a schedule indicating implementation and termination of each temporary utility for which the Contractor is responsible.
- C. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.
- D. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.
- E. Moisture-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage, including delivery, handling, and storage provisions for materials subject to water absorption or water damage, discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water damaged Work.
 - 1. Describe delivery, handling, and storage provisions for materials subject to water absorption or water damage.
 - 2. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.

015000
TEMPORARY FACILITIES AND
CONTROLS

3. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
- F. Dust-Control and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust-control and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Identify further options if proposed measures are later determined to be inadequate. Include the following:
 1. Locations of dust-control partitions at each phase of the work.
 2. HVAC system isolation schematic drawing.
 3. Location of proposed air filtration system discharge.
 4. Other dust-control measures.
 5. Waste management plan.
- G. Accessible Temporary Egress: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

1.03 DEFINITIONS

- A. Temporary Enclosure: As determined by Architect, temporary roofing is complete, insulated, all exterior wall openings are closed with temporary closures.
- B. Permanent Enclosure: As determined by Architect, permanent roofing is complete, insulated, and weather tight; exterior walls are insulated and weather tight; and all openings are closed with permanent construction or substantial temporary closures.
- C. Temporary Facilities: Construction, fixtures, fittings, and other built items required to accomplish the work but which are not incorporated into the finished work.
- D. Temporary Utilities: A type of temporary facility, primary sources of electric power, water, natural gas supply, etc., obtained from public utilities, other main distribution systems, or temporary sources constructed for the project, but not including the fixtures and equipment served.
- E. Temporary Services: Activities required during construction, which do not directly accomplish the work.

1.04 QUALITY ASSURANCE

- A. Regulations: The contractor shall comply with industry standards and with applicable laws and regulations of authorities having jurisdiction including, but not limited to, the following:
 1. Building code requirements.
 2. Health and safety regulations.
 3. Utility company regulations.
 4. Police, fire department and rescue squad rules.
 5. Environmental protection regulations.
- B. Standards: The Contractor shall comply with NFPA 241 "Standard for Safeguarding Construction, Alterations, and Demolition Operations," ANSI-A10 Series standards for "Safety Requirements for Construction and Demolition," and NECA Electrical Design Library "Temporary Electrical Facilities."
- C. Trade Jurisdictions: Assigned responsibilities for installation and operation of temporary utilities are not intended to interfere with the normal application of trade regulations and union jurisdictions.
- D. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

015000
TEMPORARY FACILITIES AND
CONTROLS

- E. Accessible Temporary Egress: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

1.05 USE CHARGES

- A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Architect, testing agencies, and authorities having jurisdiction.
1. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.
 2. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.
 3. Gas Service from Existing System: Gas Service from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.
- B. Cost or use charges for temporary facilities are not chargeable to the Owner or the Architect. The Architect will not accept a prime contractor's cost or use charges for temporary services or facilities as a basis of claim for an adjustment in the Contract Sum or the Contract Time.
- C. Other entities using temporary services and facilities include, but are not limited to, the following:
1. Other nonprime contractors.
 2. The Owner's work forces.
 3. Occupants of the Project.
 4. The Architect.
 5. Testing agencies.
 6. Personnel of government agencies.

1.06 PROJECT CONDITIONS

- A. Temporary Utilities: The contractor shall prepare a schedule indicating dates for implementation and termination of each temporary utility for which the Contractor is responsible. At the earliest feasible time, when acceptable to the Owner, change over from use of temporary service to use of permanent service.
- B. Conditions of Use: Keep temporary services and facilities clean. Operate in a safe and efficient manner. Relocate temporary services and facilities as the Work progresses. Do not overload facilities or permit them to interfere with progress. Take necessary fire-prevention measures. Do not allow hazardous, dangerous, or unsanitary conditions, or public nuisances to develop or persist on-site.
- C. Occupancy During Construction:
- D. All closures of areas must be scheduled with Owner, with a minimum of one weeks notice.
- E. Exit Routes must be maintained for duration of construction. All route changes to be coordinated with Owner, with a minimum of one weeks notice.
- F. Temporary Use of Permanent Facilities: If the Owner permits temporary use of the permanent facilities the Installer of each permanent service shall assume responsibility for its operation, maintenance, and protection during use as a construction facility prior to the Owner's acceptance, regardless of previously assigned responsibilities.

015000
TEMPORARY FACILITIES AND
CONTROLS

PART 2 PRODUCTS

2.01 MATERIALS

- A. Chain-Link Fencing: Minimum 2-inch, 0.148-inch- thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch- OD line posts and 2-7/8-inch- OD corner and pull posts with 1-5/8-inch- OD top rails.
- B. Portable Chain-Link Fencing: Minimum 2-inch, 0.148-inch- thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch- OD line posts and 2-7/8-inch- OD corner and pull posts, with 1-5/8-inch- OD top and bottom rails. Provide concrete bases for supporting posts.
- C. General: The contractor shall provide new materials. If acceptable to the Architect, undamaged, previously used materials in serviceable condition may be used. Provide materials suitable for use intended.
- D. Lumber and Plywood: Comply with requirements in Division 6 Section "Rough Carpentry."
 - 1. For signs and directory boards, provide exterior-type, Grade B-B high-density concrete form overlay plywood of sizes and thicknesses indicated.
 - 2. For fences and vision barriers, provide minimum 3/8-inch- thick exterior plywood.
 - 3. For safety barriers, sidewalk bridges, and similar uses, provide minimum 5/8-inch thick exterior plywood.
- E. Gypsum Wallboard: Provide 5/8 type x gypsum wallboard on interior walls of temporary offices or temporary partitions.
- F. Paint: Comply with requirements of Division 9 Section "Painting."
- G. Tarpaulins: Provide waterproof, fire-resistant, UL-labeled tarpaulins with flame-spread rating of 15 or less. For temporary enclosures, provide translucent, nylon-reinforced, laminated polyethylene or polyvinyl chloride, fire-retardant tarpaulins.
- H. Water: Provide potable water approved by local health authorities.
- I. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10-mil minimum thickness, with flame-spread rating of 15 or less per ASTM E 84 and passing NFPA 701 Test Method 2.
- J. Dust-Control Adhesive-Surface Walk-off Mats: Provide mats minimum 36 by 60 inches.
- K. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

2.02 TEMPORARY FACILITIES

- A. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations. Coordinate with Owner if use of existing building for storage and protection of materials is to be incorporated into Project.
 - 1. Store combustible materials apart from building.

2.03 EQUIPMENT

- A. General: The contractor shall provide new equipment. If acceptable to the Architect, undamaged, previously used equipment in serviceable condition may be used. Provide equipment suitable for use intended.
- B. Water Hoses: Provide 3/4-inch heavy-duty, abrasion-resistant, flexible rubber hoses 100 feet long, with pressure rating greater than the maximum pressure of the water distribution system. Provide adjustable shutoff nozzles at hose discharge.
- C. Electrical Outlets: Provide properly configured, NEMA-polarized outlets to prevent insertion of 110- to 120-V plugs into higher voltage outlets. Provide receptacle outlets equipped with ground-fault circuit interrupters, reset button, and pilot light for connection of power tools and equipment.

015000
TEMPORARY FACILITIES AND
CONTROLS

- D. Electrical Power Cords: Provide grounded extension cords. Use hard-service cords where exposed to abrasion and traffic. Provide waterproof connectors to connect separate lengths of electric cords if single lengths will not reach areas where construction activities are in progress. Do not exceed safe length-voltage ratio.
- E. Lamps and Light Fixtures: Provide general service incandescent lamps of wattage required for adequate illumination. Provide guard cages or tempered-glass enclosures, where exposed to breakage. Provide exterior fixtures where exposed to moisture.
- F. Heating Units: Provide temporary heating units that have been tested and labeled by UL, FM, or another recognized trade association related to the type of fuel being consumed.
- G. Temporary Toilet Units: Provide self-contained, single-occupant toilet units of the chemical, aerated recirculation, or combustion type. Provide units properly vented and fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material.
- H. Fire Extinguishers: Provide hand-carried, portable, UL-rated, Class A fire extinguishers for temporary offices and similar spaces. In other locations, provide hand-carried, portable, UL-rated, Class ABC, dry-chemical extinguishers or a combination of extinguishers of NFPA-recommended classes for the exposures.
 - 1. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.
- I. HVAC Equipment: If temporary heat will be needed after building enclosure: Upon Building enclosure or unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
 - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
 - 2. Heating Units: Listed and labeled for type of fuel being consumed, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - 3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return air grille in system and remove at end of construction and clean HVAC system as required in Division 01 Section "Closeout Procedures".
 - 4. Air Filtration Units: HEPA primary and secondary filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

PART 3 EXECUTION

3.01 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.02 TEMPORARY UTILITY INSTALLATION

- A. General: Engage the appropriate local utility company to install temporary service or connect to existing service. Where the company provides only part of the service, provide the remainder with matching, compatible materials and equipment. Comply with company recommendations.
 - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
 - 2. Provide adequate capacity at each stage of construction. Prior to temporary utility availability, provide trucked-in services.

015000
TEMPORARY FACILITIES AND
CONTROLS

3. Obtain easements to bring temporary utilities to the site where the Owner's easements cannot be used for that purpose.
- B. Use qualified personnel for installation of temporary facilities. Locate facilities where they will serve the Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required.
- C. The contractor shall provide each facility ready for use when needed to avoid delay. Maintain and modify as required. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.
- D. Sanitary Facilities: The General Contractor will provide temporary toilets for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
- E. Water Service: Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.
- F. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.
 1. Connect temporary service to Owner's existing power source, as directed by Owner.
- G. Temporary Electric Power Service: Provide weatherproof, grounded electric power service and distribution system of sufficient size, capacity, and power characteristics at each building addition and maintain them during construction period. Include overload-protected disconnects, automatic ground-fault interrupters.
 1. Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
 2. Power Distribution System: Install wiring overhead and rise vertically where least exposed to damage. Where permitted, wiring circuits not exceeding 125 V, ac 20 ampere rating, and lighting circuits may be nonmetallic-sheathed cable where overhead and exposed for surveillance.
 3. Provide temporary power in the areas of renovation where the existing receptacles have been removed and the proximity to power source exceeds 50'.
- H. Temporary Lighting: When an overhead floor or roof deck has been installed, provide temporary lighting with local switching.
 1. Operate temporary lighting that will fulfill security and protection requirements without operating the entire system. Provide temporary lighting that will provide adequate illumination for construction operations and traffic conditions.
 - a. Security lighting for building exteriors shall be continuously operational and maintained.
 - b. Temporary lighting shall be maintained in accordance with OSHA standards for power and foot candle levels in all areas while workers occupy the space.
 2. Provide temporary lighting in the areas of renovation where the existing fixtures have been removed and the new lighting has not been installed.
- I. Temporary Heating: Provide temporary heating required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Coordinate ventilation requirements to produce the ambient condition required and minimize energy consumption. Direct fired propane or Kerosene salamanders will not be permitted.
 1. Temporary Heat: Provide temporary heat in all existing areas that are under construction and/or have their permanent heat temporarily or permanently shut off for construction reasons.

015000
TEMPORARY FACILITIES AND
CONTROLS

2. Provide temporary heat in all new construction areas as soon as each area of new construction is fully enclosed: walls, temporary roofs, and either windows and doors or temporary windows and doors.
 3. Temporary heat provided shall be sufficient to maintain all areas of new, fully enclosed construction (and renovated areas of existing construction that, due to construction, are temporarily without permanent heat), including concealed ceiling or chase spaces, to a minimum 500F, 24 hours a day, in winter weather as cold as 150F outside.
 4. Temporary heat must not damage any materials, new or existing, within or without the Project limits, on school property, nor shall it cause noxious odors or fumes or some other nuisance.
 5. Temporary heat must be installed, operated, maintained, and dismantled in a safe, legal manner.
 6. Provide adequate ventilation as required by Codes and labor laws in all areas of Project limits as part of the work of this Section.
- J. Heating Facilities: Except where the Owner authorizes use of the permanent system, provide vented, indirect fired, self-contained, LP-gas or fuel oil heaters with individual space thermostatic control.
1. Use of direct-fired Kerosene-burning space heaters, open flame, or salamander-type heating units is prohibited.
 2. Protect all permanent equipment put into services from dust, dust infiltration and soiling by installing filtering media at each supply and return outlet. Filters shall be changed in all air handling equipment including unit vents prior to owner occupancy. Failure to provide the necessary protection to the equipment may result in the contractor to be charged to clean the equipment and associated ductwork.
- K. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
1. Provide dehumidification systems when required to reduce substrate moisture levels to level required to allow installation or application of finishes.
- L. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.
1. Prior to commencing work, isolate the HVAC system in area where work is to be performed in accordance with approved coordination drawings.
 - a. Disconnect supply and return ductwork in work area from HVAC systems servicing occupied areas.
 - b. Maintain negative air pressure within work area using HEPA-equipped air filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.
 2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust containment devices.
 3. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.

3.03 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.

015000
TEMPORARY FACILITIES AND
CONTROLS

2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
 3. Locate field offices, storage trailers, sanitary facilities, and other temporary construction and support facilities for easy access.
 4. Maintain support facilities until near Substantial Completion. Remove prior to Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to the Owner.
 5. Refer to the Owner for locations of storage/containers or trailers.
- B. Temporary Parking: Use designated areas of Owner's existing parking areas for construction personnel.
- C. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with Division 01 Section "Execution" for progress cleaning requirements.
- D. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.
- E. Existing Elevator Use: Use of Owner's existing designated elevator will be permitted, provided elevators are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore elevators to condition existing before initial use, including replacing worn cables, guide shoes, and similar items of limited life.
1. Do not load elevators beyond their rated weight capacity.
 2. Provide protective coverings, barriers, devices, signs, or other procedures to protect elevator car and entrance doors and frame. If, despite such protection, elevators become damaged, engage elevator Installer to restore damaged work so no evidence remains of correction work. Return items that cannot be refinished in field to the shop, make required repairs and refinish entire unit, or provide new units as required.
- F. Existing Stair Usage: Use of Owner's existing stairs will be permitted, provided stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.
1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If stairs become damaged, restore damaged areas so no evidence remains of correction work.
- G. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
1. Identification Signs: Provide Project identification signs as indicated on Drawings.
 - a. See example project Identification sign following this section.
 2. Warning and regulatory signage provide as required to protect from hazards and as required by authorities having jurisdiction.
 3. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
 - a. Provide temporary, directional signs for construction personnel and visitors.
 4. Maintain and touch up signs, so they are legible.

3.04 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

015000
TEMPORARY FACILITIES AND
CONTROLS

- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
 - 1. Comply with work restrictions specified in Division 01 Section "Summary."
- C. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Obtain extended warranty for Owner. Perform control operations lawfully, using environmentally safe materials.
- D. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- E. Project Identification and Temporary Signs: Prepare Project identification and other signs in sizes indicated. Install signs where indicated to inform public and persons seeking entrance to Project. Do not permit installation of unauthorized signs.
 - 1. Construct signs of exterior-type Grade B-B high-density concrete form overlay plywood. Support on posts or framing of preservative-treated wood or steel.
 - a. Size: 4-feet by 8-feet by 3/4-inch thick.
- F. Temporary Signs: Prepare signs to provide directional information to construction personnel and visitors for each site. Unauthorized signs are not permitted.
 - 1. For construction traffic control/flow at entrances/exits, as designated by the Owner.
 - 2. For warning signs as required
 - 3. Per OSHA standards as necessary
 - 4. For trailer identification
 - 5. For "No Smoking" safe work site at multiple locations.
- G. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
- H. Temporary Enclosures: Provide temporary enclosure for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities.
 - 1. Where heat is needed and the permanent building enclosure is not complete, provide temporary enclosures where there is no other provision for containment of heat. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.
 - 2. Install tarpaulins securely, with incombustible wood framing and other materials. Close openings of 25 sq. ft. or less with plywood or similar materials.
 - 3. Close openings through floor or roof decks and horizontal surfaces with load-bearing, wood-framed construction.
 - 4. Where temporary wood or plywood enclosure exceeds 100 sq. ft. in area, use UL labeled, fire-retardant-treated material for framing and main sheathing.
- I. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner and tenants from fumes and noise.
 - 1. Temporary partitions shall be installed at all openings where additions connect to existing buildings, and where required to protect areas, spaces, property, personnel, **students and faculty** ; to separate and control dust, debris, noise, access, sight, fire areas, safety and security
 - a. Temporary partitions shall be installed, maintained, and removed as directed by the Architect .

015000
TEMPORARY FACILITIES AND
CONTROLS

2. Where fire-resistance-rated temporary partitions are indicated or are required by Architect authorities having jurisdiction, construct partitions according to the rated assemblies.
 3. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire-retardant-treated plywood on construction operations side.
 4. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.
 5. Protect air-handling equipment.
 6. Provide walk-off mats at each entrance through temporary partition.
- J. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.
1. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
 2. Prohibit smoking in construction areas.
 3. Locate fire extinguishers where convenient and effective for their intended purpose, but not less than one extinguisher on each floor at or near each usable stairwell.
 4. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire-protection facilities, stairways, and other access routes for fighting fires. Prohibit smoking in hazardous fire-exposure areas.
 5. Store combustible materials in containers in fire-safe locations
 6. Provide supervision of welding operations, combustion-type temporary heating units, and similar sources of fire ignition.
- K. Security Enclosure and Lockup: Install substantial temporary enclosure of partially completed areas of construction. Provide locking entrances to prevent unauthorized entrance, vandalism, theft and similar violations of security.
1. Storage: Where materials and equipment must be stored, and are of value or attractive for theft, provide a secure lockup. Coordinate with the installation and release of material to minimize the opportunity for theft and vandalism.

3.05 MOISTURE AND MOLD CONTROL

- A. Contractor's Moisture-Protection Plan: Provide written plan for addressing any trapping of water in finished work. Document all visible signs of mold that may appear during construction. Protect stored materials and installed Work in accordance with Moisture and Mold Protection Plan.
- B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
1. Protect porous materials from water damage.
 2. Protect stored and installed material from flowing or standing water.
 3. Keep porous and organic materials from coming into prolonged contact with concrete.
 4. Remove standing water from decks.
 5. Keep deck openings covered or dammed.
- C. Partially Enclosed Construction Phase: After installation of weather barriers but before Permanent Enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
 2. Keep interior spaces reasonably clean and protected from water damage.
 3. Periodically collect and remove waste containing cellulose or other organic matter.
 4. Discard or replace water-damaged material.

015000
TEMPORARY FACILITIES AND
CONTROLS

5. Do not install material that is wet.
 6. Discard, replace or clean stored or installed material that begins to grow mold.
 7. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.
- D. Controlled Construction Phase of Construction: After completing and sealing of the permanent building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
 2. Use permanent HVAC system to control humidity.
 3. The Contractor is to provide temporary dehumidification and ventilation until the building systems are operational and the spaces are substantially completed.
 4. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.
 - a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective.
 - b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record daily readings over a forty-eight hour period. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
 - c. Remove materials that cannot be completely restored to their manufactured moisture level in 48 hours.

3.06 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Limit availability of temporary facilities to essential and intended uses to minimize waste and abuse.
- B. Maintenance: Maintain facilities in good operating condition until removal.
1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
 2. Protection: Prevent water-filled piping from freezing. Maintain markers for underground lines. Protect from damage during excavation operations.
- C. Operate Project-identification-sign lighting daily from dusk until 12:00 midnight.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
 2. Remove temporary roads not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.

015000
TEMPORARY FACILITIES AND
CONTROLS

- E. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Division 01 Section "Closeout Procedures."

END OF SECTION 015000

**SECTION 016000
PRODUCT REQUIREMENTS**

PART 1 GENERAL

1.01 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.
- B. Related Requirements:
 - 1. Section 014200 "References" for applicable industry standards for products specified.

1.02 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.

1.03 ACTION SUBMITTALS

- A. Comparable Product Requests (if allowed): After award of contract submit request for consideration of each comparable product. 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.
 - 2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within (10) ten working days of receipt of request, or (5) five working days of receipt of additional information or documentation, whichever is later.
 - a. Form of Approval: As specified in Section 013300 "Submittal Procedures."
 - b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 013300 "Submittal Procedures". Show compliance with requirements.

016000
PRODUCT REQUIREMENTS

1.04 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, Architect will determine which products shall be used.

1.05 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.

1.06 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.

016000

PRODUCT REQUIREMENTS

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

2.01 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", Architect 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. Restricted List: 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.
 4. Manufacturers:
 - a. Restricted List: 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.
- C. Visual Matching Specification: Where Specifications require "match Architect's sample", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.

016000

PRODUCT REQUIREMENTS

1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.02 EQUIVALENT PRODUCTS

- A. Conditions for Consideration: Architect will consider Contractor's request for equivalent product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:
 1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
 2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 3. Evidence that proposed product provides specified warranty.
 4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
 5. Samples, if requested.
- B. Refer to specification section 012519 "Equivalents" for additional equivalent product requirements required to be furnished by the contractor prior to execution of the contract.

PART 3 EXECUTION (NOT USED)

END OF SECTION 016000

SECTION 017300 EXECUTION

PART 1 GENERAL

1.01 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.
- B. Related Requirements:
 - 1. Division 01 "Summary" for limits on use of Project site.
 - 2. Division 01 "Submittal Procedures" for submitting surveys.
 - 3. Division 01 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.
 - 4. Division 02 "Demolition" for demolition and removal of selected portions of the building.
 - 5. Division 07 "Penetration Firestopping" for patching penetrations in fire-rated construction.

1.02 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.

1.03 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For land surveyor.
- B. Certificates: Submit certificate signed by land surveyor, certifying that location and elevation of improvements comply with requirements.
- C. Cutting and Patching Plan: Submit plan describing procedures at least (10) ten 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.
- D. Certified Surveys: Submit (2) two copies signed by land surveyor.

017300
EXECUTION

- E. Final Property Survey: Submit (10) ten copies showing the Work performed and record survey data.

1.04 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
- B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection
 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.
 - a. Operational elements include but are not limited to the following:
 - 1) Primary operational systems and equipment.
 - 2) Fire separation assemblies.
 - 3) Air or smoke barriers.
 - 4) Fire-suppression systems.
 - 5) Mechanical systems piping and ducts.
 - 6) Control systems.
 - 7) Communication systems.
 - 8) Fire-detection and -alarm systems.
 - 9) Conveying systems.
 - 10) Electrical wiring systems.
 - 11) Operating systems of special construction.
 - 12) Door access and security controls
 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.
 - a. Other construction elements include but are not limited to the following:
 - 1) Water, moisture, or vapor barriers.
 - 2) Membranes and flashings.
 - 3) Exterior curtain-wall construction.
 - 4) Spray applied fire-resistive material.
 - 5) Equipment supports.
 - 6) Piping, ductwork, vessels, and equipment.
 - 7) 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.
- C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

017300
EXECUTION

PART 2 PRODUCTS

2.01 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.
- C. 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.

PART 3 EXECUTION

3.01 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 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.

3.02 PREPARATION

- A. Existing Utility Information: Furnish information to local utility 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.

**017300
EXECUTION**

- 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."

3.03 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. General: Engage a land surveyor to lay out the Work using accepted surveying practices.
 - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
 - 2. Establish limits on use of Project site.
 - 3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 - 4. Inform installers of lines and levels to which they must comply.
 - 5. Check the location, level and plumb, of every major element as the Work progresses.
 - 6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
 - 7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. 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.
- E. 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.

3.04 FIELD ENGINEERING

- A. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
 - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
 - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

017300
EXECUTION

- B. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
 - 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
 - 2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
 - 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.
- C. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.
- D. Final Property Survey: Engage a land surveyor to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.
 - 1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
 - 2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.05 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.

017300
EXECUTION

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.

3.06 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 minimize 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: 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.

017300
EXECUTION

- 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 extending to an inside or outside corner of a wall. 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.

3.07 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.

3.08 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.

017300
EXECUTION

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 in Section 015000 "Temporary Facilities and Controls".
- 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.

3.09 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".

3.10 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.

EC3
R24.15543

West Campus Renovations
017300 - 9

017300
EXECUTION

- B. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 017300 017300

**017300
EXECUTION**

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**SECTION 017823
OPERATION AND MAINTENANCE DATA**

PART 1 GENERAL

1.01 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.
- B. Related Requirements:
 - 1. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
 - 2. Divisions 02 through 49 Sections for any specific closeout requirements for the Work in those Sections.

1.02 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.

1.03 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. Submit (1)one paper copies. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. Architect will return (2) two copies.
- C. Initial Manual Submittal: Submit draft copy of each manual at least (30) thirty 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) fifteen days before commencing demonstration and training. Architect will return copy with comments.
 - 1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within (15) fifteen days of receipt of Architect's comments and prior to commencing demonstration and training.

017823
OPERATION AND
MAINTENANCE DATA

PART 2 PRODUCTS

2.01 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. 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: Bookmark 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.
- C. 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".

2.02 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.

017823
OPERATION AND
MAINTENANCE DATA

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. 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.

2.03 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.

017823
OPERATION AND
MAINTENANCE DATA

- 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.

2.04 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.

017823
OPERATION AND
MAINTENANCE DATA

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.

2.05 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.

2.06 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.

017823
OPERATION AND
MAINTENANCE DATA

- 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

3.01 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.

017823
OPERATION AND
MAINTENANCE DATA

- 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

**017823
OPERATION AND
MAINTENANCE DATA**

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**SECTION 017839
PROJECT RECORD DOCUMENTS**

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes administrative and procedural requirements for project record documents, including the following:
 - 1. Record Drawings.
 - 2. Record Specifications.
 - 3. Record Product Data.
 - 4. Miscellaneous record submittals.
- B. Related Requirements:
 - 1. Division 01 "Execution" for final property survey.
 - 2. Division 01 "Closeout Procedures" for general closeout procedures.
 - 3. Division 01 "Operation and Maintenance Data" for operation and maintenance manual requirements.
 - 4. Divisions 02 through 49 Sections for specific requirements for project record documents of the Work in those Sections.

1.02 CLOSEOUT SUBMITTAL

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit copies of record Drawings as follows:
 - a. Initial Submittal:
 - 1) Submit (1) one paper-copy set(s) of marked-up record prints.
 - 2) Submit PDF electronic files of scanned record prints.
 - 3) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - 4) Submit Record Digital Data Files and (1) one set(s) of plots.
 - b. Final Submittal:
 - 1) Submit (1)one paper-copy set(s) of marked-up record prints.
 - 2) Submit PDF electronic files of scanned record prints.
 - 3) Print each drawing, whether or not changes and additional information were recorded.
 - 4) Submit Record Digital Data Files and (1) one set(s) of plots.
- B. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.
 - 1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.
- D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.
- E. Reports: Submit written report bi-weekly indicating items incorporated into project record documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

1.03 RECORD DRAWINGS

- A. Record Drawings: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
 - 1. Preparation: Mark record drawings 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 provide information for preparation of corresponding marked-up record prints.

017839
PROJECT RECORD
DOCUMENTS

- a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
- b. Accurately record information in an acceptable drawing technique.
- c. Record data as soon as possible after obtaining it.
- d. Record and check the markup before enclosing concealed installations.
- e. Cross-reference record prints to corresponding archive photographic documentation.
2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations below first floor.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Change Order or Construction Change Directive.
 - k. Changes made following Architect's written orders.
 - l. Details not on the original Contract Drawings.
 - m. Field records for variable and concealed conditions.
 - n. Record information on the Work that is shown only schematically.
3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
7. Submit as indicated in the Article 1.2 final submittal.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record drawings with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
 1. Format: Same digital data software program, version, and operating system as the original Contract Drawings.
 2. Format: Annotated PDF electronic file. Annotated PDF electronic file with comment function enabled.
 3. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
 4. Refer instances of uncertainty to Architect for resolution.
 5. Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
 6. Architect will furnish Contractor one set of digital data PDF files of the Contract Drawings for use in recording information.
 - a. See Section 013300 "Submittal Procedures" for requirements related to use of Architect's digital data files.

1.04 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.

017839
PROJECT RECORD
DOCUMENTS

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. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
5. Note related Change Orders and record Drawings where applicable.
6. Submit as indicated in the Article 1.2 final submittal.

1.05 RECORD PRODUCT DATA

- A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
 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 and record Drawings where applicable.
 4. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.
 5. Submit as indicated in the Article 1.2 final submittal.

1.06 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.
 1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.
 2. Submit as indicated in the Article 1.2 final submittal.

PART 2 PRODUCT (NOT USED)

PART 3 EXECUTION

3.01 RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.
- B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.

END OF SECTION 017839

EC3
R24.15543

West Campus Renovations
017839 - 4

**017839
PROJECT RECORD
DOCUMENTS**

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SECTION 017900 DEMONSTRATION AND TRAINING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Demonstration of operation of systems, subsystems, and equipment.
 - 2. Training in operation and maintenance of systems, subsystems, and equipment.
 - 3. Demonstration and training video recordings.

1.02 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
 - 1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

1.03 CLOSEOUT SUBMITTALS

- A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.
 - 1. Identification: On each copy, provide an applied label with the following information:
 - a. Name of Project.
 - b. Name of Architect.
 - c. Name of Contractor.
 - 2. Transcript: Prepared in PDF electronic format. Include a cover sheet with same label information as the corresponding video recording and a table of contents with links to corresponding training components. Include name of Project and date of video recording on each page.
- B. At completion of training, submit complete training manual(s) for Owner's use, prepared and bound in format matching operation and maintenance manuals.

1.04 QUALITY ASSURANCE

- A. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.

1.05 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

017900
DEMONSTRATION AND
TRAINING

PART 2 PRODUCTS

2.01 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
 - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.
 - 2. Documentation: Review the following items in detail:
 - a. Emergency manuals.
 - b. Operations manuals.
 - c. Maintenance manuals.
 - d. Project record documents.
 - e. Identification systems.
 - f. Warranties and bonds.
 - g. Maintenance service agreements and similar continuing commitments.
 - 3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
 - 4. Operations: Include the following, as applicable:
 - a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
 - 5. Adjustments: Include the following:
 - a. Alignments.

**017900
DEMONSTRATION AND
TRAINING**

- b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
- 6. Troubleshooting: Include the following:
 - a. Diagnostic instructions.
 - b. Test and inspection procedures.
- 7. Maintenance: Include the following:
 - a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
- 8. Repairs: Include the following:
 - a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

PART 3 EXECUTION

3.01 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."
- B. Set up instructional equipment at instruction location.

3.02 INSTRUCTION

- A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 - 1. Owner will furnish Contractor with names and positions of participants.
- B. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 - 1. Schedule training with Owner with at least **seven** days' advance notice.
- C. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- D. Cleanup: Collect used and leftover educational materials and **remove from Project site**. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

3.03 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

- A. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.
 - 1. Film training session(s) in segments not to exceed 15 minutes.

017900
DEMONSTRATION AND
TRAINING

- a. Produce segments to present a single significant piece of equipment per segment.
 - b. Organize segments with multiple pieces of equipment to follow order of Project Manual table of contents.
 - c. Where a training session on a particular piece of equipment exceeds 15 minutes, stop filming and pause training session. Begin training session again upon commencement of new filming segment.
- B. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.
- 1. Furnish additional portable lighting as required.
- C. Narration: Describe scenes on video recording by video recording is recorded. Include description of items being viewed.
- D. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.

END OF SECTION 017900

SECTION 024100 DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Selective demolition of building elements for alteration purposes.

1.02 RELATED REQUIREMENTS

- A. Division 1 Sections : Limitations on Contractor's use of site and premises, sequencing and staging requirements..
- B. Section 015001: Site fences, security, protective barriers, and waste removal.
- C. Section 016000 - Product Requirements: Handling and storage of items removed for salvage and relocation.
- D. Section 017300: Execution: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring.

1.03 DEFINITIONS

- A. Demolition: Dismantle, raze, destroy or wreck any building or structure or any part thereof.
- B. Remove: Detach or dismantle items from existing construction and dispose of them off site, unless items are indicated to be salvaged or reinstalled.
- C. Remove and Salvage: Detach or dismantle items from existing construction in a manner to prevent damage. Clean, package, label and deliver salvaged items to Owner in ready-for-reuse condition.
- D. Remove and Reinstall: Detach or dismantle items from existing construction in a manner to prevent damage. Clean and prepare for reuse and reinstall where indicated.
- E. Existing to Remain: Designation for existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

1.04 REFERENCE STANDARDS

- A. 29 CFR 1926 - Safety and Health Regulations for Construction; Current Edition.

1.05 SUBMITTALS

- A. See Section 013300 - Submittal Procedures for submittal procedures.
- B. Site Plan: Indicate:
 - 1. Vegetation to be protected.
 - 2. Areas for temporary construction and field offices.
- C. Demolition Plan: Submit demolition plan as required by OSHA and local AHJs.
 - 1. Indicate extent of demolition, removal sequencing, bracing and shoring, and location and construction of barricades and fences.
 - 2. Demolition firm qualifications.
- D. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

PART 2 PRODUCTS -- NOT USED

PART 3 EXECUTION

3.01 GENERAL PROCEDURES AND PROJECT CONDITIONS

- A. Comply with other requirements specified in Section 17300.
- B. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
 - 1. Obtain required permits.

024100
DEMOLITION

2. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
 3. Provide, erect, and maintain temporary barriers and security devices.
 4. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
 5. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
 6. Do not close or obstruct roadways or sidewalks without permits from authority having jurisdiction.
 7. Conduct operations to minimize obstruction of public and private entrances and exits. Do not obstruct required exits at any time. Protect persons using entrances and exits from removal operations.
 8. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon, or limit access to their property.
- C. Do not begin removal until receipt of notification to proceed from Owner.
- D. Protect existing structures and other elements to remain in place and not removed.
1. Provide bracing and shoring.
 2. Prevent movement or settlement of adjacent structures.
 3. Stop work immediately if adjacent structures appear to be in danger.
- E. Minimize production of dust due to demolition operations. Do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.
- F. If hazardous materials are discovered during removal operations, stop work and notify Architect and Owner; hazardous materials include regulated asbestos containing materials, lead, PCB's, and mercury.

3.02 EXISTING UTILITIES

- A. Coordinate work with utility companies. Notify utilities before starting work, comply with their requirements, and obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.
- D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.
- E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without 7 days prior written notification to Owner.
- F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.
- G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.
- H. Prepare building demolition areas by disconnecting and capping utilities outside the demolition zone. Identify and mark, in same manner as other utilities to remain, utilities to be reconnected.

3.03 SELECTIVE DEMOLITION FOR ALTERATIONS

- A. Existing construction and utilities indicated on drawings are based on casual field observation and existing record documents only.
1. Verify construction and utility arrangements are as indicated.
 2. Report discrepancies to Architect before disturbing existing installation.
 3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.

024100
DEMOLITION

- B. Separate areas in which demolition is being conducted from areas that remain occupied.
 - 1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 015000 in locations indicated on drawings.
 - 2. Provide sound retardant partitions of construction and in locations indicated on drawings.
- C. Maintain weatherproof exterior building enclosure, except for interruptions required for replacement or modifications; prevent water and humidity damage.
- D. Remove existing work as indicated and required to accomplish new work.
 - 1. Remove rotted wood, corroded metals, and deteriorated masonry and concrete; replace with new construction indicated.
 - 2. Remove items indicated on drawings.
- E. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, Telecommunications, and Smoke and Fire Detection): Remove existing systems and equipment as indicated.
 - 1. Maintain existing active systems to remain in operation, and maintain access to equipment and operational components.
 - 2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
 - 3. See Section 011000 - Summary for limitations on outages and required notifications.
 - 4. Verify that abandoned services serve only abandoned facilities before removal.
 - 5. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings. Remove back to source of supply where possible, otherwise cap stub and tag with identification.
- F. Protect existing work to remain.
 - 1. Prevent movement of structure. Provide shoring and bracing as required.
 - 2. Perform cutting to accomplish removal work neatly and as specified for cutting new work.
 - 3. Repair adjacent construction and finishes damaged during removal work.
 - 4. Patch to match new work.

3.04 DEBRIS AND WASTE REMOVAL

- A. Remove debris, junk, and trash from site.
- B. Leave site in clean condition, ready for subsequent work.
- C. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION 024100

**024100
DEMOLITION**

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**SECTION 035416
CEMENTITIOUS UNDERLAYMENT**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Cementitious self leveling underlayment
- B. Cementitious trowelable patching compound

1.02 RELATED DOCUMENTS

- A. Drawings, general provisions of the Contract, and other related construction documents such as Division 01 specifications apply to this Section.

1.03 SUMMARY

- A. This Section includes a self-leveling underlayment that consists of a blend of Portland cement and other hydraulic cements and polymers that is used to level and smooth interior concrete prior to the installation of finish flooring on all grade levels.
- B. Related Sections include the following:
 - 1. Division 09 Flooring Sections

1.04 REFERENCE STANDARDS

- A. ASTM C109M, Compressive Strength Air-Cure Only
- B. ASTM C348, Flexural Strength of Hydraulic-Cement Mortars
- C. ASTM F2170, Relative Humidity in Concrete Floor Slabs Using in situ Probes
- D. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring

1.05 SUBMITTALS

- A. See Section 013300-Submittal Procedures.
- B. Product Data: Submit manufacturer's product data for each material and product used.

1.06 QUALITY ASSURANCE

- A. Installation of the product must be completed by a factory-trained applicator.
- B. Product must have a hydraulic cement-based inorganic binder content as the primary binder which includes portland cement per ASTM C150: Standard Specification for Portland Cement and other specialty hydraulic cements. Gypsum-based products are not acceptable.
- C. Manufacturer Experience: Provide products of this section by companies which have successfully specialized in production of this type of work for not less than 3 years. Contact Manufacturer Representative prior to installation.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products in original packaging, labeled with product identification, manufacturer, batch number and shelf life.
- B. Store products in a dry area with temperature maintained between 50° and 85°F (10° and 29°C) and protect from direct sunlight.
- C. Handle products in accordance with manufacturer's printed recommendations.

1.08 PROJECT CONDITIONS

- A. Do not install material below 50°F (10°C) surface and air temperatures. These temperatures must also be maintained during and for 48 hours after the installation of products included in this section. Install quickly if the substrate is warm and follow warm weather instructions.

1.09 WARRANTY

- A. See Section 017700 - Closeout Procedures for additional warranty requirements.

035416
CEMENTITIOUS
UNDERLAYMENT

- B. Manufacturer Warranty: Provide two-year manufacturer warranty against delamination and degradation of underlayment. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.01 HYDRAULIC CEMENT-BASED SELF LEVELING UNDERLAYMENT

- A. Hydraulic Cement-Based Self-Leveling Underlayment: Polymer-modified, self-leveling, hydraulic cement product that can be applied in minimum uniform thickness of 1/4 inch (6 mm) and that can be feathered at edges to match adjacent floor elevations.
1. Basis-of-Design Product: Subject to compliance with requirements, provide ARDEX K 15; Manufactured by ARDEX Engineered Cements or a comparable product by one of the following:
 - a. Laticrete International, Inc.
 - b. MAPEI Corporation.
 - c. Uzin Utz North America, Inc.
 2. Primer:
 - a. Standard Absorbent Concrete: ARDEX P 51 Primer or equal.
 - b. Extremely Absorbent Concrete: May require two applications of ARDEX P 51™ to minimize the potential for pinholes forming in the ARDEX K 15 or equal.
 - c. Other Non-Porous Substrates (burnished concrete, terrazzo, wellbonded ceramic, quarry and porcelain tiles, epoxy coating systems and non-water soluble adhesive residue on concrete and concrete treated with silicate compounds): ARDEX P 82™ Ultra Prime or equal.
 - d. Performance and Physical Properties: Meet or exceed the following values for material cured at 73° F+/-3°F (23° C+/-3°C) and 50% +/-5% relative humidity:
 - 1) Application: Barrel Mix or Pump
 - 2) Flow Time: 10 minutes
 - 3) Walkable: 2 to 3 hours
 - 4) Compressive Strength: 5,500 psi (385 kg/cm²) at 28 days, ASTM C109M
 - 5) Flexural Strength: 1,200 psi (84 kg/cm²) at 28 days, ASTM C348
 - 6) VOC: 0
 3. Water: Water shall be clean, potable, and sufficiently cool (not warmer than 70°F).

2.02 CEMENT-BASED TROWELABLE UNDERLAYMENT

- A. Cement-Based Self-Leveling Underlayment: Polymer-modified, trowelable, cement product that can be applied in minimum uniform thickness of 1/4 inch (6 mm) and that can be feathered at edges to match adjacent floor elevations.
1. Basis-of-Design Product: Subject to compliance with requirements, provide ARDEX SD-P; Manufactured by ARDEX Engineered Cements or a comparable product by one of the following:
 - a. Laticrete International, Inc.
 - b. MAPEI Corporation.
 - c. Approved equal.
 2. Primer:
 - a. Standard Absorbent Concrete: ARDEX P 51 Primer or equal.
 - b. Extremely Absorbent Concrete: May require two applications of ARDEX P 51™ to minimize the potential for pinholes forming in the ARDEX K 15 or equal.
 - c. Wood: ARDEX P 82™ Ultra Prime or equal.
 - d. Other Non-Porous Substrates (burnished concrete, terrazzo, wellbonded ceramic, quarry and porcelain tiles, epoxy coating systems and non-water soluble adhesive residue on concrete and concrete treated with silicate compounds): ARDEX P 82™ Ultra Prime or equal.

035416
CEMENTITIOUS
UNDERLAYMENT

- e. Performance and Physical Properties: Meet or exceed the following values for material cured at 73° F+/-3°F (23° C+/-3°C) and 50% +/-5% relative humidity:
 - 1) Initial Set: 30 minutes
 - 2) Final Set: 90 minutes
 - 3) Walkable: 2 to 3 hours
 - 4) Compressive Strength: 400 psi (385 kg/cm²) at 28 days, ASTM C109M
 - 5) Flexural Strength: 1,000 psi (84 kg/cm²) at 28 days, ASTM C348
 - 6) VOC: 0
- 3. Water: Water shall be clean, potable, and sufficiently cool (not warmer than 70°F).

B.

PART 3 EXECUTION

3.01 PREPARATION

- A. General: Prepare substrate in accordance with manufacturer's instructions.
 - 1. Concrete:
 - a. Prior to proceeding please refer to ASTM F710 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring. All concrete subfloors must be sound, solid, clean, and free of all oil, grease, dirt, curing compounds and any substance that might act as a bond breaker before priming. Mechanically clean if necessary using shot blasting or other. Acid etching and the use of sweeping compounds and solvents are not acceptable.
 - b. Substrates shall be inspected in accordance with ASTM F2170 and corrected for moisture or any other conditions that could affect the performance of the underlayment or the finished floor covering. For areas where moisture vapor emissions exceed the RH limitations of the flooring or flooring adhesive manufacturer equired limits install Ardex MC Rapid (or approved equal).
- B. Crack and Joint Preparation:
 - 1. Moving Joints and Moving Cracks – honor all expansion, isolation joints and moving cracks up through the underlayment. Seal with flexible sealing compound, ARDEX ARDISEAL Rapid Plus Semi-Rigid Joint Sealant may be installed.
 - 2. Saw Cuts, Dormant Control Joints and Dormant Cracks – fill all dormant control joints and dormant cracks with ARDEX ARDIFIX Low Viscosity Rigid Polyurethane Crack & Joint Repair or ARDEX FEATHER FINISHvSelf-Drying, Cement-Based Finish Underlayment (or equal) as recommended by the manufacturer.
- C. Adhesive residues on concrete must first be tested to make certain they are not water-soluble. Water-soluble adhesives must be completely mechanically removed down to clean concrete. Non-water-soluble adhesives should be prepared to a thin, well-bonded residue using the wetscraping technique as recommended by the Resilient Floor Covering Institute (www.rfci.com). The prepared residue should appear as nothing more than a transparent stain on the concrete after scraping.
- D. Non-porous subfloors such as ceramic, porcelain and quarry tile, burnished concrete, epoxy coating systems as well as terrazzo should be clean and free of all waxes, sealers, dust, dirt, debris and any other contaminant that may act as a bond breaker. If necessary, clean by mechanical methods such as shot blasting.

3.02 APPLICATION

- A. Examine substrates and conditions under which materials will be installed. Do not proceed with installation until unsatisfactory conditions are corrected. Proceeding with installation constitutes acceptance of existing conditions.
- B. Coordinate installation with adjacent work to ensure proper sequence of construction. Protect adjacent areas from contact due to mixing and handling of materials.

035416
CEMENTITIOUS
UNDERLAYMENT

- C. Priming:
1. Note: When using ARDEX P 51, It is critical to ensure that the ARDEX P 51 is dry prior to proceeding with the next installation step. To determine if the ARDEX P 51 is dry after a minimum of 30 minutes (max. 24 hours), pour water onto the surface of the primer in several areas and rub it with your finger. If the water remains clear, the primer is dry.
 2. Primer for standard absorbent concrete subfloors: Dilute ARDEX P 51 1:1 with water and apply evenly with a soft push broom. Do not leave any bare spots. Remove all puddles and excess primer. Allow to dry to a clear, thin film (min. 30 minutes, max. 24 hours). Underlayment shall not be applied until the primer is dry.
 3. Primer for extremely absorbent concrete subfloors: Make an initial application of ARDEX P 51 mixed with 3 parts water using a soft push broom. Do not leave any bare spots. Remove all puddles and excess primer. Allow to dry thoroughly (1 to 3 hours) before proceeding with the standard application of primer as described above for standard absorbent concrete.
 4. Primer for non-porous subfloors such as burnished concrete, terrazzo, well-bonded ceramic, porcelain and quarry tile, epoxy coating systems, wooden subfloors and non-water soluble adhesive residues over concrete: Prime with ARDEX P 82 Ultra Prime (or equal). Follow the mixing instructions on the container and apply with a short-nap or sponge paint roller, leaving a thin coat of primer no heavier than a coat of paint. Do not leave any bare spots. Remove all puddles and excess primer. Allow to dry to a clear, slightly tacky film (minimum 3 hours, maximum 24 hours). Underlayment shall not be installed until primer is dry. Note: If a suitable acrylic curing compound has been used on the concrete, test the surface for porosity. If the concrete is porous, prime with ARDEX P 51. If it is non-porous, prime with ARDEX P 82. For wood substrates, once the primer is applied, install 3.4 galvanized, expanded diamond metal lath mesh, stapling approximately every 6 inches (15.2 cm). Do not walk on wet primer.
- D. Mixing: Comply with manufacturer's printed instructions and the following.
1. Aggregate mix: For areas to be installed over 1 inch thick, aggregate may be added to reduce material costs. Follow manufacturer's instructions for type of aggregate, mixing and installation..
- E. Application: Comply with manufacturer's printed instructions.
- F. Curing
1. Do not force dry the underlayment.
 2. Moisture-insensitive tiles such as ceramic, quarry and porcelain can be installed when hardened, approximately 90 minutes. All other finish floor coverings can be installed after 16 hours at 70°F (21°C). For resinous systems such as epoxy and polyurethane floors please contact the ARDEX Technical Services Department.

3.03 PROTECTION

- A. Prior to the installation of the finish flooring, the surface of the underlayment must be protected from abuse by other trades by the use of plywood, Masonite or other suitable protection course.

END OF SECTION 035416

**SECTION 042000
UNIT MASONRY**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Concrete block
- B. Precast concrete Shapes
- C. Mortar and grout.
- D. Reinforcement and anchorage.
- E. Flashings.
- F. Installation of lintels.
- G. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 055000 - Metal Fabrications: Loose steel lintels.
- B. Section 072100 - Thermal Insulation: Insulation for cavity spaces.
- C. Section 076200 - Sheet Metal Flashing and Trim: Through-wall masonry flashings.
- D. Section 078400 - Firestopping: Firestopping at penetrations of fire-rated masonry and at top of fire-rated walls.
- E. Section 079200 - Joint Sealants: Sealing control and expansion joints.

1.03 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- B. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire; 2019.
- C. ASTM A951/A951M - Standard Specification for Steel Wire for Masonry Joint Reinforcement; 2022.
- D. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2022.
- E. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units; 2023.
- F. ASTM C129 - Standard Specification for Nonloadbearing Concrete Masonry Units; 2023.
- G. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2018.
- H. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.
- I. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2018.
- J. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019a, with Editorial Revision.
- K. ASTM C476 - Standard Specification for Grout for Masonry; 2023.
- L. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete; 2016.
- M. BIA Technical Notes No. 7 - Water Penetration Resistance – Design and Detailing; 2017.
- N. BIA Technical Notes No. 28B - Brick Veneer/Steel Stud Walls; 2005.
- O. BIA Technical Notes No. 46 - Maintenance of Brick Masonry; 2017.
- P. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2022, with Errata (2024).
- Q. UL (FRD) - Fire Resistance Directory; Current Edition.

042000
UNIT MASONRY

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all relevant installers.

1.05 SUBMITTALS

- A. See Section 013300 -Submittal Procedures.
- B. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar mix design, masonry accessories, precast concrete mix, and grout mix design.
- C. Shop Drawings : Indicate pertinent dimensions, materials, anchorage, size and type of fasteners, and accessories for brickwork support system. Provide shop drawings for the following:
 - 1. Steel reinforcing.
 - 2. Precast concrete units.
- D. Verification Samples: Submit five samples of facing brick units to illustrate color, texture, and extremes of color range.
- E. Manufacturer's Certificate: Certify that masonry units and precast concrete meet or exceed fire ratings and other specified requirements.
- F. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
- G. Cold and Hot weather procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.06 QUALITY ASSURANCE

- A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.
- B. Fire Rated Assemblies: Comply with applicable code for UL Assembly's requirements for fire rated masonry construction.
- C. Source limitations for masonry units: Obtain exposed masonry units of a uniform quality and color, from single manufacturer for each cementitious component and from single source or producer for each aggregate.
- D. Source limitations for mortar materials: Obtain mortar ingredients of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product listed.
- E. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section with minimum three years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, handle, and store masonry units by means that will prevent mechanical damage, rusting and contamination by other materials.

PART 2 PRODUCTS

2.01 CONCRETE MASONRY UNITS

- A. Concrete Block: Comply with referenced standards and as follows:
 - 1. Size: Standard units with nominal face dimensions of 16 by 8 inches and nominal depths as indicated on drawings for specific locations.
 - 2. Special Shapes: Provide non-standard blocks configured for corners, lintels, control joint edges and other detailed conditions where indicated on Drawings.
 - 3. Load-Bearing Units: ASTM C90, normal weight.
 - 4. Nonloadbearing Units: ASTM C129.
 - a. Hollow block, as indicated.

042000
UNIT MASONRY

- b. Normal weight.

2.02 PRECAST CONCRETE SHAPES

- A. Shapes: As indicated on Drawings.
- B. Manufacturers:
 - 1. Southside Precast Products: (Basis of Design) www.southsideprecast.com/#sle.
 - 2. Equivalent: Approved equal.
- C. Color and Finish Texture - Match Architect's sample.

2.03 GROUT MATERIALS

- A. Grout: Refer to Notes in Structural Drawings.

2.04 MORTAR AND GROUT MATERIALS

- A. Mortar: ASTM C270 Type S or N.
 - 1. Refer to Structural Notes for additional requirements..
- B. Portland Cement: ASTM C150/C150M, Type I, color as required to match existing.
- C. Hydrated Lime: ASTM C207, Type S.
- D. Mortar Aggregate: ASTM C144.
- E. Color: Match Owner's standard color.
- F. Pigments for Colored Mortar: Pure, concentrated mineral pigments specifically intended for mixing into mortar and complying with ASTM C979/C979M.
 - 1. Manufacturers:
 - a. Davis Colors, a division of Venator Materials PLC: www.daviscolors.com/#sle.
 - b. Solomon Colors, Inc: www.solomoncolors.com/#sle.
 - c. Equivalent: Approved equal.
- G. Water: Clean and potable.
- H. Moisture-Resistant Admixture: Water repellent compound designed to reduce capillarity.

2.05 REINFORCEMENT AND ANCHORAGE

- A. Joint Reinforcement: Use ladder type joint reinforcement where vertical reinforcement is involved and truss type elsewhere, unless otherwise indicated.
- B. Single Wythe Joint Reinforcement: ASTM A951/A951M.
 - 1. Type: Truss or ladder.
 - 2. Material: ASTM A1064/A1064M steel wire, mill galvanized to ASTM A641/A641M Class 3.
 - 3. Size: 0.1875 inch side rods with 0.1483 inch cross rods; width as required to provide not less than 5/8 inch of mortar coverage on each exposure.
- C. Flexible Anchors: 2-piece anchors that permit differential movement between masonry and building frame, sized to provide not less than 5/8 inch of mortar coverage from masonry face.
- D. Metal-to-Metal Fasteners: Self-drilling, self-tapping screws; corrosion resistant finish or hot dip galvanized to ASTM A153/A153M.
 - 1. Manufacturers:
 - a. ITW Commercial Construction North America; Teks Select Series: www.ITWBuildex.com/#sle.
 - b. Equivalent: Approved equal.

2.06 FLASHINGS

- A. Metal Flashing Materials: Stainless Steel, as specified in Section 076200.
- B. Termination Bars: Stainless steel; compatible with membrane and adhesives.
 - 1. Manufacturers:

042000
UNIT MASONRY

- a. Hohmann & Barnard, Inc: www.h-b.com/#sle.
 - b. Mortar Net Solutions; Termination Bars: www.mortarnet.com/#sle.
 - c. Equivalent: Approved equal.
- C. Drip Edge: Stainless steel; angled drip with hemmed edge; compatible with membrane and adhesives.
- 1. Manufacturers:
 - a. Hohmann & Barnard, Inc: www.h-b.com/#sle.
 - b. Mortar Net Solutions; Metal Drip Edges: www.mortarnet.com/#sle.
 - c. Equivalent: Approved equal.
- D. Lap Sealants and Tapes: As recommended by flashing manufacturer; compatible with membrane and adhesives.

2.07 ACCESSORIES

- A. Preformed Control Joints: Rubber material. Provide with corner and tee accessories, fused joints.
- 1. Manufacturers:
 - a. Hohmann & Barnard, Inc: www.h-b.com/#sle.
 - b. WIRE-BOND: www.wirebond.com/#sle.
 - c. Equivalent: Approved equal.
- B. Joint Filler: Closed cell polyvinyl chloride; oversized 50 percent to joint width; self expanding; in maximum lengths available.
- 1. Manufacturers:
 - a. Hohmann & Barnard, Inc: www.h-b.com/#sle.
 - b. WIRE-BOND: www.wirebond.com/#sle.
 - c. Equivalent: Approved equal.
- C. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

2.08 MORTAR AND GROUT MIXING

- A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.
- 1. Masonry below grade and in contact with earth: Type S.
 - 2. Exterior, non-loadbearing masonry: Type N.
 - 3. Interior, non-loadbearing masonry: Type O.
- B. Colored Mortar: Proportion selected pigments and other ingredients to match Architect's sample, without exceeding manufacturer's recommended pigment-to-cement ratio.
- C. Grout: ASTM C476; consistency required to fill completely volumes indicated for grouting; fine grout for spaces with smallest horizontal dimension of 2 inches or less; coarse grout for spaces with smallest horizontal dimension greater than 2 inches.
- D. Mixing: Use mechanical batch mixer and comply with referenced standards.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive masonry.
- B. Verify that related items provided under other sections are properly sized and located.
- C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.02 PREPARATION

- A. Direct and coordinate placement of metal anchors supplied for installation under other sections.
- B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

042000
UNIT MASONRY

3.03 PROTECTION OF MASONRY

- A. During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
 - 1. Extend cover a minimum of 24 inches down both sides of walls and hold cover securely in place.
 - 2. Where one wythe of multi-wythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
 - 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
 - 2. Protect sills, ledges, and projections from mortar droppings.
 - 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 - 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

3.04 COURSING

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Concrete Masonry Units:
 - 1. Bond: Running.
 - 2. Coursing: One unit and one mortar joint to equal 8 inches.
 - 3. Mortar Joints: Concave.

3.05 PLACING AND BONDING

- A. Lay hollow masonry units with face shell bedding on head and bed joints.
- B. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
- C. Remove excess mortar and mortar smears as work progresses.
- D. Remove excess mortar as work progresses.
- E. Interlock intersections and external corners, except for units laid in stack bond.
- F. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- G. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
- H. Cut mortar joints flush where wall tile is scheduled or resilient base is scheduled.
- I. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

3.06 REINFORCEMENT AND ANCHORAGE - GENERAL AND SINGLE WYTHE MASONRY

- A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches on center.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.

042000
UNIT MASONRY

- C. Place continuous joint reinforcement in first and second joint below top of walls.
- D. Embed longitudinal wires of joint reinforcement in mortar joint with at least 5/8 inch mortar cover on each side.
- E. Lap joint reinforcement ends minimum 6 inches.
- F. Reinforce stack bonded unit joint corners and intersections with strap anchors 16 inches on center.
- G. Fasten anchors to structural framing and embed in masonry joints as masonry is laid. Unless otherwise indicated on drawings or closer spacing is indicated under specific wall type, space anchors at maximum of 16 inches horizontally and 16 inches vertically.
- H. Embed ties and anchors in mortar joint and extend into masonry unit a minimum of 1-1/2 inches with at least 5/8 inch mortar cover to the outside face of the anchor.

3.07 MASONRY FLASHINGS

- A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
 - 1. Extend flashings full width at such interruptions and at least 6 inches, minimum, into adjacent masonry or turn up flashing ends at least 1 inch, minimum, to form watertight pan at nonmasonry construction.
 - 2. Remove or cover protrusions or sharp edges that could puncture flashings.
 - 3. Seal lapped ends and penetrations of flashing before covering with mortar.
- B. Terminate flashing up 8 inches minimum on vertical surface of backing:
 - 1. Install vertical leg of flashing behind water-resistive barrier sheet over backing.
 - 2. Anchor vertical leg of flashing into backing with a termination bar and sealant.
 - 3. Apply cap bead of sealant on top edge of self-adhered flashing.
- C. Install flashing in accordance with manufacturer's instructions and BIA Technical Notes No. 7.
- D. Extend metal flashings through exterior face of masonry and terminate in an angled drip with hemmed edge. Install joint sealer below drip edge to prevent moisture migration under flashing.
- E. Support flexible flashings across gaps and openings.
- F. Lap end joints of flashings at least 6 inches, minimum, and seal watertight with flashing sealant/adhesive.

3.08 LINTELS

- A. Install loose steel lintels over openings.
- B. Maintain minimum 8 inch bearing on each side of opening.

3.09 GROUTED COMPONENTS

- A. Refer to structural drawings.
- B. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
- C. Place and consolidate grout fill without displacing reinforcing.

3.10 CONTROL AND EXPANSION JOINTS

- A. Do not continue horizontal joint reinforcement through control or expansion joints.
- B. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.
- C. Size control joints as indicated on drawings; if not indicated, 3/4 inch wide and deep.
- D. Form expansion joint as detailed on drawings.

042000
UNIT MASONRY

3.11 TOLERANCES

- A. Install masonry within the site tolerances found in TMS 402/602.
- B. Maximum Variation from Alignment of Columns: 1/4 inch.
- C. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.
- D. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.
- E. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.
- F. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.
- G. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.

3.12 CUTTING AND FITTING

- A. Cut and fit for chases. Coordinate with other sections of work to provide correct size, shape, and location.
- B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.13 CLEANING

- A. Remove excess mortar and mortar droppings.
- B. Replace defective mortar. Match adjacent work.
- C. Clean soiled surfaces with cleaning solution.
- D. Use non-metallic tools in cleaning operations.

3.14 PROTECTION

- A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

END OF SECTION 042000

042000
UNIT MASONRY

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**SECTION 055000
METAL FABRICATIONS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Shop fabricated steel and aluminum items.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provision of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 042000 - Unit Masonry: Placement of metal fabrications in masonry.
- C. Section 099000 - Paintings and Coatings: Paint Finish.

1.03 REFERENCE STANDARDS

- A. AAMA 611 - Specification for Anodized Architectural Aluminum; 2024.
- B. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- C. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2024.
- D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- E. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
- F. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- G. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.
- H. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.
- I. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2021.
- J. ASTM A554 - Standard Specification for Welded Stainless Steel Mechanical Tubing; 2021.
- K. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- L. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
- M. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.
- N. ASTM B210/B210M - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes; 2019a.
- O. ASTM B211/B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire; 2019.
- P. ASTM B26/B26M - Standard Specification for Aluminum-Alloy Sand Castings; 2018, with Editorial Revision.
- Q. ASTM B85/B85M - Standard Specification for Aluminum-Alloy Die Castings; 2018, with Editorial Revision.
- R. ASTM B177/B177M - Standard Guide for Engineering Chromium Electroplating; 2011 (Reapproved 2021).

055000
METAL FABRICATIONS

- S. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- T. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- U. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2023.
- V. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.
- W. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021, with Errata (2023).
- X. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).
- Y. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).
- Z. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.
- AA. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.
- BB. SSPC-SP 2 - Hand Tool Cleaning; 2024.

1.04 SUBMITTALS

- A. See Section 013300 - Submittal Procedures, for submittal procedures.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
 - 1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
 - 2. Design data: Submit drawings and supporting calculations, signed and sealed by a qualified professional structural engineer.
 - a. Include the following, as applicable:
 - 1) Design criteria.
 - 2) Engineering analysis depicting stresses and deflections.
 - 3) Member sizes and gauges.
 - 4) Details of connections.
 - 5) Support reactions.
 - 6) Bracing requirements.
- C. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.
- D. Designer's Qualification Statement.

1.05 QUALITY ASSURANCE

- A. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and AWS D1.2/D1.2M and dated no more than 12 months before start of scheduled welding work.

PART 2 PRODUCTS

2.01 MATERIALS - STEEL

- A. Steel Sections: ASTM A36/A36M.
- B. Steel Tubing: ASTM A501/A501M hot-formed structural tubing.
- C. Plates: ASTM A283/A283M.
- D. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.

055000
METAL FABRICATIONS

- E. Stainless Steel, General: ASTM A666, Type 304.
- F. Stainless Steel Tubing: ASTM A554, Type 304, 16 gauge, 0.0625 inch minimum metal thickness, 1-1/2 inch diameter.
- G. Stainless Steel Bars, Shapes and Moldings: ASTM A276/A276M, Type 304.
- H. Slotted Channel Fittings: ASTM A1011/A1011M.
- I. Mechanical Fasteners: Same material as or compatible with materials being fastened; type consistent with design and specified quality level.
- J. Bolts, Nuts, and Washers: ASTM A307, Grade A, plain.
- K. Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, plain.
- L. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- M. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
- N. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.02 MATERIALS - ALUMINUM

- A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.
- B. Sheet Aluminum: ASTM B209/B209M, 5052 alloy, H32 or H22 temper.
- C. Aluminum-Alloy Drawn Seamless Tubes: ASTM B210/B210M, 6063 alloy, T6 temper.
- D. Aluminum-Alloy Bars: ASTM B211/B211M, 6061 alloy, T6 temper.
- E. Aluminum-Alloy Sand Castings: ASTM B26/B26M.
- F. Aluminum-Alloy Die Castings: ASTM B85/B85M.
- G. Bolts, Nuts, and Washers: Stainless steel.
- H. Welding Materials: AWS D1.2/D1.2M; type required for materials being welded.

2.03 FABRICATION

- A. Fit and shop assemble items in largest practical sections, for delivery to site.
- B. Fabricate items with joints tightly fitted and secured.
- C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- D. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
- E. Furnish components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.04 FINISHES - STEEL

- A. Prime paint steel items.
 - 1. Exceptions: Galvanize items to be embedded in concrete and items to be embedded in masonry.
 - 2. Exceptions: Do not prime surfaces in direct contact with concrete, where field welding is required, and items to be covered with sprayed fireproofing.
- B. Prepare surfaces to be primed in accordance with SSPC-SP2.
- C. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- D. Prime Painting: One coat.

055000
METAL FABRICATIONS

- E. Galvanizing of Structural Steel Members: Galvanize after fabrication to ASTM A123/A123M requirements. Provide minimum 1.7 oz/sq ft galvanized coating.
- F. Galvanizing of Non-structural Items: Galvanize after fabrication to ASTM A123/A123M requirements.
- G. Chrome Plating: ASTM B177/B177M, nickel-chromium alloy, satin finish.
- H. Slotted Channel Framing: ASTM A653/A653M, Grade 33.
- I. Stainless Steel Finish: No. 4 Bright Polished finish.

2.05 FINISHES - ALUMINUM

- A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.
- B. Superior Performance Organic Coating System: AAMA 2605 multiple coat, thermally cured polyvinylidene fluoride system; color as indicated.

2.06 FABRICATION TOLERANCES

- A. Squareness: 1/8 inch maximum difference in diagonal measurements.
- B. Maximum Offset Between Faces: 1/16 inch.
- C. Maximum Misalignment of Adjacent Members: 1/16 inch.
- D. Maximum Bow: 1/8 inch in 48 inches.
- E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Furnish setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.03 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Field weld components as indicated on drawings.
- D. Perform field welding in accordance with AWS D1.1/D1.1M.
- E. Obtain approval prior to site cutting or making adjustments not scheduled.
- F. After erection, prime welds, abrasions, and surfaces not shop primed , except surfaces to be in contact with concrete.

3.04 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.
- C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION 055000

**SECTION 061000
ROUGH CARPENTRY**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Roof-mounted curbs.
- B. Roofing nailers.
- C. Roofing cant strips.
- D. Preservative treated wood materials.
- E. Fire retardant treated wood materials.
- F. Communications and electrical room mounting boards.
- G. Concealed wood blocking, nailers, and supports.
- H. Miscellaneous wood nailers, furring, and grounds.

1.02 RELATED REQUIREMENTS

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

1.03 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- C. ASTM C557 - Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing; 2003 (Reapproved 2017).
- D. ASTM D2898 - Standard Practice for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing; 2010 (Reapproved 2017).
- E. ASTM D3498 - Standard Specification for Adhesives for Field-Gluing Wood Structural Panels (Plywood or Oriented Strand Board) to Wood Based Floor System Framing; 2019a.
- F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- G. AWC (WFCM) - Wood Frame Construction Manual for One- and Two-Family Dwellings; 2024, with Errata.
- H. AWPA U1 - Use Category System: User Specification for Treated Wood; 2024.
- I. NELMA (SGR) - Standard Grading Rules for Northeastern Lumber; 2024.
- J. PS 20 - American Softwood Lumber Standard; 2025.
- K. WWPA G-5 - Western Lumber Grading Rules; 2025.

1.04 SUBMITTALS

- A. See Section 013300 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide technical data on insulated sheathing and wood preservative materials.
- C. Manufacturer's Certificate: Certify that wood products supplied for rough carpentry meet or exceed specified requirements.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.
- B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, and installation.

061000
ROUGH CARPENTRY

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
 - 1. If no species is specified, provide species graded by the agency specified; if no grading agency is specified, provide lumber graded by grading agency meeting the specified requirements.
 - 2. Grading Agency: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee at www.alsc.org, and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.
 - 3. Lumber of other species or grades is acceptable provided structural and appearance characteristics are equivalent to or better than products specified.

2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

- A. Grading Agency: Northeastern Lumber Manufacturers Association; NELMA (SGR).
- B. Sizes: Nominal sizes as indicated on drawings, S4S.
- C. Moisture Content: S-dry or MC19.
- D. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
 - 1. Lumber: S4S, No. 2 or Standard Grade.
 - 2. Boards: Standard or No. 3.

2.03 CONSTRUCTION PANELS

2.04 ACCESSORIES

- A. Fasteners and Anchors:
 - 1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
- B. General Purpose Construction Adhesives: Comply with ASTM C557.
 - 1. Products:
 - a. Substitutions: See Section 016000 - Product Requirements.
- C. Vapor Retarder: See Section 072600.

2.05 FACTORY WOOD TREATMENT

- A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
 - 1. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.
 - 2. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWPA standards.
- B. Fire Retardant Treatment:
 - 1. Products:
 - a. Lonza Group: www.wolmanizedwood.com/#sle.
 - b. Hoover Treated Wood Products, Inc: www.frtw.com/#sle.
 - c. Koppers, Inc: www.koppersperformancechemicals.com/#sle.
 - d. Substitutions: See Section 016000 - Product Requirements.

061000
ROUGH CARPENTRY

2. Exterior Type: AWPA U1, Category UCFB, Commodity Specification H, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes both before and after accelerated weathering test performed in accordance with ASTM D2898.
 - a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
 - b. Do not use treated wood in direct contact with the ground.
- C. Preservative Treatment:
 1. Products:
 - a. Lonza Group: www.wolmanizedwood.com/#sle.
 - b. Koppers Performance Chemicals, Inc: www.koppersperformancechemicals.com/#sle.
 - c. Substitutions: See Section 016000 - Product Requirements.

PART 3 EXECUTION

3.01 PREPARATION

- A. Coordinate installation of rough carpentry members specified in other sections.

3.02 INSTALLATION - GENERAL

- A. Select material sizes to minimize waste.
- B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.
- C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.03 BLOCKING, NAILERS, AND SUPPORTS

- A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
- B. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.
- C. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.
- D. Provide the following specific nonstructural framing and blocking:
 1. Cabinets and shelf supports.
 2. Wall brackets.
 3. Handrails.
 4. Grab bars.
 5. Towel and bath accessories.
 6. Wall-mounted door stops.
 7. Chalkboards and marker boards.
 8. Wall paneling and trim.
 9. Joints of rigid wall coverings that occur between studs.

3.04 TOLERANCES

- A. Variation from Plane, Other than Floors: 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

3.05 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements for additional requirements.

061000
ROUGH CARPENTRY

3.06 CLEANING

- A. Waste Disposal:
 - 1. Comply with applicable regulations.
 - 2. Do not burn scrap on project site.
 - 3. Do not burn scraps that have been pressure treated.
 - 4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or "waste-to-energy" facilities.
- B. Do not leave wood, shavings, sawdust, etc. on the ground or buried in fill.
- C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION 061000

**SECTION 064100
ARCHITECTURAL WOOD CASEWORK**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Specially fabricated cabinet units.
- B. Brackets and supports for Countertops
- C. Hardware.

1.02 RELATED REQUIREMENTS

- A. Section 061000 - Rough Carpentry: Support framing, grounds, and concealed blocking.
- B. Section 088000 - Glazing: Glass for casework.
- C. Section 123600 - Countertops.

1.03 REFERENCE STANDARDS

- A. ANSI A208.1 - American National Standard for Particleboard; 2022.
- B. AWI (QCP) - Quality Certification Program; Current Edition.
- C. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
- D. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.
- E. BHMA A156.9 - Cabinet Hardware; 2020.
- F. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.04 SUBMITTALS

- A. See Section 013300 - Submittal Procedures.
- B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
 - 1. Scale of Drawings: 1-1/2 inch to 1 foot, minimum.
- C. Product Data: Provide data for hardware accessories.

1.05 QUALITY ASSURANCE

- A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
 - 1. Company with at least one project in the past 5 years with value of woodwork within 20 percent of cost of woodwork for this Project.
 - 2. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.
 - 3. Single Source Responsibility: Provide and install this work from single fabricator.
- B. Quality Certification:
 - 1. Comply with AWI (QCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect units from moisture damage.

1.07 FIELD CONDITIONS

- A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

064100
ARCHITECTURAL WOOD
CASEWORK

PART 2 PRODUCTS

2.01 CABINETS

- A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
- B. Plastic Laminate Faced Cabinets: Custom grade.
- C. Cabinets
 - 1. Finish - Exposed Exterior Surfaces: Decorative laminate.
 - 2. Finish - Exposed Interior Surfaces: Decorative laminate.
 - 3. Finish - Semi-Exposed Surfaces: Decorative laminate
 - 4. Finish - Concealed Surfaces: Manufacturer's option.
 - 5. Door and Drawer Front Edge Profiles: Square edge with thin applied band.
 - 6. Casework Construction Type: Type A - Frameless.
 - 7. Style - Flush Overlay.
 - 8. Adjustable Shelf Loading: 40 psf.

2.02 PANEL CORE MATERIALS

- A. Particleboard: Composite panel composed of cellulosic particles, additives, and bonding system; comply with ANSI A208.1.
 - 1. Panel Thickness: 3/4 inch.

2.03 LAMINATE MATERIALS

- A. Manufacturers:
 - 1. Basis of Design: Subject to requirements, provide laminate by manufacturer with color and pattern as indicated on Finish schedule.
 - 2. Equivalent: Approved equal.
- B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications.
- C. Provide specific types as indicated.
 - 1. Horizontal Surfaces: HGS, 0.048 inch nominal thickness, through color, finish as indicated.
 - 2. Vertical Surfaces: VGS, 0.028 inch nominal thickness, through color, finish as indicated.
 - 3. Cabinet Liner: CLS, 0.020 inch nominal thickness, through color, finish as indicated.

2.04 ACCESSORIES

- A. Plastic Edge Banding: Extruded PVC, convex shaped; smooth finish; self locking serrated tongue; of width to match component thickness.
 - 1. Color: As selected by Architect from manufacturer's standard range.
 - 2. Use where indicated on drawings.
- B. Aluminum Edge Banding: Extruded convex shape; smooth surface finish; self locking serrated tongue; of width to match component thickness; clear anodized finish.
 - 1. Use where indicated on drawings.
- C. Aluminum Trim and Mouldings: Extruded, alloy 6063 T5.
 - 1. Type: As indicated on drawings.
 - 2. Finish: Clear anodized.
 - 3. Products:
 - a. Schluter: Basis of Design
- D. Aluminum Trim: As indicated or detailed on drawings.
- E. Glass: Type as specified in Section 088000.

064100
ARCHITECTURAL WOOD
CASEWORK

- F. Fasteners: Size and type to suit application.
- G. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.
- H. Concealed Joint Fasteners: Threaded steel.
- I. Grommets: Standard plastic grommets for cut-outs, in color to match adjacent surface.s

2.05 HARDWARE

- A. Cabinet Hardware: Comply with BHMA A156.9 for hardware types and grades indicated below:
 - 1. Hardware Types: As indicated on drawings.
 - 2. Product Grade: Grade 2.
- B. Metal Z-Shaped Wall Cabinet Support Clips: Paired, cleated, structural anchorage components applied to back of cabinets and walls for wall cabinet mounting.
 - 1. Material: Extruded Aluminum.
- C. Adjustable Shelf Supports: Standard side-mounted system using recessed metal shelf standards and coordinated self rests, polished chrome finish, for nominal 1 inch spacing adjustments.
 - 1. Product: Recessed shelf standards manufactured by Knappe and Vogt. Basis of Design
- D. Countertop Support Brackets: Fixed, L-shaped, face-of-stud mounting.
 - 1. Materials: Steel; Rectangular cross-section.
 - a. Finish: Manufacturer's standard, factory-applied, powder coat.
 - b. Color: Black.
 - c. 500 lb. capacity
 - 2. Products:
 - a. Richelieu: Basis of Design: Heavy Duty Bracket
 - b. Equivalent: Approved equal.
- E. Drawer and Door Pulls: "U" shaped wire pull, steel with chrome finish, 4 inch centers.
- F. Keyed Cabinet Locks: Keyed cylinder, two keys per lock, master keyed, steel with satin finish.
- G. Cabinet Catches and Latches:
 - 1. Type: Push latch.
- H. Drawer Slides:
 - 1. Type: Full extension.
 - 2. Static Load Capacity: Heavy Duty grade.
- I. Hinges: European style concealed self-closing type, steel with nickel-plated finish.
- J. Locking Hardware for Display Cabinets: Lock for double glass doors: Richelieu #BP641751140, satin chrome finish.

2.06 FABRICATION

- A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.
- B. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.
- C. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.
- D. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs.

064100
ARCHITECTURAL WOOD
CASEWORK

1. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
- E. Mechanically fasten back splash to countertops as recommended by laminate manufacturer at 16 inches on center.
- F. Provide cutouts for plumbing fixtures. Verify locations of cutouts from on-site dimensions. Prime paint cut edges.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify adequacy of backing and support framing.
- B. Verify location and sizes of utility rough-in associated with work of this section.

3.02 INSTALLATION

- A. Install work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.
- B. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.
- C. Use fixture attachments in concealed locations for wall mounted components.
- D. Use concealed joint fasteners to align and secure adjoining cabinet units.
- E. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.
- F. Secure cabinets to floor using appropriate angles and anchorages.

3.03 ADJUSTING

- A. Adjust installed work.
- B. Adjust moving or operating parts to function smoothly and correctly.

3.04 CLEANING

- A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION 064100

**SECTION 078400
FIRESTOPPING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Firestopping systems.
- B. Firestopping of joints and penetrations in fire-resistance-rated and smoke-resistant assemblies, whether indicated on drawings or not, and other openings indicated.

1.02 RELATED REQUIREMENTS

- A. Section 017300 - Execution: Cutting and patching.
- B. Section 092116 - Gypsum Board Assemblies: Gypsum wallboard fireproofing.

1.03 REFERENCE STANDARDS

- A. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2023a.
- C. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems; 2015 (Reapproved 2019).
- D. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestop Systems; 2020a.
- E. ASTM E2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers; 2020a.
- F. ASTM E2307 - Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-story Test Apparatus; 2023b.
- G. ITS (DIR) - Directory of Listed Products; Current Edition.
- H. FM 4991 - Approval Standard of Firestop Contractors; 2013.
- I. FM (AG) - FM Approval Guide; Current Edition.
- J. SCAQMD 1168 - Adhesive and Sealant Applications; 1989, with Amendment (2022).
- K. UL 1479 - Standard for Fire Tests of Penetration Firestops; Current Edition, Including All Revisions.
- L. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems; Current Edition, Including All Revisions.
- M. UL (DIR) - Online Certifications Directory; Current Edition.
- N. UL (FRD) - Fire Resistance Directory; Current Edition.

1.04 SUBMITTALS

- A. See Section 013300 - Submittal Procedures.
- B. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.
- C. Product Data: Provide data on product characteristics, performance ratings, and limitations.
- D. Sustainable Design Submittal: Submit VOC content documentation for nonpreformed materials.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Manufacturer's qualification statement.
- G. Installer's qualification statement.

078400
FIRESTOPPING

1.05 QUALITY ASSURANCE

- A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
 - 1. Listing in UL (FRD) will be considered as constituting an acceptable test report.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Installer Qualifications: Company specializing in performing the work of this section and:
 - 1. Trained by manufacturer.
 - 2. Approved by Factory Mutual Research Corporation under FM 4991, or meeting any two of the following requirements:
 - 3. Verification of minimum three years documented experience installing work of this type.
 - 4. Verification of at least five satisfactorily completed projects of comparable size and type.
 - 5. Licensed by local authorities having jurisdiction (AHJ).

1.06 FIELD CONDITIONS

- A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Firestopping Manufacturers:
 - 1. 3M Fire Protection Products: www.3m.com/firestop/#sle.
 - 2. Hilti, Inc: www.us.hilti.com/#sle.
 - 3. RectorSeal, a CSW Industrials Company; Metacaulk 150+ General Purpose Firestop Sealant: www.rectorseal.com/firestop-solutions/#sle.
 - 4. Tremco Commercial Sealants & Waterproofing; TREMstop Acrylic: www.tremcosealants.com/#sle.
 - 5. Substitutions: See Section 016000 - Product Requirements.

2.02 MATERIALS

- A. Firestopping Materials: Any materials meeting requirements.
- B. Volatile Organic Compound (VOC) Content: Provide products having VOC content lower than that required by SCAQMD 1168.
- C. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.
- D. Fire Ratings: Refer to drawings for required systems and ratings.

2.03 FIRESTOPPING ASSEMBLY REQUIREMENTS

- A. Perimeter Fire Containment Firestopping: Use system that has been tested according to ASTM E2307 to have fire resistance F Rating equal to required fire rating of floor assembly.
 - 1. Movement: Provide systems that have been tested to show movement capability as indicated.
- B. Floor-to-Floor (FF), Floor-to-Wall (FW), Head-of-Wall (HW), and Wall-to-Wall (WW) Joints, Except Perimeter, Where Both Are Fire-Rated: Use system that has been tested according to ASTM E1966 or UL 2079 to have fire resistance F Rating equal to required fire rating of the assembly in which the joint occurs.
 - 1. Listing by FM (AG), ITS (DIR), UL (DIR), or UL (FRD) in their certification directories will be considered evidence of successful testing.
- C. Through Penetration Firestopping: Use system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.

078400
FIRESTOPPING

1. Listing by FM (AG), ITS (DIR), UL (DIR), or UL (FRD) in their certification directories will be considered evidence of successful testing.

2.04 FIRESTOPPING FOR PERIMETER CONTAINMENT

- A. Perimeter Joint Systems That Have Not Been Tested For Movement Capabilities (Static-S):
 1. 2 Hour Construction: UL System CW-S-2015; RectorSeal MetaCaulk 1200 Spray.
 2. 2 Hour Construction: UL System CW-S-2017; RectorSeal MetaCaulk 1200 Spray.
- B. Perimeter Joint Systems That Have Movement Capabilities (Dynamic-D):
 1. 2 Hour Construction: Intertek System BP-120-03; RectorSeal MetaCaulk 1200 Spray.
 2. 2 Hour Construction: Intertek System BP-120-05; RectorSeal MetaCaulk 1200 Spray.
 3. 2 Hour Construction: Intertek System BP-120-09; RectorSeal MetaCaulk 1200 Spray.
 4. 2 Hour Construction: Intertek System BP-120-12; RectorSeal MetaCaulk 1200 Spray.
 5. 2 Hour Construction: UL System CW-D-2014; RectorSeal MetaCaulk 1200 Spray.
 6. 2 Hour Construction: UL System CW-D-2016; RectorSeal MetaCaulk 1200 Spray.
 7. 2 Hour Construction: UL System CW-D-2018; RectorSeal MetaCaulk 1200 Spray.
 8. 2 Hour Construction: UL System CW-D-2047; RectorSeal MetaCaulk 1200 Spray.
 9. 2 Hour Construction: UL System CW-D-2049; RectorSeal MetaCaulk 1200 Spray.

2.05 FIRESTOPPING FOR FLOOR-TO-FLOOR, FLOOR-TO-WALL, HEAD-OF-WALL, AND WALL-TO-WALL JOINTS

- A. Concrete and Concrete Masonry Walls and Floors:
 1. Floor-to-Floor Joints:
 - a. 4 Hour Construction: UL System FF-D-0023; RectorSeal MetaCaulk 150+.
 - b. 3 Hour Construction: UL System FF-D-1024; RectorSeal MetaCaulk 1200 Spray.
 - c. 3 Hour Construction: UL System FF-D-1027; RectorSeal MetaCaulk 150+.
 - d. 3 Hour Construction: UL System FF-D-1077; RectorSeal MetaCaulk 835+.
 - e. 2 Hour Construction: UL System FF-D-0024; RectorSeal MetaCaulk 150+.
 - f. 2 Hour Construction: UL System FF-D-0053; RectorSeal MetaCaulk Joint Strip.
 - g. 2 Hour Construction: UL System FF-D-0084; RectorSeal MetaCaulk Joint Strip.
 - h. 2 Hour Construction: UL System FF-D-1013; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
 - i. 2 Hour Construction: UL System FF-D-1085; Tremco, TREMstop Acrylic Firestop Sealant.
 2. Head-of-Wall Joints at Concrete/Concrete Masonry Wall to Concrete Over Metal Deck Floor:
 - a. 2 Hour Construction: UL System HW-D-0058; RectorSeal MetaCaulk 1200 Spray.
 - b. 2 Hour Construction: UL System HW-D-0149; RectorSeal MetaCaulk 150+.
 - c. 2 Hour Construction: UL System HW-D-0181; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
 - d. 2 Hour Construction: UL System HW-D-1037; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
 3. Head-of-Wall Joints at Concrete/Concrete Masonry Wall to Concrete Floor:
 - a. 3 Hour Construction: UL System HW-D-1058; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
 - b. 3 Hour Construction: UL System HW-D-0166; RectorSeal MetaCaulk 1200 Spray.
 - c. 2 Hour Construction: UL System HW-D-0268; Hilti CP 606 Flexible Firestop Sealant.
 - d. 2 Hour Construction: UL System HW-D-0312; Specified Technologies Inc. SIL Silicone Sealant.
 4. Concrete/Concrete Masonry Wall-to-Wall Joint Systems That Have Not Been Tested For Movement Capabilities (Static-S):
 - a. 2 Hour Construction: UL System WW-S-1025; RectorSeal MetaCaulk 835+.
 - b. 2 Hour Construction: UL System WW-S-1038; RectorSeal MetaCaulk 835+.

078400
FIRESTOPPING

5. Concrete/Concrete Masonry Wall-to-Wall Joint Systems That Have Movement Capabilities (Dynamic-D):
 - a. 4 Hour Construction: UL System WW-D-0054; RectorSeal MetaCaulk Joint Strip.
 - b. 3 Hour Construction: UL System WW-D-0023; RectorSeal MetaCaulk 1200 Spray.
 - c. 3 Hour Construction: UL System WW-D-0095; RectorSeal MetaCaulk 150+.
 - d. 3 Hour Construction: UL System WW-D-1028; RectorSeal MetaCaulk 1200 Spray.
 - e. 2 Hour Construction: UL System WW-D-0025; RectorSeal MetaCaulk 1200 Spray.
 - f. 2 Hour Construction: UL System WW-D-0027; RectorSeal MetaCaulk 150+.
 - g. 2 Hour Construction: UL System WW-D-0110; RectorSeal MetaCaulk 150+.
 - h. 2 Hour Construction: UL System WW-D-1077; Tremco, TREMstop Acrylic Firestop Sealant.
 - i. 2 Hour Construction: UL System WW-D-0017; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
 - j. 2 Hour Construction: UL System WW-D-0032; Hilti CP 606 Flexible Firestop Sealant.
- B. Gypsum Board Walls:
 1. Wall-to-Wall Joints That Have Not Been Tested For Movement Capabilities (Static-S):
 - a. 2 Hour Construction: UL System WW-S-0089; RectorSeal MetaCaulk 150+.
 2. Wall-to-Wall Joints That Have Movement Capabilities (Dynamic-D):
 - a. 3 Hour Construction: UL System WW-D-0101; RectorSeal MetaCaulk 150+.
 - b. 2 Hour Construction: UL System WW-D-0067; Hilti CP 606 Flexible Firestop Sealant.
 - c. 1 Hour Construction: UL System WW-D-0067; Hilti CP 606 Flexible Firestop Sealant.
 3. Head-of-Wall Joints at Underside of Steel Beam and Concrete Over Metal Deck Floor with Sprayed On Fireproofing:
 - a. 2 Hour Construction: UL System HW-D-0259; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
 - b. 1 Hour Construction: UL System HW-D-0259; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
 4. Head-of-Wall Joints at Underside of Flat Concrete:
 - a. 4 Hour Construction: UL System HW-D-0108; RectorSeal MetaCaulk 1200 Spray.
 - b. 2 Hour Construction: UL System HW-D-0798; RectorSeal Blaze Foam.
 - c. 2 Hour Construction: UL System HW-D-1068; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
 - d. 2 Hour Construction: UL System HW-D-0757; Hilti CFS-TTS Top Track Seal.
 - e. 2 Hour Construction: UL System HW-D-0016; Tremco, TREMstop Acrylic Firestop Sealant.
 - f. 2 Hour Construction: UL System HW-D-0017; Tremco, TREMstop Acrylic Firestop Sealant.
 - g. 2 Hour Construction: UL System HW-D-1072; Tremco, TREMstop Acrylic Firestop Sealant.
 - h. 1 Hour Construction: UL System HW-D-1068; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
 - i. 1 Hour Construction: UL System HW-D-0757; Hilti CFS-TTS Top Track Seal.
 - j. 1 Hour Construction: UL System HW-D-0016; Tremco, TREMstop Acrylic Firestop Sealant.
 5. Head-of-Wall Joints at Concrete Over Metal Deck:
 - a. 2 Hour Construction: UL System HW-D-0144; RectorSeal MetaCaulk 150+.
 - b. 2 Hour Construction: UL System HW-D-0256; Tremco, TREMstop Acrylic Firestop Sealant.
 - c. 1 Hour Construction: UL System HW-D-0256; Tremco, TREMstop Acrylic Firestop Sealant.
 6. Head-of-Wall Joints at Concrete Over Metal Deck, Wall Parallel to Ribs:

078400
FIRESTOPPING

- a. 2 Hour Construction: UL System HW-D-0049; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
- b. 2 Hour Construction: UL System HW-D-0184; Hilti CP 606 Flexible Firestop Sealant.
- c. 1 Hour Construction: UL System HW-D-0049; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
- d. 1 Hour Construction: UL System HW-D-0184; Hilti CP 606 Flexible Firestop Sealant.
- 7. Head-of-Wall Joints at Concrete Over Metal Deck, Wall Perpendicular to Ribs, Cut to Fit Ribs:
 - a. 2 Hour Construction: UL System HW-D-0045; Hilti CP 606 Flexible Firestop Sealant.
 - b. 1 Hour Construction: UL System HW-D-0045; Hilti CP 606 Flexible Firestop Sealant.
- 8. Head-of-Wall Joints at Concrete Over Metal Deck, Wall Perpendicular to Ribs, Not Cut to Fit:
 - a. 2 Hour Construction: UL System HW-D-0042; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
 - b. 2 Hour Construction: UL System HW-D-0045; Hilti CP 606 Flexible Firestop Sealant.
 - c. 1 Hour Construction: UL System HW-D-0042; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
 - d. 1 Hour Construction: UL System HW-D-0045; Hilti CP 606 Flexible Firestop Sealant.

2.06 FIRESTOPPING FOR FLOOR-TO-WALL MOVABLE JOINTS

- A. Floor-To-Wall Joint System That Have Movement Capabilities (Dynamic-D):
 - 1. 2 Hour Construction: UL System FW-D-1069; Tremco, TREMstop Acrylic Firestop Sealant.

2.07 FIRESTOPPING PENETRATIONS THROUGH CONCRETE AND CONCRETE MASONRY CONSTRUCTION

- A. Blank Openings:
 - 1. In Floors or Walls:
 - a. 4 Hour Construction: UL System C-AJ-0042; RectorSeal MetaCaulk Fire Rated Mortar.
 - b. 4 Hour Construction: UL System C-AJ-0088; RectorSeal MetaCaulk Composite Sheet.
 - c. 3 Hour Construction: UL System C-AJ-0045; RectorSeal MetaCaulk Fire Rated Putty.
 - d. 2 Hour Construction: UL System C-AJ-0090; Hilti FS-ONE MAX Intumescent Firestop Sealant.
- B. Penetrations Through Floors or Walls By:
 - 1. Multiple Penetrations in Large Openings:
 - a. 3 Hour Construction: UL System C-AJ-8047; RectorSeal MetaCaulk 1000.
 - b. 3 Hour Construction: UL System C-AJ-8099; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - c. 3 Hour Construction: UL System C-AJ-8110; Hilti CFS-BL Firestop Block.
 - d. 3 Hour Construction: UL System C-AJ-8133; RectorSeal Fire Rated Mortar.
 - e. 2 Hour Construction: UL System C-AJ-8143; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - f. 2 Hour Construction: UL System C-AJ-8042; RectorSeal MetaCaulk 1000.
 - g. 2 Hour Construction: UL System C-AJ-8129; RectorSeal MetaCaulk 1200 Spray.
 - h. 2 Hour Construction: UL System C-AJ-8149; RectorSeal MetaCaulk 1000.
 - i. 2 Hour Construction: UL System C-AJ-8171; RectorSeal MetaCaulk Wrap Strip.
 - 2. Bathtub Drains:
 - a. Up to 3 Hour Construction: UL System F-A-1037, F-A-1038, F-A-2094, or F-A-2095; Hilti CP 681 Tub Box Kit.
 - 3. Uninsulated Metallic Pipe, Conduit, and Tubing:

078400
FIRESTOPPING

- a. 3 Hour Construction: UL System C-AJ-1076; RectorSeal MetaCaulk 950.
- b. 3 Hour Construction: UL System C-AJ-1184; Hilti FS-ONE MAX Intumescent Firestop Sealant.
- c. 3 Hour Construction: UL System C-AJ-1226; Hilti FS-ONE MAX Intumescent Firestop Sealant.
- d. 3 Hour Construction: UL System C-AJ-1261; RectorSeal MetaCaulk 1000.
- e. 3 Hour Construction: UL System C-AJ-1320; RectorSeal MetaCaulk 1000.
- f. 3 Hour Construction: UL System C-AJ-1421; Hilti FS-ONE MAX Intumescent Firestop Sealant or CP 604 Self-Leveling Firestop Sealant.
- g. 3 Hour Construction: UL System C-AJ-1425; Hilti CFS-S SIL GG Firestop Silicone Sealant Gun-Grade.
- h. 2 Hour Construction: UL System C-AJ-1036; RectorSeal MetaCaulk 950.
- i. 2 Hour Construction: UL System C-AJ-1090; Specified Technologies Inc. SSP Firestop Putty.
- j. 2 Hour Construction: UL System C-AJ-1186; RectorSeal MetaCaulk 950.
- k. 2 Hour Construction: UL System C-AJ-1226; Hilti FS-ONE MAX Intumescent Firestop Sealant.
- l. 2 Hour Construction: UL System C-AJ-1425; Hilti CFS-S SIL GG Firestop Silicone Sealant Gun-Grade.
- m. 1 Hour Construction: UL System C-AJ-1039; RectorSeal MetaCaulk 950.
- 4. Uninsulated Non-Metallic Pipe, Conduit, and Tubing:
 - a. 3 Hour Construction: UL System C-AJ-2109; Hilti CP 643N/644 Firestop Collar.
 - b. 3 Hour Construction: UL System C-AJ-2151; RectorSeal MetaCaulk 1200.
 - c. 3 Hour Construction: UL System C-AJ-2220; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - d. 3 Hour Construction: UL System C-AJ-2342; Hilti CP-E/S Firestop Wrap Strip.
 - e. 3 Hour Construction: UL System C-AJ-2661; RectorSeal MetaCaulk 1000.
 - f. 2 Hour Construction: UL System C-AJ-2047; RectorSeal MetaCaulk 1000.
 - g. 2 Hour Construction: UL System C-AJ-2167; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - h. 2 Hour Construction: UL System C-AJ-2109; Hilti CP 643N/644 Firestop Collar.
 - i. 2 Hour Construction: UL System C-AJ-2348; RectorSeal MetaCaulk 150+.
 - j. 2 Hour Construction: UL System C-AJ-2707; RectorSeal MetaCaulk 1000.
 - k. 2 Hour Construction: UL System C-BJ-2021; Hilti CP 643N Firestop Collar.
- 5. Electrical Cables Not In Conduit:
 - a. 3 Hour Construction: UL System C-AJ-3095; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - b. 3 Hour Construction: UL System C-AJ-3208; Hilti CP 618 Firestop Putty Stick.
 - c. 2 Hour Construction: UL System C-AJ-3216; Hilti CFS-PL Firestop Plug.
 - d. 2 Hour Construction: UL System C-AJ-3283; Hilti CP653 Speed Sleeve.
 - e. 2 Hour Construction: UL System C-AJ-3283; Hilti CFS-SL SK Firestop Sleeve Kit.
 - f. 2 Hour Construction: UL System C-AJ-3283; Hilti CFS-SL SK Firestop Sleeve Kit with Hilti CFS-SL GP Gangplate.
 - g. 2 Hour Construction: UL System W-J-3198; Hilti CFS-SL RK Retrofit Sleeve Kit for Existing Cables.
 - h. 2 Hour Construction: UL System W-J-3199; Hilti CFS-SL SK Firestop Sleeve Kit.
- 6. Cable Trays with Electrical Cables:
 - a. 3 Hour Construction: UL System C-AJ-4093; Hilti CFS-BL Firestop Block.
 - b. 2 Hour Construction: UL System C-AJ-4094; Hilti CFS-BL Firestop Block.
- 7. Electrical Busways:
 - a. 3 Hour Construction: UL System C-AJ-6017; Hilti FS-ONE MAX Intumescent Firestop Sealant.

078400
FIRESTOPPING

8. Insulated Pipes:
 - a. 3 Hour Construction: UL System C-AJ-5090; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - b. 2 Hour Construction: UL System C-AJ-5048; Hilti FS-ONE MAX Intumescent Firestop Sealant, CP 606 Flexible Firestop Sealant, CP 601S Elastomeric Firestop Sealant, CP 604 Self-Leveling Firestop Sealant or CFS-S SIL GG Firestop Silicone Sealant Gun-Grade.
 - c. 2 Hour Construction: UL System C-AJ-5091; Hilti FS-ONE IMAX Intumescent Firestop Sealant.
9. HVAC Ducts, Uninsulated:
 - a. 3 Hour Construction: UL System C-AJ-7051; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - b. 2 Hour Construction: UL System C-AJ-7111; Hilti FS-ONE MAX Intumescent Firestop Sealant.
- C. Penetrations Through Floors By:
 1. Multiple Penetrations in Large Openings:
 - a. 4 Hour Construction: UL System F-A-0019; RectorSeal Cast-in-Place Firestop Device.
 - b. 3 Hour Construction: UL System F-A-1224; Hilti CFS-CID U Firestop Cast-In Device.
 - c. 2 Hour Construction: UL System F-A-0021; RectorSeal Cast-in-Place Firestop Device.
 - d. 2 Hour Construction: UL System F-A-8012; Hilti CFS-S SIL GG Firestop Silicone Sealant Gun-Grade or CFS-S SIL SL Firestop Silicone Sealant Self-Leveling.
 2. Uninsulated Metallic Pipe, Conduit, and Tubing:
 - a. 2 and 3 Hour Construction: UL System F-A-1222; Hilti CFS-CID U Firestop Cast-In Device.
 3. Uninsulated Non-Metallic Pipe, Conduit, and Tubing:
 - a. 2 and 3 Hour Construction: UL System F-A-2411; Hilti CFS-CID U Firestop Cast-In Device.
 - b. 2 and 3 Hour Construction: UL System F-A-2412; Hilti CFS-CID U Firestop Cast-In Device.
 - c. 3 Hour Construction: UL System F-A-2213; Hilti CFS-DID Drop-In Device.
 - d. 2 Hour Construction: UL System F-A-2213; Hilti CFS-DID Drop-In Device.
 4. Electrical Cables Not In Conduit:
 - a. 2 and 3 Hour Construction: UL System F-A-3091; Hilti CFS-CID U Firestop Cast-In Device.
 5. Electrical Busways:
 - a. 3 Hour Construction: UL System C-AJ-6017; Hilti CFS-S SIL GG Firestop Silicone Sealant Gun-Grade or CFS-S SIL SL Firestop Silicone Sealant Self-Leveling.
 - b. 2 Hour Construction: UL System F-A-6002; Hilti CP 604 Self-Leveling Firestop Sealant.
 6. Insulated Pipes:
 - a. 2 and 3 Hour Construction: UL System F-A-5083; Hilti CFS-CID U Firestop Cast-In Device.
 - b. 2 and 3 Hour Construction: UL System F-A-5084; Hilti CFS-CID U Firestop Cast-In Device.
- D. Penetrations Through Walls By:
 1. Uninsulated Metallic Pipe, Conduit, and Tubing:
 - a. 2 Hour Construction: UL System W-J-1067; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - b. 1 Hour Construction: UL System W-J-1067; Hilti FS-ONE MAX Intumescent Firestop Sealant.

078400
FIRESTOPPING

2. Electrical Cables Not In Conduit:
 - a. 2 Hour Construction: UL System C-AJ-3095; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - b. 2 Hour Construction: UL System C-AJ-3216; Hilti CFS-PL Firestop Plug.
3. Insulated Pipes:
 - a. 2 Hour Construction: UL System C-AJ-5090; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - b. 2 Hour Construction: UL System C-AJ-5091; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - c. 1 Hour Construction: UL System C-AJ-5090; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - d. 1 Hour Construction: UL System C-AJ-5091; Hilti FS-ONE MAX Intumescent Firestop Sealant.
4. HVAC Ducts, Uninsulated:
 - a. 2 Hour Construction: UL System W-J-7109; Hilti FS-ONE MAX Intumescent Firestop Sealant, or CP 606 Flexible Firestop Sealant.
5. HVAC Ducts, Insulated:
 - a. 2 Hour Construction: UL System W-J-7112; Hilti FS-ONE MAX Intumescent Firestop Sealant.

2.08 FIRESTOPPING PENETRATIONS THROUGH GYPSUM BOARD WALLS

- A. Blank Openings:
 1. 2 Hour Construction: UL System W-L-3334; Hilti CP 653 Speed Sleeve.
 2. 1 Hour Construction: UL System W-L-3334; Hilti CP 653 Speed Sleeve.
- B. Penetrations By:
 1. Multiple Penetrations in Large Openings:
 - a. 2 Hour Construction: UL System W-L-1408; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - b. 2 Hour Construction: UL System W-L-8013; Hilti CFS-BL Firestop Block.
 - c. 2 Hour Construction: UL System W-L-8071; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - d. 2 Hour Construction: UL System W-L-8079; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - e. 1 Hour Construction: UL System W-L-1408; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - f. 1 Hour Construction: UL System W-L-8013; Hilti CFS-BL Firestop Block.
 - g. 1 Hour Construction: UL System W-L-8071; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - h. 1 Hour Construction: UL System W-L-8073; Specified Technologies Inc. Composite Sheet.
 - i. 1 Hour Construction: UL System W-L-8079; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 2. Uninsulated Metallic Pipe, Conduit, and Tubing:
 - a. 2 Hour Construction: UL System W-L-1054; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - b. 2 Hour Construction: UL System W-L-1164; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - c. 2 Hour Construction: UL System W-L-1506; Hilti CFS-D Firestop Cable Disc.
 - d. 1 Hour Construction: UL System W-L-1054; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - e. 1 Hour Construction: UL System W-L-1164; Hilti FS-ONE MAX Intumescent Firestop Sealant.

078400
FIRESTOPPING

- f. 1 Hour Construction: UL System W-L-1506; Hilti CFS-D Firestop Cable Disc.
- 3. Uninsulated Non-Metallic Pipe, Conduit, and Tubing:
 - a. 2 Hour Construction: UL System W-L-2078; Hilti CP 643N/644 Firestop Collar.
 - b. 2 Hour Construction: UL System W-L-2128; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - c. 1 Hour Construction: UL System W-L-2078; Hilti CP 643N/644 Firestop Collar.
 - d. 1 Hour Construction: UL System W-L-2128; Hilti FS-ONE MAX Intumescent Firestop Sealant.
- 4. Electrical Cables Not In Conduit:
 - a. 2 Hour Construction: UL System W-L-3065; Hilti FS-ONE MAX Intumescent Firestop Sealant, CP 606 Flexible Firestop Sealant, CD 601S Elastomeric Firestop Sealant, or CP 618 Firestop Putty Stick.
 - b. 2 Hour Construction: UL System W-L-3334; Hilti CP 653 Speed Sleeve.
 - c. 2 Hour Construction: UL System W-L-3393; Hilti CFS-SL RK Retrofit Sleeve Kit for Existing Cables.
 - d. 2 Hour Construction: UL System W-L-3395; Hilti CP653 Speed Sleeve.
 - e. 2 Hour Construction: UL System W-L-3395; Hilti CFS-SL SK Firestop Sleeve Kit.
 - f. 2 Hour Construction: UL System W-L-3395; Hilti CFS-SL SK Firestop Sleeve Kit with Hilti CFS-SL GP Gangplate.
 - g. 2 Hour Construction: UL System W-L-3414; Hilti CFS-D Firestop Cable Disc.
 - h. 1 Hour Construction: UL System W-L-3065; Hilti FS-ONE MAX Intumescent Firestop Sealant, CP 606 Flexible Firestop Sealant, CD 601S Elastomeric Firestop Sealant, or CP 618 Firestop Putty Stick.
 - i. 1 Hour Construction: UL System W-L-3334; Hilti CP 653 Speed Sleeve.
 - j. 1 Hour Construction: UL System W-L-3393; Hilti CFS-SL RK Retrofit Sleeve Kit for Existing Cables.
 - k. 1 Hour Construction: UL System W-L-3414; Hilti CFS-D Firestop Cable Disc.
- 5. Cable Trays with Electrical Cables:
 - a. 2 Hour Construction: UL System W-L-4011; Hilti CFS-BL Firestop Block.
 - b. 2 Hour Construction: UL System W-L-4060; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - c. 1 Hour Construction: UL System W-L-4011; Hilti CFS-BL Firestop Block.
 - d. 1 Hour Construction: UL System W-L-4060; Hilti FS-ONE MAX Intumescent Firestop Sealant.
- 6. Insulated Pipes:
 - a. 2 Hour Construction: UL System W-L-5028; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - b. 2 Hour Construction: UL System W-L-5029; Hilti FS-ONE Intumescent Firestop Sealant.
 - c. 1 Hour Construction: UL System W-L-5028; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - d. 1 Hour Construction: UL System W-L-5029; Hilti FS-ONE Intumescent Firestop Sealant.
- 7. HVAC Ducts, Insulated:
 - a. 2 Hour Construction: UL System W-L-7156; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - b. 1 Hour Construction: UL System W-L-7156; Hilti FS-ONE MAX Intumescent Firestop Sealant.

2.09 FIRESTOPPING SYSTEMS

- A. Firestopping: Any material meeting requirements.

078400
FIRESTOPPING

1. Fire Ratings: Use system that is listed by UL (FRD) and tested in accordance with ASTM E814, ASTM E119, or UL 1479 with F Rating equal to fire rating of penetrated assembly and minimum T Rating Equal to F Rating and in compliance with other specified requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify openings are ready to receive the work of this section.

3.02 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.
- B. Remove incompatible materials that could adversely affect bond.
- C. Install backing materials to prevent liquid material from leakage.

3.03 INSTALLATION

- A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
- B. Do not cover installed firestopping until inspected by authorities having jurisdiction.
- C. Install labeling required by code.

3.04 FIELD QUALITY CONTROL

- A. Independent Testing Agency: Inspection agency employed and paid by Owner, will examine penetration firestopping in accordance with ASTM E2174 and ASTM E2393.
- B. Repair or replace penetration firestopping and joints at locations where inspection results indicate firestopping or joints do not meet specified requirements.

3.05 CLEANING

- A. Clean adjacent surfaces of firestopping materials.

3.06 PROTECTION

- A. Protect adjacent surfaces from damage by material installation.

END OF SECTION 078400

SECTION 079200 JOINT SEALANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Nonsag gunnable joint sealants.
- B. Joint backings and accessories.
- C. Contractor provided field quality control.

1.02 RELATED REQUIREMENTS

- A. Section 092116 - Gypsum Board Assemblies: Sealing acoustical and sound-rated walls and ceilings.

1.03 REFERENCE STANDARDS

- A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer; 2015 (Reapproved 2022).
- B. ASTM C794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants; 2018 (Reapproved 2022).
- C. ASTM C834 - Standard Specification for Latex Sealants; 2017 (Reapproved 2023).
- D. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications; 2022.
- E. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- F. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems; 2023.
- G. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).
- H. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants; 2022.
- I. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants; 2023.
- J. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints; 2019 (Reapproved 2020).

1.04 SUBMITTALS

- A. See Section 013300 Submittal Procedures, for submittal procedures.
- B. Product Data: Submit manufacturer's technical datasheets for each product to be used; include the following:
 - 1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
 - 2. List of backing materials approved for use with the specific product.
 - 3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
 - 4. Substrates the product should not be used on.
 - 5. Substrates for which use of primer is required.
 - 6. Substrates for which laboratory adhesion and/or compatibility testing is required.
 - 7. Installation instructions, including precautions, limitations, and recommended backing materials and tools.
 - 8. Sample product warranty.
 - 9. Certification by manufacturer indicating that product complies with specification requirements.
- C. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.

079200
JOINT SEALANTS

- D. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.
- E. Preconstruction Laboratory Test Reports: Submit at least four weeks prior to start of installation.
- F. Preinstallation Field Adhesion Test Plan: Submit at least two weeks prior to start of installation.
- G. Preinstallation Field Adhesion Test Reports: Submit filled out Preinstallation Field Adhesion Test Reports log within 10 days after completion of tests; include bagged test samples and photographic records.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section and with at least three years of documented experience.
- C. Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.
 - 1. Adhesion Testing: In accordance with ASTM C794.
 - 2. Compatibility Testing: In accordance with ASTM C1087.
 - 3. Allow sufficient time for testing to avoid delaying the work.
 - 4. Deliver sufficient samples to manufacturer for testing.
 - 5. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.
- D. Preinstallation Field Adhesion Test Plan: Include destructive field adhesion testing of one sample of each combination of sealant type and substrate, except interior acrylic latex sealants, and include the following for each tested sample.
 - 1. Identification of testing agency.
 - 2. Preinstallation Field Adhesion Test Log Form: Include the following data fields, with known information filled out.
 - a. Test date.
 - b. Copy of test method documents.
 - c. Age of sealant upon date of testing.
 - d. Test results, modeled after the sample form in the test method document.
 - e. Indicate use of photographic record of test.
- E. Field Adhesion Test Procedures:
 - 1. Allow sealants to fully cure as recommended by manufacturer before testing.
 - 2. Have a copy of the test method document available during tests.
 - 3. Record the type of failure that occurred, other information required by test method, and the information required on the Field Quality Control Log.
 - 4. When performing destructive tests, also inspect the opened joint for proper installation characteristics recommended by manufacturer, and report any deficiencies.
 - 5. Deliver the samples removed during destructive tests in separate sealed plastic bags, identified with project, location, test date, and test results, to Owner.
 - 6. If any combination of sealant type and substrate does not show evidence of minimum adhesion or shows cohesion failure before minimum adhesion, report results to Architect.
- F. Destructive Field Adhesion Test: Test for adhesion in accordance with ASTM C1521, using Destructive Tail Procedure.
 - 1. Sample: At least 18 inches long.

079200
JOINT SEALANTS

2. Minimum Elongation Without Adhesive Failure: Consider the tail at rest, not under any elongation stress; multiply the stated movement capability of the sealant in percent by two; then multiply 1 inch by that percentage; if adhesion failure occurs before the 1-inch mark is that distance from the substrate, the test has failed.
3. If either adhesive or cohesive failure occurs before minimum elongation, take necessary measures to correct conditions and retest; record each modification to products or installation procedures.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Nonsag Sealants:
 1. Dow Chemical Company: consumer.dow.com/en-us/industry/ind-building-construction.html/#sle.
 2. Hilti, Inc: www.us.hilti.com/#sle.
 3. Master Builders Solutions by BASF: www.master-builders-solutions.basf.us/en-us/#sle.
 4. Pecora Corporation: www.pecora.com/#sle.
 5. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
 6. Tremco Commercial Sealants & Waterproofin: www.tremcosealants.com/#sle.
 7. Substitutions: See Section 016000 - Product Requirements.

2.02 JOINT SEALANT APPLICATIONS

- A. Scope:
 1. Exterior Joints: Seal open joints, whether or not the joint is indicated on drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to, the following items.
 - a. Wall expansion and control joints.
 - b. Joints between door, window, and other frames and adjacent construction.
 - c. Joints between different exposed materials.
 - d. Openings below ledge angles in masonry.
 - e. Other joints indicated below.
 - f. Joints indicated on Drawings.
 2. Do Not Seal:
 - a. Intentional weep holes in masonry.
 - b. Joints indicated to be covered with expansion joint cover assemblies.
 - c. Joints where sealant is specified to be furnished and installed by manufacturer of product to be sealed.
 - d. Joints where sealant installation is specified in other sections.
 - e. Joints between suspended ceilings and walls.
- B. Exterior Joints: Use non-sag polyurethane sealant, unless otherwise indicated.
- C. Interior Joints: Use non-sag silicone sealant, unless otherwise indicated.
 1. Wall and Ceiling Joints in Non-Wet Areas: Acrylic emulsion latex sealant.
 2. Joints between Fixtures in Wet Areas and Floors, Walls, and Ceilings: Mildew-resistant silicone sealant; white.
 3. In Sound-Rated Assemblies: Acrylic emulsion latex sealant.
- D. Interior Wet Areas: restrooms and food service areas; fixtures in wet areas include plumbing fixtures, countertops, cabinets, and other similar items.
- E. Sound-Rated Assemblies: Walls and ceilings identified as STC-rated, sound-rated, or acoustical.

2.03 JOINT SEALANTS - GENERAL

- A. Colors: Architect to select from manufacturer's standard range..

079200
JOINT SEALANTS

2.04 NONSAG JOINT SEALANTS

- A. Non-Staining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
 - 1. Movement Capability: Plus and minus 50 percent, minimum.
 - 2. Non-Staining To Porous Stone: Non-staining to light-colored masonry when tested in accordance with ASTM C1248.
 - 3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
 - 4. Hardness Range: 15 to 35, Shore A, when tested in accordance with ASTM C661.
 - 5. Color: To be selected by Architect from manufacturer's standard range.
 - 6. Service Temperature Range: Minus 20 to 180 degrees F.
 - 7. Products:
 - a. Dow; DOWSIL 756 SMS Building Sealant: www.dow.com/#sle.
 - b. Dow; DOWSIL 790 Silicone Building Sealant: www.dow.com/#sle.
 - c. Dow; DOWSIL 791 Silicone Weatherproofing Sealant: www.dow.com/#sle.
 - d. Tremco Commercial Sealants & Waterproofing; Spectrem 1: www.tremcosealants.com/#sle.
 - e. Substitutions: See Section 016000 - Product Requirements.
- B. Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Uses M and A; single component, mildew resistant; not expected to withstand continuous water immersion or traffic.
 - 1. Color: White.
- C. Polyurethane Sealant for Continuous Water Immersion: ASTM C920, Grade NS, Uses M and A; single or multi-component; explicitly approved by manufacturer for continuous water immersion; suitable for traffic exposure when recessed below traffic surface.
 - 1. Movement Capability: Plus and minus 35 percent, minimum.
 - 2. Hardness Range: 20 to 35, Shore A, when tested in accordance with ASTM C661.
 - 3. Color: To be selected by Architect from manufacturer's full range.
 - 4. Service Temperature Range: Minus 40 to 180 degrees F.
 - 5. Products:
 - a. Sika Corporation; Sikaflex-1A: usa.sika.com/#sle.
- D. Acrylic Emulsion Latex: Water-based; ASTM C834, single component, nonstaining, nonbleeding, nonsagging; not intended for exterior use.
 - 1. Color: To be selected by Architect from manufacturer's standard range.
 - 2. Grade: ASTM C834; Grade 0 Degrees F (Minus 18 Degrees C).
 - 3. Products:
 - a. Sherwin-Williams Company; 850A Acrylic Latex Caulk: www.sherwin-williams.com/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.

2.05 ACCESSORIES

- A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
 - 1. Type for Joints Not Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type O - Open Cell Polyurethane.
 - 2. Type for Joints Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type B - Bi-Cellular Polyethylene.
 - 3. Open Cell: 40 to 50 percent larger in diameter than joint width.
 - 4. Closed Cell and Bi-Cellular: 25 to 33 percent larger in diameter than joint width.
 - 5. Manufacturers:
 - a. ADFAST Corporation; ADSEAL BR-2600 (Backer Rod): www.adfastcorp.com/#sle.
 - b. Nomaco, Inc: www.nomaco.com/#sle.

079200
JOINT SEALANTS

- c. Substitutions: See Section 016000 - Product Requirements.
- B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that joints are ready to receive work.
- B. Verify that backing materials are compatible with sealants.
- C. Verify that backer rods are of the correct size.
- D. Preinstallation Adhesion Testing: Install a sample for each test location indicated in the test plan.
 - 1. Test each sample as specified in PART 1 under QUALITY ASSURANCE article.
 - 2. Notify Architect of date and time that tests will be performed, at least seven days in advance.
 - 3. Record each test on Preinstallation Adhesion Test Log as indicated.
 - 4. If any sample fails, review products and installation procedures, consult manufacturer, or take other measures that are necessary to ensure adhesion; retest in a different location; if unable to obtain satisfactory adhesion, report to Architect.
 - 5. After completion of tests, remove remaining sample material and prepare joints for new sealant installation.

3.02 PREPARATION

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

3.03 INSTALLATION

- A. Install this work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Provide joint sealant installations complying with ASTM C1193.
- C. Install acoustical sealant application work in accordance with ASTM C919.
- D. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
- E. Install bond breaker backing tape where backer rod cannot be used.
- F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
- G. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.
- H. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

END OF SECTION 079200

079200
JOINT SEALANTS

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SECTION 080671 – DOOR HARDWARE SCHEDULE

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 references specification sections relating to commercial door hardware for the following:
 - 1. Swinging doors.
 - 2. Sliding Doors.
 - 3. Other doors to the extent indicated.
- B. Commercial door hardware includes, but is not necessarily limited to, the following:
 - 1. Mechanical door hardware.
 - 2. Electromechanical and access control door hardware.
 - 3. Electromechanical and access control door hardware power supplies, back-ups and surge protection.
 - 4. Automatic operators.
 - 5. Cylinders specified for doors in other sections.
- C. Related Sections:
 - 1. Division 08 Section "Door Hardware".
- D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
 - 1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
 - 2. ICC/IBC - International Building Code.
 - 3. NFPA 70 - National Electrical Code.
 - 4. NFPA 80 - Fire Doors and Windows.
 - 5. NFPA 101 - Life Safety Code.
 - 6. NFPA 105 - Installation of Smoke Door Assemblies.
 - 7. State Building Codes, Local Amendments.
- E. Standards: Reference Related Sections for requirements regarding compliance with applicable industry standards.

1.3 SUBMITTALS

- A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.
- B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - 1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
 - 2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
 - 3. Content: Include the following information:
 - a. Type, style, function, size, label, hand, and finish of each door hardware item.
 - b. Manufacturer of each item.
 - c. Fastenings and other pertinent information.
 - d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
 - e. Explanation of abbreviations, symbols, and codes contained in schedule.
 - f. Mounting locations for door hardware.
 - g. Door and frame sizes and materials.
 - 4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.
- C. Keying Schedule: Prepared under the supervision of the Owner, separate schedule detailing final keying instructions for locksets and cylinders in writing. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner to approve submitted keying schedule prior to the ordering of permanent cylinders.
- D. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

- E. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Submittals. The manual to include the name, address, and contact information of the manufacturers providing the hardware and their nearest service representatives. The final copies delivered after completion of the installation test to include "as built" modifications made during installation, checkout, and acceptance.
- F. Warranties and Maintenance: Special warranties and maintenance agreements specified in the Related Sections.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.
- B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.
- C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.5 WARRANTY

- A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

1.6 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A. Refer to "PART 3 – EXECUTION" for required specification sections.

PART 3 - EXECUTION

3.1 DOOR HARDWARE SETS

- A. The door hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.
1. Quantities listed are for each pair of doors, or for each single door.
 2. The supplier is responsible for handing and sizing all products.
 3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.
 4. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.
- B. Products listed in the hardware sets shall be supplied by and in accordance with the requirements described in the specification section as noted for each item.
1. Section 08 71 00 – Door Hardware.
- C. Manufacturer's Abbreviations:
1. MK - McKinney
 2. PE - Pemko
 3. RO - Rockwood
 4. YA - ASSA ABLOY ACCENTRA
 5. MC - Medeco
 6. RF - Rixson
 7. OT - Other

Hardware Sets

Set: 1.0

Doors: 116

2 Continuous Hinge	BSPFM__SLF-HD1-M	PE 087100
2 Flush Bolt	555 (12", 72" A.F.F.)	BSP RO 087100

1 Dust Proof Strike	570	BSP	RO 087100
1 Classroom Lock	UCR6 8808RL LC	BSP	YA 087100
1 Cylinder	By Medeco	BB	MC 087100 ⚡
2 Door Stop & Holder	491-RKW	BSP	RO 087100
1 Gasketing	By Alum Storefront Mfr	OT	

Notes: Special closer templating required to allow for 180 degree swing.

Set: 2.0

Doors: 114C, ST0M

6 Hinge, Full Mortise, Hvy Wt	T4A3786 [NRP]	BSP	MK 087100
2 Fire Rated Surf Vert Rod, Passage	7170F90 LBR UC628F ECK1	BSP	YA 087100
2 Surface Closer w/ Stop	4430	BSP	YA 087100
2 Kick Plate	K1050 10" high CSK BEV	BSP	RO 087100
1 Astragal	S771x6BL	PE	087100
1 Gasketing	S88BL	PE	087100

Set: 3.0

Doors: 053

3 Hinge, Full Mortise, Hvy Wt	T4A3786 [NRP]	BSP	MK 087100
1 Fire Rated Rim Exit, Passage	7100F UC628F ECK1	BSP	YA 087100
1 Surface Closer	4400	BSP	YA 087100
1 Kick Plate	K1050 10" high CSK BEV	BSP	RO 087100
1 Wall Stop	409 [OR] 441	BSP	RO 087100
1 Gasketing	S88BL	PE	087100

Notes: ***Where existing doors and/or frames are to remain - field verify that the existing door and/or frame conditions are able to accommodate the above hardware items.***

Set: 4.0

Doors: 115B-1, H119, H121

6 Hinge, Full Mortise	TA2714 [NRP]	BSP	MK 087100
2 Flush Bolt	555 (12", 72" A.F.F.)	BSP	RO 087100
1 Dust Proof Strike	570	BSP	RO 087100
1 Storeroom Lock	UCR6 8805RL LC	BSP	YA 087100
1 Cylinder	By Medeco	BB	MC 087100 ⚡

2 Surf Overhead Stop 10-_36 BSP RF 087100

Set: 5.0

Doors: H109

3 Hinge, Full Mortise	TA2714 [NRP]	BSP	MK	087100
1 Storeroom Lock	UCR6 8805RL LC	BSP	YA	087100
1 Cylinder	By Medeco	BB	MC	087100 ⚡
1 Door Stop & Holder	491-RKW	BSP	RO	087100

Set: 6.0

Doors: 115B-2

3 Hinge, Full Mortise	TA2714 [NRP]	BSP	MK	087100
1 Storeroom Lock	UCR6 8805RL LC	BSP	YA	087100
1 Cylinder	By Medeco	BB	MC	087100 ⚡
1 Surface Closer	4400	BSP	YA	087100
1 Wall Stop	409 [OR] 441	BSP	RO	087100
1 Gasketing	S88BL		PE	087100

Notes: ***Where existing doors and/or frames are to remain - field verify that the existing door and/or frame conditions are able to accommodate the above hardware items.***

Set: 7.0

Doors: C13A, C23A, C33A

3 Hinge, Full Mortise	TA2714 [NRP]	BSP	MK	087100
1 Storeroom Lock	UCR6 8805RL LC	BSP	YA	087100
1 Cylinder	By Medeco	BB	MC	087100 ⚡
1 Surface Closer w/ Stop	4430	BSP	YA	087100
1 Kick Plate	K1050 10" high CSK BEV	BSP	RO	087100
1 Gasketing	S88BL		PE	087100

Set: 8.0

Doors: 120

3 Hinge, Full Mortise	TA2714 [NRP]	BSP	MK	087100
1 Storeroom Lock	UCR6 8805RL LC	BSP	YA	087100
1 Cylinder	By Medeco	BB	MC	087100 ⚡

1 Surf Overhead Stop	10-_36	BSP	RF	087100
1 Surface Closer	4400	BSP	YA	087100
1 Gasketing	S88BL		PE	087100

Notes: ***Where existing doors and/or frames are to remain - field verify that the existing door and/or frame conditions are able to accommodate the above hardware items.***

Set: 9.0

Doors: H120

3 Hinge, Full Mortise	TA2714 [NRP]	BSP	MK	087100
1 Office Lock	UCR6 8807RL LC	BSP	YA	087100
1 Cylinder	By Medeco	BB	MC	087100 ⚡
1 Wall Stop	409 [OR] 441	BSP	RO	087100

Set: 10.0

Doors: H124

6 Hinge, Full Mortise	TA2714 [NRP]	BSP	MK	087100
2 Flush Bolt	555 (12", 72" A.F.F.)	BSP	RO	087100
1 Dust Proof Strike	570	BSP	RO	087100
1 Classroom Lock	UCR6 8808RL LC	BSP	YA	087100
1 Cylinder	By Medeco	BB	MC	087100 ⚡
2 Surf Overhead Stop	10-_36	BSP	RF	087100

Set: 11.0

Doors: 121

6 Hinge, Full Mortise	TA2714 [NRP]	BSP	MK	087100
1 Flush Bolt	2845	BSP	RO	087100
1 Dust Proof Strike	570	BSP	RO	087100
1 Classroom Lock	UCR6 8808RL LC	BSP	YA	087100
1 Cylinder	By Medeco	BB	MC	087100 ⚡
1 Coordinator	2600 Series	Black	RO	087100
2 Surface Closer	4400	BSP	YA	087100
2 Kick Plate	K1050 10" high CSK BEV	BSP	RO	087100
2 Electromagnetic Holder	980M/996M (To Suit)	689	RF	087100 ⚡
1 Astragal	S771x6BL		PE	087100
1 Gasketing	S88BL		PE	087100

Notes: Magnetic hold opens to release upon actuation of fire alarm.

Special closer templating required to allow for 180 degree swing.

Set: 12.0

Doors: [H125](#), [H127](#), [H128](#)

3 Hinge, Full Mortise	TA2714 [NRP]	BSP	MK 087100
1 Classroom Lock	UCR6 8808RL LC	BSP	YA 087100
1 Cylinder	By Medeco	BB	MC 087100 ⚡
1 Wall Stop	409 [OR] 441	BSP	RO 087100

Set: 13.0

Doors: [H126](#), [H131](#)

3 Hinge, Full Mortise	TA2714 [NRP]	BSP	MK 087100
1 Classroom Lock	UCR6 8808RL LC	BSP	YA 087100
1 Cylinder	By Medeco	BB	MC 087100 ⚡
1 Surf Overhead Stop	10-_36	BSP	RF 087100

Set: 14.0

Doors: [H123](#), [H129](#)

3 Hinge, Full Mortise	TA2714 [NRP]	BSP	MK 087100
1 Classroom Lock	UCR6 8808RL LC	BSP	YA 087100
1 Cylinder	By Medeco	BB	MC 087100 ⚡
1 Door Stop & Holder	491-RKW	BSP	RO 087100

Set: 15.0

Doors: H100-A, [H106](#), [H114](#), H118, [H122](#)

3 Hinge, Full Mortise	TA2714 [NRP]	BSP	MK 087100
1 Classroom Lock	UCR6 8808RL LC	BSP	YA 087100
1 Cylinder	By Medeco	BB	MC 087100 ⚡
1 Surface Closer w/ Holder	4410	BSP	YA 087100
1 Kick Plate	K1050 10" high CSK BEV	BSP	RO 087100

Notes: ***Where existing doors and/or frames are to remain - field verify that the existing door and/or frame conditions are able to accommodate the above hardware items.***

Set: 16.0

Doors: [H130](#)

3 Hinge, Full Mortise	TA2714 [NRP]	BSP	MK 087100
1 Privacy Lock	UCR6 8802RL V21	BSP	YA 087100
1 Door Stop & Holder	491-RKW	BSP	RO 087100
1 Gasketing	S88BL		PE 087100

Set: 17.0

Doors: [C13B](#), [C23B](#), [C33B](#)

3 Hinge, Full Mortise	TA2714 [NRP]	BSP	MK 087100
1 Passage Latch	UCR6 8801RL	BSP	YA 087100
1 Surf Overhead Stop	10-_36	BSP	RF 087100

Set: 18.0

Doors: [H115](#), [H116](#)

3 Hinge, Full Mortise	TA2714 [NRP]	BSP	MK 087100
1 Passage Latch	UCR6 8801RL	BSP	YA 087100
1 Surface Closer	4400	BSP	YA 087100
1 Kick Plate	K1050 10" high CSK BEV	BSP	RO 087100
1 Door Stop & Holder	491-RKW	BSP	RO 087100
1 Gasketing	S88BL		PE 087100

Set: 19.0

Doors: [H117](#)

3 Hinge, Full Mortise	TA2714 [NRP]	BSP	MK 087100
1 Passage Latch	UCR6 8801RL	BSP	YA 087100
1 Surface Closer w/ Holder	4410	BSP	YA 087100
1 Kick Plate	K1050 10" high CSK BEV	BSP	RO 087100
1 Gasketing	S88BL		PE 087100

Set: 20.0

Doors: [C11](#), [C12](#), [C21](#), [C22](#), [C31](#), [C32](#)

3 Hinge, Full Mortise	TA2714 [NRP]	BSP	MK 087100
1 Passage Latch	UCR6 8801RL	BSP	YA 087100

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West Campus Renovations
080671 - 10

1 Surface Closer w/ Stop	4430	BSP	YA	087100
1 Kick Plate	K1050 10" high CSK BEV	BSP	RO	087100
1 Gasketing	S88BL		PE	087100

Set: 21.0

Doors: 115A, H100

1 All Hardware	By Rated Aluminum Manufacturer	OT
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Set: 22.0

Doors: ST0H

2 Hinge, Spring	1502	BSP	MK	087100
4 Hinge, Full Mortise, Hvy Wt	T4A3786 [NRP]	BSP	MK	087100
1 Flush Bolt	2845	BSP	RO	087100
1 Dust Proof Strike	570	BSP	RO	087100
1 Mortise Exit Device, Passage	7130 UC658F	BSP	YA	087100
1 Coordinator	2600 Series	Black	RO	087100
1 Surface Closer	4400	BSP	YA	087100
2 Kick Plate	K1050 10" high CSK BEV	BSP	RO	087100
2 Door Stop & Holder	491-RKW	BSP	RO	087100

END OF SECTION 080671

**SECTION 081113
HOLLOW METAL DOORS AND FRAMES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Non-fire-rated hollow metal doors and frames.
- B. Hollow metal frames for wood doors.
- C. Fire-rated hollow metal doors and frames.
- D. Hollow metal borrowed lites glazing frames.

1.02 RELATED REQUIREMENTS

- A. Section 081416 - Flush Wood Doors
- B. Section 087100 - Door Hardware.
- C. Section 088000 - Glazing: Glass for doors and borrowed lites.
- D. Section 099000 - Exterior and interior Painting: Field painting.

1.03 ABBREVIATIONS AND ACRONYMS

- A. ANSI: American National Standards Institute.
- B. ASCE: American Society of Civil Engineers.
- C. HMMA: Hollow Metal Manufacturers Association.
- D. NAAMM: National Association of Architectural Metal Manufacturers.
- E. NFPA: National Fire Protection Association.
- F. SDI: Steel Door Institute.
- G. UL: Underwriters Laboratories.

1.04 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2024.
- C. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames; 2024.
- D. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2023.
- E. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2020.
- F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- G. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2023, with Editorial Revision.
- H. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.
- I. BHMA A156.115 - Hardware Preparation in Steel Doors and Frames; 2016.
- J. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
- K. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames; 2002.
- L. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2011.

081113
HOLLOW METAL DOORS AND
FRAMES

- M. NAAMM HMMA 840 - Guide Specifications for Receipt, Storage and Installation of Hollow Metal Doors and Frames; 2024.
- N. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames; 2014.
- O. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2025.
- P. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2025.
- Q. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.
- R. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames; 2023.
- S. UL (DIR) - Online Certifications Directory; Current Edition.
- T. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- U. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.

1.05 SUBMITTALS

- A. See Section 013300 - Submittal Procedures.
- B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes.
- C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.
- D. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.
- E. Installer's Qualification Statement.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.
- B. Maintain at project site copies of reference standards relating to installation of products specified.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Hollow Metal Doors and Frames:
 - 1. Ceco Door, an Assa Abloy Group company: www.assaabloydss.com/#sle.
 - 2. Curries, an Assa Abloy Group company: www.assaabloydss.com/#sle.
 - 3. Republic Doors, an Allegion brand: www.republicdoor.com/#sle.
 - 4. Steelcraft, an Allegion brand: www.allegion.com/#sle.
 - 5. Substitutions: See Section 016000 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

- A. Requirements for Hollow Metal Doors and Frames:

081113
HOLLOW METAL DOORS AND
FRAMES

1. Steel Sheet: Comply with one or more of the following requirements; galvanized steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
 2. Accessibility: Comply with ICC A117.1 and ADA Standards.
 3. Door Edge Profile: Manufacturers standard for application indicated.
 4. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Manufacturer's standard.
 5. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
Zinc Coating for Typical Exterior Locations: Provide metal components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvanized) by the hot-dip process in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness, unless noted otherwise for specific hollow metal doors and frames.
 - a. Based on SDI Standards: Provide at least A40/ZF120 (galvanized) when necessary, coating not required for typical interior door applications, and at least A60/ZF180 (galvanized) for corrosive locations.
- B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.03 HOLLOW METAL DOORS

- A. Door Finish: Factory primed and field finished.
- B. Interior Doors, Non-Fire-Rated:
 1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 2 - Heavy-duty.
 - b. Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Model 2 - Seamless.
 - d. Door Face Metal Thickness: 18 gauge, 0.042 inch, minimum.
 - e. Zinc Coating: A60/ZF180 galvanized coating; ASTM A653/A653M.
 2. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements.
 3. Door Thickness: 1-3/4 inches, nominal.
 4. Door Face Sheets: Flush.
- C. Fire-Rated Doors:
 1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 2 - Heavy-duty.
 - b. Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Model 2 - Seamless.
 - d. Door Face Metal Thickness: 18 gauge, 0.042 inch, minimum.
 2. Fire Rating: As indicated on Door Schedule, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").
 3. Temperature-Rise Rating (TRR) Across Door Thickness: In accordance with local building code and authorities having jurisdiction.
 4. Provide units listed and labeled by UL (DIR).
 - a. Attach fire rating label to each fire rated unit.

081113
HOLLOW METAL DOORS AND
FRAMES

5. Smoke and Draft Control Doors: Self-closing or automatic closing doors in accordance with NFPA 80 and NFPA 105, with fire-resistant-rated wall construction rated the same or greater than the fire-rated doors, and the following;
 - a. Maximum Air Leakage: 3.0 cfm/sq ft of door opening at 0.10 inch w.g. pressure, when tested in accordance with UL 1784 at both ambient and elevated temperatures.
 - b. Gasketing: Provide gasketing or edge sealing as necessary to achieve leakage limit.
 - c. Label: Include the "S" label on fire-rating label of door.
6. Door Core Material: Manufacturers standard core material/construction in compliance with requirements.
7. Door Thickness: 1-3/4 inches, nominal.
8. Door Face Sheets: Flush.

2.04 HOLLOW METAL FRAMES

- A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.
- B. Frame Finish: Factory primed and field finished.
- C. Interior Door Frames, Non-Fire Rated: Knock-down type.
 1. Frame Metal Thickness: 16 gauge, 0.053 inch, minimum.
- D. Door Frames, Fire-Rated: Full profile/continuously welded type.
 1. Fire Rating: Same as door, labeled.
 2. Frame Metal Thickness: 16 gauge, 0.053 inch, minimum.
- E. Borrowed Lites Glazing Frames: Construction and face dimensions to match door frames, and as indicated on drawings.
- F. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inches high to fill opening without cutting masonry units.
- G. Frames Wider than 48 inches: Reinforce with steel channel fitted tightly into frame head, flush with top.

2.05 FINISHES

- A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

2.06 ACCESSORIES

- A. Door Window Frames: Door window frames with glazing securely fastened within door opening.
 1. Size: As indicated on drawings.
 2. Frame Material: 18 gauge, 0.0478 inch, galvanized steel.
 3. Metal Finish: Gray polyester powder coating.
 4. Glazing: type, as indicated on drawings., in compliance with requirements of authorities having jurisdiction.
 5. Manufacturers:
 - a. All Metal Stamping: www.allmetalstamping.com/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.
- B. Glazing: As specified in Section 088000, factory installed.
- C. Mechanical Fasteners for Concealed Metal-to-Metal Connections: Self-drilling, self-tapping, steel with electroplated zinc finish.
 1. Manufacturers:
 - a. ITW Commercial Construction North America; ITW CCNA-Buildex Tekes Select Series: www.ITWBuildex.com/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.

081113
HOLLOW METAL DOORS AND
FRAMES

- D. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.
- E. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Verify that finished walls are in plane to ensure proper door alignment.

3.02 PREPARATION

- A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

3.03 INSTALLATION

- A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.
- B. Install fire rated units in accordance with NFPA 80.
- C. Coordinate frame anchor placement with wall construction.
- D. Install door hardware as specified in Section 087100.
 - 1. Comply with recommended practice for hardware placement of doors and frames in accordance with ANSI/SDI A250.6 or NAAMM HMMA 861.
- E. Comply with glazing installation requirements of Section 088000.
- F. Coordinate installation of electrical connections to electrical hardware items.
- G. Touch up damaged factory finishes.

3.04 TOLERANCES

- A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.
- B. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

3.05 ADJUSTING

- A. Adjust for smooth and balanced door movement.

END OF SECTION 081113

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West Campus Renovations
081113 - 6

**081113
HOLLOW METAL DOORS AND
FRAMES**

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**SECTION 081416
FLUSH WOOD DOORS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Flush wood doors; flush configuration; fire-rated and non-rated.

1.02 RELATED REQUIREMENTS

- A. Section 081113 - Hollow Metal Doors and Frames .
- B. Section 087100 - Door Hardware.
- C. Section 088000 - Glazing.

1.03 REFERENCE STANDARDS

- A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
- B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.
- C. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2025.
- D. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2025.
- E. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- F. WDMA I.S. 1A - Interior Architectural Wood Flush Doors; 2021, with Errata (2022).

1.04 SUBMITTALS

- A. See Section 013300 - Submittal Procedures.
- B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
- C. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.
 - 1. Provide information as required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).
- D. Verification Samples: Submit two samples of each selection, of door laminate, 4" x 4" in size illustrating plastic laminate pattern and color for final selections.
- E. Specimen warranty.
- F. Warranty, executed in Owner's name.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with not less than three years of documented experience.
 - 1. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.
- B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.
- C. Woodwork Quality Assurance Program:
 - 1. Provide labels indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Package, deliver and store doors in accordance with specified quality standard.
- B. Accept doors on site in manufacturer's packaging, and inspect for damage.

081416
FLUSH WOOD DOORS

- C. Protect doors with resilient packaging sealed with heat shrunk plastic; do not store in damp or wet areas or areas where sunlight might bleach veneer; seal top and bottom edges with tinted sealer if stored more than one week, and break seal on site to permit ventilation.

1.07 WARRANTY

- A. See Section 017700 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide manufacturer's warranty on interior doors for the life of the installation. Complete forms in Owner's name and register with manufacturer.
 - 1. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Wood Veneer Faced Doors:
 - 1. Masonite Architectural; Aspiro Select Wood Veneer Doors: Basis of Design: www.architectural.masonite.com/#sle.
 - 2. VT Industries, Inc: www.vtindustries.com/#sle.
 - 3. Substitutions: See Section 016000 - Product Requirements.

2.02 DOORS

- A. Doors: See drawings for locations and additional requirements.
 - 1. Quality Standard: Custom Grade, Heavy Duty performance, in accordance with WDMA I.S. 1A.
 - 2. High Pressure Decorative Laminate (HPDL) Faced Doors: 5-ply unless otherwise indicated.
- B. Interior Doors: 1-3/4 inches thick unless otherwise indicated; flush construction.
 - 1. Provide solid core doors at each location.
 - 2. Fire Rated Doors: Tested to ratings indicated on drawings in accordance with UL 10C - Positive Pressure; Underwriters Laboratories Inc (UL) labeled without any visible seals when door is open.

2.03 DOOR AND PANEL CORES

- A. Non-Rated Solid Core and 20 Minute Rated Doors: Type structural composite lumber core (SCLC), plies and faces as indicated.
- B. Fire-Rated Doors: Mineral core type, with fire resistant composite core (FD), plies and faces as indicated above; with core blocking as required to provide adequate anchorage of hardware without through-bolting.

2.04 DOOR FACINGS

- A. Veneer Facing for Transparent Finish: White birch, quarter cut, with slip match
 - 1. Vertical Edges: Any option allowed by quality standard for grade.
 - 2. "Running Match" each pair of doors and doors in close proximity to each other.
- B. Facing Adhesive: Type I - waterproof.

2.05 DOOR CONSTRUCTION

- A. Fabricate doors in accordance with door quality standard specified.
- B. Cores Constructed with stiles and rails:
 - 1. Provide solid blocks at lock edge and top of door for closer for hardware reinforcement.
 - 2. Provide solid blocking for other throughbolted hardware.
- C. Where supplementary protective edge trim is required, install trim after veneer facing has been applied full-width.

081416
FLUSH WOOD DOORS

- D. Glazed Openings: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings.
- E. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.
- F. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.
- G. Provide edge clearances in accordance with the quality standard specified.

2.06 FINISHES - WOOD VENEER DOORS

- A. Finish work in accordance with WDMA I.S. 1A for grade specified and as follows:
 - 1. Transparent:
 - a. System - TR-4, Conversion Varnish.
 - b. Stain: Architect to select from manufacturer's standard selections
 - c. Sheen: Satin.
- B. Factory finish doors in accordance with approved sample.
- C. Seal door top edge with color sealer to match door facing.

2.07 ACCESSORIES

- A. Hollow Metal Door Frames: See Section 081113.
- B. Door Window Frames: Door window frames with glazing securely fastened within door opening.
 - 1. Frame Material: 18 gauge, 0.0478 inch, galvanized steel.
 - 2. Metal Finish: Dark Bronze polyester powder coating.
 - 3. Glazing thickness varies: Coordinate Window Frames with Glazier and Section 088000.
 - 4. Manufacturers:
 - a. All Metal Stamping: www.allmetalstamping.com/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.
- C. Glazing: See Section 088000.
- D. Glazing Stops: Rolled steel channel shape, butted corners; prepared for countersink style tamper proof screws. Paint to match door finish color.
- E. Astragals and Edges for Double Doors: Pairs of doors astragals, and door edge sealing and protection devices.
 - 1. UL listed products in compliance with requirements of authorities having jurisdiction.
 - 2. Provide surface mounted astragal to cover or fill space for full door height between pair of doors or door and adjacent jamb.
 - 3. Astragal Type: Split, two parts, and with automatic locking, cutouts for other door hardware, and sealing gasket.
 - 4. Edge Type: Beveled edge
 - 5. Material: Manufacturers standard.
 - 6. Metal Finish: Dark Bronze powder coating.
 - 7. Manufacturers:
 - a. All Metal Stamping: www.allmetalstamping.com/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.
- F. Door Hardware: See Section 087100.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.

081416
FLUSH WOOD DOORS

- C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.02 INSTALLATION

- A. Install doors in accordance with manufacturer's instructions and specified quality standard.
 - 1. Install fire-rated doors in accordance with NFPA 80 requirements.
 - 2. Install smoke and draft control doors in accordance with NFPA 105 requirements.
- B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.
- C. Use machine tools to cut or drill for hardware.
- D. Coordinate installation of doors with installation of frames and hardware.
- E. Coordinate installation of glazing.

3.03 TOLERANCES

- A. Comply with specified quality standard for fit and clearance tolerances.
- B. Comply with specified quality standard for telegraphing, warp, and squareness.

3.04 ADJUSTING

- A. Adjust doors for smooth and balanced door movement.
- B. Adjust closers for full closure.

END OF SECTION 081416

**SECTION 083100
ACCESS DOORS AND PANELS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wall- and ceiling-mounted access units.

1.02 RELATED REQUIREMENTS

- A. Section 099000: Painting and Coatings Field paint finish.
- B. Section 233300 - Air Duct Accessories: Access doors in ductwork.

1.03 REFERENCE STANDARDS

- A. UL (FRD) - Fire Resistance Directory; Current Edition.

1.04 SUBMITTALS

- A. See Section 013300 - Submittal Procedures.
- B. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.
- C. Shop Drawings: Indicate exact position of each access door and/or panel unit.
- D. Project Record Documents: Record actual locations of each access unit.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

PART 2 PRODUCTS

2.01 ACCESS DOORS AND PANELS ASSEMBLIES

- A. Wall-Mounted Units in Gypsum Board Partitions:
 - 1. Location: As indicated on drawings or required on drawings or in specifications..
 - 2. Panel Material: Aluminum extrusions with gypsum board inlay.
 - 3. Size: As indicated or as required for use intended..
 - 4. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.
 - 5. Gypsum Board Mounting Criteria: Provide drywall bead frame with door surface recessed for infill with wall finish.
- B. Wall-Mounted Units in Masonry Partitions:
 - 1. Location: As indicated on drawings or required on drawings or in specifications..
 - 2. Panel Material: Stainless steel, Type 304.
 - 3. Size: As indicated or as required for use intended..
 - 4. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.
 - 5. Masonry Mounting Criteria: Provide surface-mounted frame with door surface flush with frame surface.
- C. Wall-Mounted Units in Wet Areas:
 - 1. Location: As indicated on drawings or required on drawings or in specifications..
 - 2. Panel Material: Stainless steel, Type 304.
 - 3. Size: As indicated or as required for use intended.
 - 4. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.
 - 5. Wall Mounting Criteria: Provide surface-mounted face frame and door surface flush with frame surface.
- D. Fire-Rated Wall-Mounted Units:
 - 1. Location: Where indicated in Dwgs. and Specifications..
 - 2. Wall Fire-Rating: As indicated on drawings.
 - 3. Panel Material: Steel, hot-dipped zinc, or zinc-aluminum-alloy coated.

083100

ACCESS DOORS AND PANELS

4. Size: As indicated or as required for use intended..
 5. Door/Panel: Uninsulated single-surface panel, with tool-operated spring or cam lock and no handle.
- E. Ceiling-Mounted Units:
1. Location: As indicated in Drawings and Specifications..
 2. Panel Material: Aluminum extrusion with gypsum board inlay.
 3. Size:: As indicated or required for intended use..
 4. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.
- F. Fire-Rated Ceiling-Mounted Units:
1. Location: As indicated in Drawings and Specifications..
 2. Ceiling Fire-Rating: As indicated on drawings.
 3. Panel Material: Steel, hot-dipped zinc, or zinc-aluminum-alloy coated.
 4. Size: As indicated or required for intended use..
 5. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.

2.02 WALL- AND CEILING-MOUNTED ACCESS UNITS

- A. Manufacturers:
1. ACUDOR Products Inc: www.acudor.com/#sle. Basis-of-Design
 2. Babcock-Davis: www.babcockdavis.com/#sle.
 3. Best Access Doors: www.bestaccessdoors.com/#sle.
 4. MIFAB, Inc: www.mifab.com/#sle.
 5. Milcor, Inc: www.milcorinc.com/#sle.
- B. Wall- and Ceiling-Mounted Units: Factory-fabricated door and frame, fully assembled units with corner joints welded, filled and ground flush; square and without rack or warp; coordinate requirements with type of installation assembly being used for each unit.
1. Material: Aluminum extrusions with gypsum board inlay.
 2. Style: .
 - a. Gypsum Board Mounting Criteria: Use drywall bead type frame.
 3. Door Style: Recessed to accept drywall inlay.
 4. Units in Fire-Rated Assemblies: Fire rating as required by applicable code for fire-rated assembly that access doors are being installed.
 - a. Provide products listed by UL (FRD) as suitable for purpose indicated.
 - b. Provide certificate of compliance from authorities having jurisdiction indicating approval of fire rated doors.
 5. Primed and Factory Finish: Polyester powder coat; color white.
 6. Door/Panel Size: As indicated on drawings or as required..
 7. Hardware:
 - a. Hardware for Fire-Rated Units: As required for listing.
 - b. Hinges for Non-Fire-Rated Units: Continuous piano hinge.
 - c. Latch/Lock: Tamperproof tool-operated cam latch.
 - d. Number of Locks/Latches Required: As recommended by manufacturer for size of unit.
 - e. Inside Latch Release: Mechanism that allows door/panel to be opened from inside.
 - f. Gasketing: Extruded neoprene, around perimeter of door panel.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that rough openings are correctly sized and located.
- B. Begin installation only after substrates have been properly prepared, and if the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

083100
ACCESS DOORS AND PANELS

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to proceeding with this work.
- B. Prepare surfaces using methods recommended by manufacturer for applicable substrates in accordance with project conditions.

3.03 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Install frames plumb and level in openings, and secure units rigidly in place.
- C. Position units to provide convenient access to concealed equipment when necessary.

END OF SECTION 083100

083100
ACCESS DOORS AND PANELS

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SECTION 084243
SLIDING DOORS

PART I – GENERAL

1.01 SUMMARY

A. WORK INCLUDED:

Furnish specified complete manual sliding door system manufactured, fabricated & installed to meet manufacturer's specifications and applicable codes at the time of purchase.

B. RELATED WORK:

1. Division 7 Sections for caulking to the extent not specified in this section.

1.02 REFERENCES

A. American National Standards Institute (ANSI):

1. ANSI Z97.1: Safety Glazing Materials Used in Buildings - Methods of Test
2. ANSI A117.1: Accessible and Usable Buildings and Facilities
3. ANSI A156.5: Standard for Auxiliary Locks and Associated Products

B. National Fire Protection Association (NFPA):

1. NFPA 101: Safety to Life from Fire in Buildings & Structures

C. ASTM International:

1. ASTM B221: Aluminum-Alloy Extruded Bars, Rods, Shapes and Tubes
2. ASTM B209: Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate

D. American Architectural Manufacturers Association (AAMA):

1. AAMA 611: Voluntary Specification for Anodized Architectural Aluminum
2. AAMA 701: Voluntary Specification for Pile Weatherstripping and Replaceable Fenestration Weatherseals

E. International Code Council (ICC): ICC/IBC: International Building Code

F. Building Officials and Code Administrators International (BOCA)

G. International Conference of Building Officials / Uniform Building Code (ICBO/UBC)

H. Intertek, Warnock Hersey (ETL): Testing Laboratory and Certification Agency joined with ETL SEMKO

I. International Organization for Standardization (ISO):

1. ISO 9001: Quality Management Systems
2. ISO 14644-1, Class 3: Cleanrooms & controlled environments, Classification of air cleanliness by particle concentration.

J. Aluminum Association (AA): Aluminum Finishes Manual

K. National Association of Architectural Metal Manufacturers (NAAMM)

L. American Association of Automatic Door Manufacturers (AAADM)

M. Underwriters Laboratories (UL): UL 1784: Air Leakage Test of Door Assemblies

1.03 SUBMITTALS

A. SHOP DRAWINGS & PRODUCT DATA

1. Provide product data sheets including installation details, material descriptions, dimensions of individual components and profiles, fabrication, operational descriptions, and finishes.
2. Include plans, elevations, sections, details, hardware mounting heights, additional accessories, and attachments to other work.
3. Submit drawings showing layout, profiles, product components including anchorage, accessories, finish, and glazing details (where required)
4. Samples: Provide color samples of factory-applied color finishes.

B. CLOSEOUT SUBMITTALS:

Owner's Manual & Warranty document as specified herein.

Operating and Maintenance Manuals: Provide manufacturers operating, owners and maintenance manuals for each item specified as required. Include the name, address, and contact information of the manufacturers providing the entrance and their nearest service representatives. The final copies delivered after completion of the installation test to include spare parts list.

1.04 QUALITY ASSURANCE

A. INSTALLERS QUALIFICATIONS: Installer shall be factory trained, certified by AAADM, and experienced to perform work of this section.

B. MANUFACTURER'S QUALIFICATIONS:

1. Manufacturer to have minimum of (5) five years successful experience in the fabrication of doors of the type required for this project.
2. Manufacturer to provide field service representation during installation, to review the installation method.

1.06 DELIVERY, STORAGE AND HANDLING

A. ORDERING AND DELIVERY: Delivery shall be in factory's original, unopened, undamaged containers with identification labels intact.

B. STORAGE AND PROTECTION: Provide protection from exposure to harmful weather conditions and vandalism

1.07 WARRANTIES

A. WARRANTY PERIOD: 2-year warranty: Labor & transportation costs covered for replacement of parts defective in material and workmanship from the Date of Substantial Completion.

B. DISTRIBUTOR'S WARRANTY: 1-year warranty: Labor & transportation charges for defective parts replacement

C. SERVICE AND REPAIRS:

1. During the warranty period, provide a factory-trained technician to perform service and make repairs.
2. A safety inspection shall be performed after each adjustment or repair and a completed inspection form submitted to the owner.

PART II – PRODUCTS

2.01 MANUFACTURER

1. Horton Automatics: Basis of Design: www.hortondoors.com.
2. Stanley Access Technologies
3. Assa Abloy Entrance Systems

2.02.01. DOOR ASSEMBLIES

A. MANUFACTURED DOOR UNITS: Shall include operator, header with roller track, carrier assemblies, framing, sliding door panel(s), activation, safety devices and accessories required for complete installation.

1. Configuration: Hand: SO-SX. Type: Single.
2. Mounting Type: Perimeter Mount.
3. Door Type: 110.

B. DEFINITIONS

1. SO panel: stationary sidelite capable of swinging away for emergency egress
2. SX panel: sliding panel capable of swinging away for emergency egress
3. Type 110 – full breakout: Slide-swing panel(s) 'SX' shall slide along interior 'SO' swing-out sidelite(s)
4. Type10 Trackless: Slide-swing panel 'SX' shall slide along interior side of swing-out sidelite 'SO' (door must be in fully open position) utilizing trackless floor system with no floor track/guide or recess required.
5. Width: The width of the door opening refers to the horizontal distance between the two sides of the opening - Unit Width
6. Height: The height of the door opening indicates the vertical distance from the floor or threshold to the topmost point of the opening - Unit Height

2.02.02 COMPONENTS

A. HEADER:

1. Shall be 4" (102 mm) deep by 2 1/2" (63 mm) high aluminum construction and have a removable face plate for service and adjustment.

B. CARRIER ASSEMBLIES AND HEADER ROLLER TRACK:

1. Telescoping doors to have two separate tracks for sliding panels to travel.
2. Rollers to be steel, high quality ball bearing wheels 1-1/4" (32 mm) diameter.
3. Continuous aluminum extrusion full length of slide panel travel, to prevent derailment.
4. The overhead header roller track shall be continuous aluminum, nylon covered, and replaceable.

C. SLIDING PANEL(S) AND SIDELITE(S):

Minimum door panel extrusion thickness: 0.09"

1. Stile: Shall be aluminum. Narrow, 2" (51 mm) wide x 1 3/4" (44 mm) deep.
2. Muntin Bar: An intermediate horizontal rail, shall be furnished for safety and division of glass. 1/2" (13 mm)
3. Bottom rail: Shall be 10 inches deep
4. Track and non-threshold application.
5. Sliding panels shall have concealed bottom guides to stabilize slide travel.
6. Weather-stripping: Along perimeter of sliding panel(s) and swing-out sidelite(s). Weatherstripping material mechanically fastened to extruded aluminum door panel. Adjustable spring-loaded double astragal weather-stripping at lead edge, double mohair at interlock rails.
7. Finger Safety: Strike rail of sliding panel will stop short of adjacent sidelite.
8. Weight Limit: The total weight limit per panel shall be:
 - a. 200 lbs. (90.7 kg) for slide panel (non-breakout)
 - b. 156 lbs. (70.7 kg) for slide-swing panel

D. BREAKOUT PANELS:

Slide-swing panels to swing out a minimum of 90° from any position of slide movement and require no more than 50 lbf. (222 N) of force applied at the lock stile to open.

1. Slide-swing panels and swing-out sidelites shall utilize a spring-loaded ball detent and shall have a torsion spring designed to re-close the panel if pushed open in the direction of egress without user intervention.
2. The breakout mechanism provides support across the full width of the door in normal operating mode. In breakout mode, the torsion assembly shall support the weight of the door to minimize drop during emergency egress.
3. Slide-swing panels shall include an intermediate horizontal rail.
4. Units with a breakout feature are ETL listed as an exit away and are compliant with NFPA 101.

E. JAMBS/FRAME: Shall be aluminum Dimensions: 1 3/4" (44 mm) deep by 7" (178 mm).

F. HARDWARE:

1. Tubular pull on each side of the sliding panel.
2. Flush bolt lock for SO panel.
3. ANSI A156.5, Grade 1-Point Locking provided and installed in strike rail shall include:
 - a. Hookbolt Latch, 5/8" laminated stainless steel, latching into jamb or adjacent strike rail.
 - b. Keyed 1 5/32" (29 mm) Cylinder mounted on exterior side with 31/32" (25 mm) backset
 - c. Thumbturn mounted on interior side.

G. GLASS AND GLAZING:

1. Glass stops, glazing vinyl and setting blocks for field glazing as per Safety Glazing standard ANSI Z97.1.2. Glazing prep to be for 1/4" Beveled Glazing (6mm), fully tempered.

2.02.05 MATERIALS, FINISHES, AND FABRICATION EXTRUDED ALUMINUM:

A. EXTRUDED ALUMINUM: ASTM B221, 6063-T5 alloy and temper, anodized:

1. Structural Header Sections: Minimum 3/16" (5 mm) thickness.
2. Structural Frame Sections: Minimum 1/8" (3 mm) thickness.
3. Structural Panel Sections: Minimum 1/8" (3 mm) thickness.

B. FINISH:

1. Black powder coat enamel.

C. PANEL CONSTRUCTION:

1. Corner block type with 3/16" steel backup plate construction, mechanically secured with minimum of four hardened steel screws and threaded rod reinforcement. Sash consists of snap-in glass stops, snap-in glazing beads and vinyl gaskets.
2. Slide-swing doors to be supplied with adjustable glass setting block to allow for adjusting of door to meet site conditions.
3. Adjustable double astragal with dual weatherstrip physically captured for superior seal standard

D. FRAME CONSTRUCTION: Butt joints, mechanically secured with screws and formed alum. corner brackets.

PART III - EXECUTION

3.01 EXAMINATION

SITE VERIFICATION OF CONDITIONS:

1. The installer shall verify that the base conditions meet the manufacturer's instructions for product installation. Any negative conditions that may affect the proper and timely completion of work must be notified to the Architect in writing.
2. With the installer present, examine doors and frames for compliance with installation tolerances, wall and floor construction, and other conditions affecting performance.
3. All unsatisfactory conditions before proceeding with the installation. Start of installation signifies acceptance of conditions.

3.02 INSTALLATION

A. ENTRANCES:

Install entrances plumb and true in alignment with established lines and grades without warp or crack of framing members and doors. Use concealed fasteners to the greatest extent possible for surface-mounted hardware. Set headers, carrier assemblies, tracks, operating brackets, and guides level and true to location with anchorage for permanent support.

C. GLAZING:

Install glazing according to the door manufacturer's instructions, the Glass Association of North America (GANA) Glazing Manual, and glass product manufacturer recommendations.

D. SEALANTS:

Use sealants to comply with the requirements specified in Division 7 Section "Joint Sealants" to provide a weather-tight installation. Set framing members in full bed of sealant.

E. DISSIMILAR MATERIALS:

Separate aluminum materials and other corrodible surfaces from sources of corrosion or electrolytic action contact points to comply with AAMA 101, Appendix Dissimilar Materials.

3.03 CLEANING, ADJUSTMENT, AND PROTECTION

A. CLEANING AND ADJUSTMENT:

1. Remove construction debris from construction site and legally dispose of debris. Repair or replace damaged installed products. Clean product surfaces and lubricate operating equipment for optimum condition and safety.
2. Adjust door hardware for smooth and safe operation
3. Verify installation and alignment of all entrance weather-stripping as required.

B. Protect doors through the remainder of the construction period, to ensure that doors will be without damage or deterioration at the time of acceptance.

3.04 FIELD QUALITY CONTROL

Manufacturer's representative shall provide technical assistance and guidance for installation of doors. Factory trained representative shall test and inspect each door to determine compliance with applicable codes.

3.05 INSTRUCTION

Following the installation and final adjustments, the installer shall fully instruct the facility staff as to the correct operating procedure and safety requirements of the sliding door package.

END OF SECTION

**SECTION 084313
ALUMINUM-FRAMED STOREFRONTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Aluminum-framed storefront, with vision glass.
- B. Aluminum doors and frames.
- C. Door hardware.

1.02 RELATED REQUIREMENTS

- A. Section 055000 - Metal Fabrications: Steel attachment devices.
- B. Section 079200 - Joint Sealants: Sealing joints between frames and adjacent construction.
- C. Section 087100 - Door Hardware: Hardware items other than specified in this section.
- D. Section 088000 - Glazing: Glass and glazing accessories.

1.03 REFERENCE STANDARDS

- A. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site; 2015.
- B. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems; 2015.
- C. AAMA 503 - Voluntary Specification for Field Testing of Newly Installed Storefronts, Curtain Walls and Sloped Glazing Systems; 2014.
- D. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum; 2025.
- E. AAMA 611 - Specification for Anodized Architectural Aluminum; 2024.
- F. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; 2009.
- G. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- H. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- I. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- J. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- K. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- L. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- M. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- N. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.
- O. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).
- P. ASTM E783 - Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors; 2002 (Reapproved 2018).

084313
ALUMINUM-FRAMED
STOREFRONTS

- Q. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference; 2015 (Reapproved 2023).
- R. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with installation of other components that comprise the exterior enclosure.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

- A. See Division 1 for submittal procedures.
- B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, and internal drainage details.
- C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.
- D. Samples: Submit two samples 4 x 4 inches in size illustrating finished aluminum surface, glass, glazing materials.
- E. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.
- F. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.
- G. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.
- H. Manufacturer's qualification statement.
- I. Installer's qualification statement.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least 5 years of documented experience.
 - 1. Provide certified glass products through ANSI accredited certifications that include plant audits and independent laboratory performance testing.
 - a. Insulating Glass Certification Council (IGCC).
 - b. Safety Glazing Certification Council (SGCC).
- B. Installer Qualifications: Company specializing in performing work of type specified and with at least 3 years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Handle products of this section in accordance with AAMA CW-10.
- B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.08 FIELD CONDITIONS

- A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.09 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Correct defective Work within a One year period after Date of Substantial Completion.

084313
ALUMINUM-FRAMED
STOREFRONTS

- C. Provide ten year extended manufacturer warranty against failure of framing system, including manufacture and materials.
- D. Provide ten year extended manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design: Efco Corporation: www.efcocorp.com/#sle..
- B. Aluminum-Framed Storefronts:
 - 1. Kawneer North America: www.kawneer.com/#sle.
 - 2. Oldcastle BuildingEnvelope: www.oldcastlebe.com/#sle.
 - 3. Tubelite, Inc: www.tubeliteinc.com/#sle.
 - 4. Substitutions: See Section 016000 - Product Requirements.

2.02 BASIS OF DESIGN -- FRAMING FOR MONOLITHIC GLAZING

- A. Front-Set Style:
 - 1. Basis of Design: Efco, 401.
 - 2. Vertical Mullion Dimensions: 1-3/4 inches wide by 4-1/2 inches deep.

2.03 BASIS OF DESIGN -- SWINGING DOORS

- A. Narrow Stile, Monolithic Glazing:
 - 1. Basis of Design: Efco D500.
 - 2. Thickness: 1-3/4 inches.
- B. Equivalent: Approved Equal.

2.04 ALUMINUM-FRAMED STOREFRONT

- A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
 - 1. Glazing Rabbet: For 1/4 inch monolithic glazing.
 - 2. Glazing Position: Front-set.
 - 3. Finish: Pigmented organic coatings.
 - a. Factory finish all surfaces that will be exposed in completed assemblies.
 - b. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.
 - c. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
 - 4. Finish Color: Black.
 - 5. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
 - 6. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
 - 7. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.

2.05 COMPONENTS

- A. Aluminum Framing Members: Tubular aluminum sections..
 - 1. Framing members for interior applications need not be thermally broken.
 - 2. Glazing Stops: Flush.
- B. Glazing: See Section 088000.
- C. Swing Doors: Glazed aluminum.

084313
ALUMINUM-FRAMED
STOREFRONTS

1. Basis of Design: Efco, D500 Narrow Stile
2. Bottom Rail: 10 inches wide.
3. Glazing Stops: Square.
4. Finish: Match storefront.

2.06 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M).
- B. Sheet Aluminum: ASTM B209/B209M.
- C. Structural Steel Sections: ASTM A36/A36M; galvanized in accordance with requirements of ASTM A123/A123M.
- D. Fasteners: Stainless steel.
- E. Glazing Accessories: See Section 088000.
- F. Shop and Touch-Up Primer for Steel Components: Zinc oxide, alkyd, linseed oil primer appropriate for use over hand cleaned steel.
- G. Touch-Up Primer for Galvanized Steel Surfaces: SSPC-Paint 20, zinc rich.

2.07 FINISHES

- A. Pigmented Organic Coatings: AAMA 2603; polyester or acrylic baked enamel finish.
 1. Products:
 - a. Substitutions: See Section 016000 - Product Requirements.
- B. Color: Black.

2.08 HARDWARE

- A. Other Door Hardware: Storefront manufacturer's standard type to suit application.
 1. Finish on Hand-Contacted Items: Polished chrome.
 2. For each door, include butt hinges, push handle, pull handle, closer, and wall mounted door stop.
- B. Hinges: Butt type; top and bottom.
- C. Push/Pull Set: Standard configuration push/pull handles.
- D. Door Closers: Concealed overhead.
- E. Locks: Dead latch with thumbturn inside ; keyed cylinder outside.
 1. Cylinder to be keyed alike with other doors on floor.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify dimensions, tolerances, and method of attachment with other work.
- B. Verify that storefront wall openings are ready to receive work of this section.

3.02 INSTALLATION

- A. Install wall system in accordance with manufacturer's instructions.
- B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- C. Provide alignment attachments and shims to permanently fasten system to building structure.
- D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- E. Install hardware using templates provided.
 1. See Section 087100 for hardware installation requirements.

084313
ALUMINUM-FRAMED
STOREFRONTS

- F. Install glass in accordance with Section 088000, using glazing method required to achieve performance criteria.
- G. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES

- A. Maximum Variation from Plumb: 0.06 inch per 3 feet non-cumulative or 0.06 inch per 10 feet, whichever is less.
- B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

3.04 ADJUSTING

- A. Adjust operating hardware and door leafs for smooth operation.

3.05 CLEANING

- A. Remove protective material from pre-finished aluminum surfaces.
- B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, and take care to remove dirt from corners and to wipe surfaces clean.
- C. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.

3.06 PROTECTION

- A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION 084313

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West Campus Renovations
084313 - 6

084313
ALUMINUM-FRAMED
STOREFRONTS

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**SECTION 084435
PROTECTIVE FRAMED GLAZING ASSEMBLIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Interior protective framed glazing assembly.
- B. Interior doors in protective framed glazing assembly.

1.02 RELATED REQUIREMENTS

- A. Section 055000 - Metal Fabrications: Steel attachment devices.
- B. Section 079200 - Joint Sealants: Sealing joints between frames and adjacent construction.
- C. Section 087100 - Door Hardware: Hardware installation requirements.
- D. Section 087100 - Door Hardware.

1.03 REFERENCE STANDARDS

- A. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site; 2015.
- B. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- D. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- E. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- F. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.
- G. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).
- H. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2016.
- I. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2025.
- J. UL (DIR) - Online Certifications Directory; Current Edition.
- K. UL 263 - Standard for Fire Tests of Building Construction and Materials; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with installation of other components that comprise the exterior enclosure.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by each affected installer.

1.05 SUBMITTALS

- A. See Section 013300 - Submittal Procedures.
- B. Product Data: Provide evidence of compliance with fire performance criteria and manufacturer's published product data on framing components, glazing, anchorage and fasteners, and doors, if any.
- C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.
- D. Samples: Submit samples as follows illustrating each exposed metal finish of interior and exterior project-specific applications.

084435
PROTECTIVE FRAMED
GLAZING ASSEMBLIES

1. For aluminum, submit minimum of three samples illustrating expected range of color in actual production.
- E. Design Data: Submit framing member structural and physical characteristics and engineering calculations, and identify dimensional limitations.
- F. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.
- G. Installer's Qualification Statement.
- H. Warranty Documentation: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with at least three years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Handle products of this section in accordance with AAMA CW-10.
- B. Protect finished surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to substrate when exposed to sunlight or weather.

1.08 FIELD CONDITIONS

- A. Do not install sealants when ambient temperature is less than 40 degrees F, and maintain above this minimum temperature during and for 48 hours after installation.

1.09 WARRANTY

- A. See Section 017700 for additional warranty requirements.
- B. Correct defective Work within a One year period after Date of Substantial Completion.
- C. Provide five year manufacturer warranty that the product shall be free from defects from the date of delivery..

PART 2 PRODUCTS

2.01 INTERIOR PROTECTIVE FRAMED GLAZING ASSEMBLIES

- A. Manufacturers:
 1. SAFTIFIRST, a division of O'Keeffe's Inc; ; GPX Architectural Series with temperature rise doors: www.safti.com/#sle.
 2. Technical Glass Products: Basis of Design; Fireframes Designer Series with Fireframes Designer Series doors: www.fireglass.com/#sle.
 3. Vetrotech North America; VDS 60 with VDS Doors: www.vetrotechusa.com/#sle.
 4. Substitutions: See Section 016000 - Product Requirements.
- B. Provide factory fabricated, factory finished framing members with glazing and related flashings, anchorage and attachment devices.
 1. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
- C. Structural Performance: Design to support dead loads and horizontal live loads equivalent to the following; coordinate connection to main structural members.
 1. Measure performance by testing in accordance with ASTM E330/E330M, using test loads equal to 1.5 times the design loads and 10 second duration of maximum pressure.
 2. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.

084435
PROTECTIVE FRAMED
GLAZING ASSEMBLIES

3. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths or 3/4 inch, whichever is less, under specified design load.
- D. Fire Performance: Provide hourly fire-resistance-rating as indicated; tested as an assembly including glazing in compliance with ASTM E119 or UL 263 and requirements of local authorities having jurisdiction.
 1. Fire Rating: As indicated on Drawings.
 2. Acceptable evidence of compliance includes listing by UL (DIR) or testing agency acceptable to authorities having jurisdiction.

2.02 COMPONENTS

- A. Framing Members: Formed steel structural members with aluminum cladding and non-combustible thermally-resistive material as required for fire rating.
 1. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors; fasteners and attachments concealed from view; reinforced as required for imposed loads.
 2. Glazing Stops: Flush.
 3. Cross-Section: Manufacturer's standard profile.
 4. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
- B. Glazing type as indicated on Drawings and as required to achieve a complete fire rated assembly with listing by UL(DIR).

2.03 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M).
- B. Sheet Aluminum: ASTM B209/B209M.
- C. Structural Steel Sections: ASTM A36/A36M; shop primed.
- D. Structural Supporting Anchors Attached to Structural Steel: Design for bolted attachment.
- E. Fasteners: Stainless steel.
 1. Arrange fasteners and attachments to conceal from view.
- F. Firestopping: See Section 078400.
- G. Sealants Within Fire-Rated Assembly: As required by fire-rating and manufacturer's assembly.
- H. Sealants: See Section 079200 for additional information.
- I. Glazing Gaskets: Type to suit application to achieve fire-rating, weather, moisture, and air infiltration requirements.
- J. Shop and Touch-Up Primer for Steel Components: Zinc oxide, alkyd, linseed oil primer appropriate for use over hand cleaned steel.

2.04 DOORS AND HARDWARE

- A. Doors: Glazed aluminum.
 1. Type: Manual swinging.
 2. Thickness: 1-3/4 inches.
 3. Top Rail: 4 inches wide.
 4. Vertical Stiles: 4-1/2 inches wide.
 5. Bottom Rail: 10 inches wide.
 6. Finish: Same as framing.
- B. Door Hardware:
 1. Types: As specified in Section 087100

084435
PROTECTIVE FRAMED
GLAZING ASSEMBLIES

2.05 FINISHES

- A. Finishing: Apply factory finish to surfaces that will be exposed in completed assemblies.
 - 1. Touch-up surfaces cut during fabrication so that no natural metal surfaces are visible in completed assemblies, including joint edges.
- B. Aluminum Finish: Pigmented organic coatings
- C. Pigmented Organic Coatings: AAMA 2603; polyester or acrylic baked enamel finish.
- D. Color: black.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify dimensions, tolerances, and method of attachment with other work.
- B. Verify that anchorage devices have been properly installed and located.

3.02 INSTALLATION

- A. Install wall system in accordance with limitations of fire rating and with manufacturer's instructions.
- B. Install framed glazing assemblies in accordance with NFPA 80 and requirements of local authorities having jurisdiction.
- C. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- D. Provide alignment attachments and shims to permanently fasten system to building structure.
- E. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- F. Provide thermal isolation where components penetrate or disrupt building insulation.
- G. Install door hardware using templates provided.
 - 1. See Section 087100 for hardware installation requirements.
- H. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES

- A. Maximum Variation from Plumb: 1/16 inch every 3 feet non-cumulative or 1/2 inch per 100 ft, whichever is less.
- B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.
- C. Sealant Space Between Mullions and Adjacent Construction: Maximum of 3/4 inch and minimum of 1/4 inch.

3.04 ADJUSTING

- A. Adjust doors for smooth operation.

3.05 CLEANING

- A. Remove protective material from pre-finished surfaces.
- B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.

3.06 PROTECTION

- A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION 084435

**SECTION 088000
GLAZING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Glazing units.
- B. Fire Resistive Glazing Units.
- C. Glazing compounds.

1.02 RELATED REQUIREMENTS

- A. Section 079200 - Joint Sealants: Sealants for other than glazing purposes.
- B. Section 081113 - Hollow Metal Doors and Frames : Glazed lites in doors and borrowed lites.
- C. Section 081416 - Flush Wood Doors : Glazed lites in doors.
- D. Section 084435 - Protective Framed Glazing Assemblies: Glazing fire-tested as part of wall assembly.

1.03 REFERENCE STANDARDS

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Current Edition.
- B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015 (Reaffirmed 2020).
- C. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- D. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2019).
- E. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- F. ASTM C1036 - Standard Specification for Flat Glass; 2021.
- G. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.
- H. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).
- I. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass; 2021a.
- J. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2016.
- K. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2019.
- L. BS EN 14179-1 - Glass in Building - Heat Soaked Thermally Toughened Soda Lime Silicate Safety Glass - Part 1: Definition and Description; 2016.
- M. GANA (GM) - GANA Glazing Manual; 2022.
- N. GANA (SM) - GANA Sealant Manual; 2008.
- O. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- P. IGMA TM-3000 - North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use; 1990 (Reaffirmed 2016).
- Q. ITS (DIR) - Directory of Listed Products; Current Edition.
- R. NFRC 100 - Procedure for Determining Fenestration Product U-factors; 2023.
- S. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence; 2023.

088000
GLAZING

- T. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems; 2023.
- U. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by each of the affected installers.

1.05 SUBMITTALS

- A. See Section 013300 - Submittal Procedures.
- B. Product Data on Fire rated Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.
- C. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.
- D. Certificate: Certify that products of this section meet or exceed specified requirements.
- E. Installer's qualification statement.
- F. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.

1.06 QUALITY ASSURANCE

- A. Perform Work in accordance with GANA (GM), GANA (SM), GANA (LGRM), and IGMA TM-3000 for glazing installation methods.
- B. All interior glazing sizes and types shall comply with NFPA 80 and/or ASTM E119.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
 - 1. Provide certified glass products through ANSI accredited certifications that include plant audits and independent laboratory performance testing.
 - a. Insulating Glass Certification Council (IGCC).
 - b. Safety Glazing Certification Council (SGCC).
- D. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.
 - 1. Provide company, field supervisors, and installers that hold active ANSI accredited certifications in appropriate categories for work specified.
 - a. North American Contractor Certification (NACC) for glazing contractors.
 - b. Equivalent independent third-party ANSI accredited certification.

1.07 FIELD CONDITIONS

- A. Do not install glazing when ambient temperature is less than 40 degrees F.
- B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.08 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.

088000
GLAZING

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Glass Fabricators:
 - 1. Basis-of-Design-Guardian Glass, LLC
 - 2. Trulite Glass & Aluminum Solutions, LLC: www.trulite.com/#sle.
 - 2. Viracon, Inc: www.viracon.com/#sle.
- B. Equivalents: Approved Equal.
- C. Float Glass Manufacturers:
 - 1. Guardian Glass, LLC: www.guardianglass.com/#sle.
 - 2. Pilkington North America Inc: www.pilkington.com/na/#sle.
 - 3. Vitro Architectural Glass (formerly PPG Glass): www.vitroglazings.com/#sle.
 - 4. Equivalent: Approved Equal.

2.02 GLASS MATERIALS

- A. Float Glass: Provide float glass based glazing unless otherwise indicated.
 - 1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality - Q3.
 - 2. Kind HS - Heat-Strengthened Type: Complies with ASTM C1048.
 - 3. Kind FT - Fully Tempered Type: Complies with ASTM C1048.
 - 4. Fully Tempered Safety Glass: Complies with ANSI Z97.1 or 16 CFR 1201 criteria for safety glazing used in hazardous locations.
 - 5. Heat-Soak Testing (HST): Provide HST of fully tempered glass used on canopy, point-supported, spider wall, high-risk, sloping overhead, horizontal overhead, free-standing glass protective barrier, or other demanding applications of project, to reduce risks of spontaneous breakage due to nickel sulfide (NiS) induced fractures in accordance with BS EN 14179-1.
 - 6. Thicknesses: As indicated; provide greater thickness as required for exterior glazing wind load design.

2.03 GLAZING UNITS

- A. Type FRG45 - Fire-Resistance-Rated Glazing: Type, thickness, and configuration of glazing that contains flame, smoke, and blocks radiant heat, as required to achieve indicated fire-rating period exceeding 45 minutes.
 - 1. Basis of Design: TGP Firelite Plus
 - 2. See Section 084435 for glazing in fire-rated framing assemblies.
 - 3. Applications:
 - a. Glazing in fire-rated door assembly.
 - b. Glazing in fire-rated window assembly.
 - c. Glazing in sidelites, borrowed lites, and other glazed openings in fire-rated wall assemblies.
 - d. Other locations as indicated on drawings.
 - 4. Glass Type: Multi-laminate annealed glass with intumescent fire retardant interlayers.
 - 5. Provide products listed by UL (DIR) and approved by authorities having jurisdiction.
 - 6. Safety Glazing Certification: 16 CFR 1201 Category II.
 - 7. Glazing Method: As required for fire rating.
 - 8. Fire-Rating Period: 45 minutes.
- B. Type FRG60 - Fire-Resistance-Rated Glazing: Type, thickness, and configuration of glazing that contains flame, smoke, and blocks radiant heat, as required to achieve indicated fire-rating period exceeding 60 minutes.
 - 1. Basis of Design: TGP Firelite Plus
 - 2. Equivalent: Approved equal.
 - 3. Applications:

088000
GLAZING

- a. Glazing in fire-rated door assembly.
- b. Glazing in fire-rated window assembly.
- c. Glazing in sidelites, borrowed lites, and other glazed openings in fire-rated wall assemblies.
- d. Other locations as indicated on drawings.
4. Glass Type: Multi-laminate annealed glass with intumescent fire retardant interlayers.
5. Provide products listed by UL (DIR) and approved by authorities having jurisdiction.
6. Safety Glazing Certification: 16 CFR 1201 Category II.
7. Glazing Method: As required for fire rating.
- C. Markings for Fire-Resistance-Rated Glazing Assemblies: Provide permanent markings on fire-resistance-rated glazing in compliance with authorities having jurisdiction and New York State Building Code.
 1. "W" - meets wall assembly criteria of ASTM E119 or UL 263 fire test standards.
 2. "D" - meets fire door assembly criteria of NFPA 252, UL 10B, or UL 10C fire test standards.
 3. "H" - meets fire door assembly hose stream test of NFPA 252, UL 10B, or UL 10C fire test standards.
 4. "T" - meets temperature rise of not more than 450 degrees F above ambient at end of 30 minutes fire exposure in accordance with NFPA 252, UL 10B, or UL 10C fire test standards.
 5. "XXX" - placeholder that represents fire-rating period, in minutes.
 6. Manufacturers:
 - a. SAFTIFIRST, a division of O'Keeffe's Inc; : www.safti.com/#sle.
 - b. Technical Glass Products(TGP); Pilkington : www.fireglass.com/#sle.
 - c. Vetrotech North America; : www.vetrotechusa.com/#sle.
 - d. Equivalent: Approved equal.
- D. Type TG-1 - Monolithic Safety Glazing: Non-fire-rated.
 1. Applications:
 - a. Glazed lites in doors, except fire doors.
 - b. Glazed sidelights to doors, except in fire-rated walls and partitions.
 - c. Glazed view windows and panels in partitions enclosing athletic activity rooms, except in fire-rated walls and partitions.
 - d. Other locations required by applicable federal, state, and local codes and regulations.
 - e. Other locations indicated on drawings.
 2. Glass Type: Fully tempered safety glass as specified.
 3. Tint: Clear.
 4. Thickness: 1/4 inch, nominal.
 5. Glazing Method: Dry glazing method, gasket glazing.

2.04 GLAZING COMPOUNDS

- A. Type GC-1 - Glazing Putty: Polymer modified latex recommended by manufacturer for outdoor use, knife grade consistency; gray color.
- B. Type GC-2 - Butyl Sealant: Single component; ASTM C920 Grade NS, Class 12-1/2, Uses M and A, Shore A hardness of 10 to 20; black color.
- C. Type GC-3 - Polysulfide Sealant: Two component; chemical curing, nonsagging type; ASTM C920 Type M, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 15 to 25; color as selected.
- D. Type GC-4 - Polyurethane Sealant: Single component, chemical curing, nonstaining, nonbleeding; ASTM C920 Type S, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 20 to 35; color as selected.

088000
GLAZING

- E. Type GC-5 - Silicone Sealant: Single component; neutral curing; capable of water immersion without loss of properties; nonbleeding, nonstaining; ASTM C920 Type S, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 15 to 25; color as selected.
- F. Manufacturers:
 - 1. BASF Corporation: www.basf.com/#sle.
 - 2. Bostik Inc: www.bostik-us.com/#sle.
 - 3. Dow Corning Corporation: www.dowcorning.com/construction/#sle. Dow Corning Corporation: www.dowcorning.com/construction/#sle.
 - 4. Pecora Corporation: www.pecora.com/#sle.
 - 5. Tremco Commercial Sealants & Waterproofing; Proglaze: www.tremcosealants.com/#sle.

2.05 ACCESSORIES

- A. Setting Blocks: Silicone, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot of glazing or minimum 4 inch by width of glazing rabbet space minus 1/16 inch by height to suit glazing method and pane weight and area.
- B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Minimum 3 inch long by one half the height of the glazing stop by thickness to suit application, self adhesive on one face.
- C. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound with integral resilient spacer rod applicable to application indicated; 5 to 30 cured Shore A durometer hardness; coiled on release paper; black color.
 - 1. Width: As required for application.
 - 2. Thickness: As required for application.
 - 3. Spacer Rod Diameter: As required for application.
 - 4. Manufacturers:
 - a. Pecora Corporation: www.pecora.com/#sle.
 - b. Tremco Global Sealants: www.tremcosealants.com/#sle.
 - c. Equivalent: Approved equal.
- D. Glazing Splines: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.
- E. Glazing Clips: Manufacturer's standard type.
- F. Rescue Window/Glazing Unit Markings: Adhesive backed markings affixed to manually operable windows in classrooms to identify units intended for emergency evacuation of students in compliance with New York State Requirements.

2.06 SOURCE QUALITY CONTROL

- A. See Section 014000 - Quality Requirements for additional requirements.

PART 3 EXECUTION

3.01 VERIFICATION OF CONDITIONS

- A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.
- B. Verify that the minimum required face and edge clearances are being provided.
- C. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.
- D. Verify that sealing between joints of glass framing members has been completed effectively.

088000
GLAZING

- E. Proceed with glazing system installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.
- B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

3.03 INSTALLATION, GENERAL

- A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.
- B. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.
- C. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.
- D. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.
- E. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.
- F. Prevent glass from contact with any contaminating substances that may be the result of construction operations such as, and not limited to the following; weld splatter, fire-safing, plastering, mortar droppings, and paint.

3.04 INSTALLATION - DRY GLAZING METHOD (GASKET GLAZING)

- A. Application - Exterior and/or Interior Glazed: Set glazing infills from either the exterior or the interior of the building.
- B. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.
- C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.
- D. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

3.05 INSTALLATION - DRY GLAZING METHOD (TAPE AND GASKET SPLINE GLAZING)

- A. Application - Exterior Glazed: Set glazing infills from the exterior of the building.
- B. Cut glazing tape to length; install on glazing pane. Seal corners by butting tape and sealing junctions with butyl sealant.
- C. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.
- D. Rest glazing on setting blocks and push against fixed stop with sufficient pressure to attain full contact.
- E. Install removable stops without displacing glazing spline. Exert pressure for full continuous contact.
- F. Carefully trim protruding tape with knife.

3.06 INSTALLATION - DRY GLAZING METHOD (TAPE AND TAPE)

- A. Application - Interior Glazed: Set glazing infills from the interior of the building.
- B. Cut glazing tape to length and set against permanent stops, projecting 1/16 inch above sight line.
- C. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.

088000
GLAZING

- D. Rest glazing on setting blocks and push against tape for full contact at perimeter of pane or unit.
- E. Place glazing tape on free perimeter of glazing in same manner described above.
- F. Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.
- G. Carefully trim protruding tape with knife.

3.07 INSTALLATION - WET GLAZING METHOD (SEALANT AND SEALANT)

- A. Application - Exterior Glazed: Set glazing infills from the exterior of the building.
- B. Place setting blocks at 1/4 points and install glazing pane or unit.
- C. Install removable stops with glazing centered in space by inserting spacer shims both sides at 24 inch intervals, 1/4 inch below sight line.
- D. Fill gaps between glazing and stops with type sealant to depth of bite on glazing, but not more than 3/8 inch below sight line to ensure full contact with glazing and continue the air and vapor seal.
- E. Apply sealant to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

3.08 INSTALLATION - WET/DRY GLAZING METHOD (PREFORMED TAPE AND SEALANT)

- A. Application - Exterior Glazed: Set glazing infills from the exterior of the building.
- B. Cut glazing tape to length and set against permanent stops, 3/16 inch below sight line. Seal corners by butting tape and dabbing with butyl sealant.
- C. Apply heel bead of butyl sealant along intersection of permanent stop with frame ensuring full perimeter seal between glass and frame to complete the continuity of the air and vapor seal.
- D. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.
- E. Rest glazing on setting blocks and push against tape and heel bead of sealant with sufficient pressure to attain full contact at perimeter of pane or glass unit.
- F. Install removable stops, with spacer strips inserted between glazing and applied stops 1/4 inch below sight lines.
 - 1. Place glazing tape on glazing pane of unit with tape flush with sight line.
- G. Fill gap between glazing and stop with type sealant to depth equal to bite of frame on glazing, but not more than 3/8 inch below sight line.
- H. Apply cap bead of type sealant along void between the stop and the glazing, to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

3.09 INSTALLATION - WET/DRY GLAZING METHOD (TAPE AND SEALANT)

- A. Application - Interior Glazed: Set glazing infills from the interior of the building.
- B. Cut glazing tape to length and install against permanent stops, projecting 1/16 inch above sight line.
- C. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.
- D. Rest glazing on setting blocks and push against tape to ensure full contact at perimeter of pane or unit.
- E. Install removable stops, spacer shims inserted between glazing and applied stops at 24 inch intervals, 1/4 inch below sight line.
- F. Fill gaps between pane and applied stop with type sealant to depth equal to bite on glazing, to uniform and level line.
- G. Carefully trim protruding tape with knife.

088000
GLAZING

3.10 INSTALLATION - BUTT JOINT GLAZING METHOD (SEALANT ONLY)

- A. Application - Interior Glazed: Set glazing infills from exterior side of building.
- B. Temporarily brace glass in position for duration of glazing process; mask edges of glass at adjoining glass edges and between glass edges and framing members.
- C. Temporarily secure a small diameter nonadhering foamed rod on back side of joint.
- D. Apply sealant to open side of joint in continuous operation; thoroughly fill joint without displacing foam rod, and then tool sealant surface smooth to concave profile.
- E. Permit sealant to cure then remove foam backer rod, and then apply sealant to opposite side, tool smooth to concave profile.
- F. Remove masking tape.

3.11 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements for additional requirements.
- B. Glass and Glazing product manufacturers to provide field surveillance of the installation of their products.
- C. Monitor and report installation procedures and unacceptable conditions.

3.12 CLEANING

- A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.
- B. Remove nonpermanent labels immediately after glazing installation is complete.
- C. Clean glass and adjacent surfaces after sealants are fully cured.
- D. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

3.13 PROTECTION

- A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.
- B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

END OF SECTION 088000

**SECTION 090561
COMMON WORK RESULTS FOR FLOORING PREPARATION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This section applies to floors identified in Contract Documents that are receiving the following types of floor coverings:
 - 1. Resilient tile.
 - 2. Carpeting.
 - 3. Porcelain and ceramic tile.
- B. Removal of existing floor coverings.
- C. Preparation of new and existing concrete floor slabs for installation of floor coverings.
- D. Testing of concrete floor slabs for moisture and alkalinity (pH).
- E. Remediation of concrete floor slabs due to unsatisfactory moisture or alkalinity (pH) conditions.
 - 1. Contractor shall perform all specified remediation of concrete floor slabs. If such remediation is indicated by testing agency's report and is due to a condition not under Contractor's control or could not have been predicted by examination prior to entering into the contract, a contract modification will be issued.
- F. Patching compound.
- G. Remedial floor coatings.
- H. Remedial floor sheet membrane.

1.02 RELATED REQUIREMENTS

- A. Section 012200 - Unit Prices: Bid pricing for remediation treatments if required.
- B. Section 014000 - Quality Requirements: Additional requirements relating to testing agencies and testing.
- C. Section 033000 - Cast-in-Place Concrete: Moisture emission reducing curing and sealing compound for slabs to receive adhered flooring, to prevent moisture content-related flooring failures; to remain in place, not to be removed.
- D. Section 033000 - Cast-in-Place Concrete: Concrete admixture for slabs to receive adhered flooring, to prevent moisture content-related flooring failures.
- E. Section 033000 - Cast-in-Place Concrete: Limitations on curing requirements for new concrete floor slabs.

1.03 PRICE AND PAYMENT PROCEDURES

- A. Unit Prices: See Section 012200 - Unit Prices.

1.04 REFERENCE STANDARDS

- A. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 50 mm [2 in.] Cube Specimens); 2023.
- B. ASTM C472 - Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters, and Gypsum Concrete; 2020.
- C. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2022.
- D. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2023.
- E. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.
- F. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings; 2018.

090561
COMMON WORK RESULTS FOR
FLOORING PREPARATION

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate scheduling of cleaning and testing, so that preliminary cleaning has been completed for at least 24 hours prior to testing.

1.06 SUBMITTALS

- A. Visual Observation Report: For existing floor coverings to be removed.
- B. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:
 - 1. Moisture and alkalinity (pH) limits and test methods.
 - 2. Manufacturer's required bond/compatibility test procedure.
- C. Remedial Materials Product Data: Manufacturer's published data on each product to be used for remediation.
 - 1. Manufacturer's qualification statement.
 - 2. Manufacturer's statement of compatibility with types of flooring applied over remedial product.
 - 3. Test reports indicating compliance with specified performance requirements, performed by nationally recognized independent testing agency.
 - 4. Manufacturer's installation instructions.
 - 5. Specimen Warranty: Copy of warranty to be issued by coating manufacturer and certificate of underwriter's coverage of warranty.
- D. Testing Agency's Report:
 - 1. Description of areas tested; include floor plans and photographs if helpful.
 - 2. Summary of conditions encountered.
 - 3. Moisture and alkalinity (pH) test reports.
 - 4. Copies of specified test methods.
 - 5. Recommendations for remediation of unsatisfactory surfaces.
 - 6. Submit report to Architect.
 - 7. Submit report not more than two business days after conclusion of testing.
- E. Adhesive Bond and Compatibility Test Report.
- F. Floor Moisture Testing Technician Certificate: International Concrete Repair Institute (ICRI) Concrete Slab Moisture Testing Technician- Grade I certificate.
- G. Copy of RFCI (RWP).

1.07 QUALITY ASSURANCE

- A. Moisture and alkalinity (pH) testing shall be performed by an independent testing agency employed and paid by Contractor.
- B. Contractor may perform adhesive and bond test with Contractor's own personnel or hire a testing agency.
- C. Testing Agency Qualifications: Independent testing agency experienced in the types of testing specified.
 - 1. Submit evidence of experience consisting of at least 3 test reports of the type required, with project Owner's project contact information.
- D. Contractor's Responsibility Relating to Independent Agency Testing:
 - 1. Provide access for and cooperate with testing agency.
 - 2. Confirm date of start of testing at least 10 days prior to actual start.
 - 3. Allow at least 4 business days on site for testing agency activities.
 - 4. Achieve and maintain specified ambient conditions.

090561
COMMON WORK RESULTS FOR
FLOORING PREPARATION

5. Notify Architect when specified ambient conditions have been achieved and when testing will start.
- E. Floor Moisture Testing Technician Qualifications: International Concrete Repair Institute (ICRI) Concrete Slab Moisture Testing Technician Certification- Grade I.
- F. Remedial Coating Installer Qualifications: Company specializing in performing work of the type specified in this section, trained by or employed by coating manufacturer, and able to provide at least 3 project references showing at least 3 years' experience installing moisture emission coatings.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, handle, and protect products in accordance with manufacturer's instructions and recommendations.
- B. Deliver materials in manufacturer's packaging; include installation instructions.
- C. Keep materials from freezing.

1.09 FIELD CONDITIONS

- A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F or more than 85 degrees F.
- B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Patching Compound: Floor covering manufacturer's recommended product, suitable for conditions, and compatible with adhesive and floor covering. In the absence of any recommendation from flooring manufacturer, provide a product with the following characteristics:
 1. Cementitious moisture-, mildew-, and alkali-resistant compound, compatible with floor, floor covering, and floor covering adhesive, and capable of being feathered to nothing at edges.
 2. Latex or polyvinyl acetate additions are permitted; gypsum content is prohibited.
 3. Compressive Strength: 3000 psi, minimum, after 28 days, when tested in accordance with ASTM C109/C109M or ASTM C472, whichever is appropriate.
 4. Products:
 - a. H.B. Fuller Construction Products, Inc; TEC Feather Edge Skim Coat: www.tecspecialty.com/#sle.
 - b. USG Corporation; Durock Brand Advanced Skim Coat Floor Patch: www.usg.com/#sle.
 - c. Substitutions: See Section 016000 - Product Requirements.
- B. Alternate Flooring Adhesive: Floor covering manufacturer's recommended product, suitable for the moisture and pH conditions present; low-VOC. In the absence of any recommendation from flooring manufacturer, provide a product recommended by adhesive manufacturer as suitable for substrate and floor covering and for conditions present.
- C. Remedial Floor Coating: Single- or multi-layer coating or coating/overlay combination intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.
 1. Thickness: As required for application and in accordance with manufacturer's installation instructions.
 2. Products:

090561
COMMON WORK RESULTS FOR
FLOORING PREPARATION

- a. ARDEX Engineered Cements; ARDEX MC RAPID: www.ardexamericas.com/#sle.
 - b. Custom Building Products; TechMVC Moisture Vapor and Alkalinity Barrier: www.custombuildingproducts.com/#sle.
 - c. Substitutions: See Section 016000 - Product Requirements.
- D. Remedial Floor Sheet Membrane: Pre-formed multi-ply sheet membrane installed over concrete subfloor and intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.
- 1. Thickness: 28 mil (0.028 inch).
 - 2. Tape: Types recommended by underlayment manufacturer to install membrane and cover seams.
 - 3. Products:
 - a. GCP Applied Technologies; Kovara MBX: www.gcpat.com/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.

PART 3 EXECUTION

3.01 CONCRETE SLAB PREPARATION

- A. Follow recommendations of testing agency.
- B. Remediations:
 - 1. Active Water Leaks or Continuing Moisture Migration to Surface of Slab: Correct this condition before doing any other remediation; re-test after correction.
 - 2. Excessive Moisture Emission or Relative Humidity: If an adhesive that is resistant to the level of moisture present is available and acceptable to flooring manufacturer, use that adhesive for installation of the flooring; if not, apply remedial floor coating or remedial sheet membrane over entire suspect floor area.
 - 3. Excessive Alkalinity (pH): If remedial floor coating is necessary to address excessive moisture, no additional remediation is required; if not, if an adhesive that is resistant to the level present is available and acceptable to the flooring manufacturer, use that adhesive for installation of the flooring; otherwise, apply a skim coat of specified patching compound over entire suspect floor area.

3.02 REMOVAL OF EXISTING FLOOR COVERINGS

- A. Comply with local, State, and federal regulations and recommendations of RFCI Recommended Work Practices for Removal of Resilient Floor Coverings, as applicable to floor covering being removed.
- B. Dispose of removed materials in accordance with local, State, and federal regulations and as specified.

3.03 PRELIMINARY CLEANING

- A. Clean floors of dust, solvents, paint, wax, oil, grease, asphalt, residual adhesive, adhesive removers, film-forming curing compounds, sealing compounds, alkaline salts, excessive laitance, mold, mildew, and other materials that might prevent adhesive bond.
- B. Do not use solvents or other chemicals for cleaning.

3.04 MOISTURE VAPOR EMISSION TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
- C. Test in accordance with ASTM F1869 and as follows.

090561
COMMON WORK RESULTS FOR
FLOORING PREPARATION

- D. Plastic sheet test and mat bond test may not be substituted for the specified ASTM test method, as those methods do not quantify the moisture content sufficiently.
- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if test values exceed 3 pounds per 1000 square feet per 24 hours.
- F. Report: Report the information required by the test method.

3.05 INTERNAL RELATIVE HUMIDITY TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
- C. Test in accordance with ASTM F2170 Procedure A and as follows.
- D. Testing with electrical impedance or resistance apparatus may not be substituted for the specified ASTM test method, as the values determined are not comparable to the ASTM test values and do not quantify the moisture content sufficiently.
- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if any test value exceeds 75 percent relative humidity.
- F. Report: Report the information required by the test method.

3.06 ALKALINITY TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if alkalinity (pH) test value is over 10.

3.07 PREPARATION

- A. See individual floor covering section(s) for additional requirements.
- B. Comply with requirements and recommendations of floor covering manufacturer.
- C. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.
- D. Do not fill expansion joints, isolation joints, or other moving joints.

3.08 ADHESIVE BOND AND COMPATIBILITY TESTING

- A. Comply with requirements and recommendations of floor covering manufacturer.

3.09 APPLICATION OF REMEDIAL FLOOR COATING

- A. Comply with requirements and recommendations of coating manufacturer.

3.10 INSTALLATION OF REMEDIAL FLOOR SHEET MEMBRANE

- A. Install in accordance with sheet membrane manufacturer's instructions.

3.11 PROTECTION

- A. Cover prepared floors with building paper or other durable covering.

END OF SECTION 090561

**090561
COMMON WORK RESULTS FOR
FLOORING PREPARATION**

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**SECTION 092116
GYPSUM BOARD ASSEMBLIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Performance criteria for gypsum board assemblies.
- B. Acoustic insulation.
- C. Cementitious backing board.
- D. Gypsum wallboard.
- E. Joint treatment and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 061000 - Rough Carpentry: Wood blocking product and execution requirements.
- B. Section 078400 - Firestopping: Top-of-wall assemblies at fire-resistance-rated walls.
- C. Section 079200 - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.
- D. Section 092216 - Non-Structural Metal Framing .

1.03 REFERENCE STANDARDS

- A. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2023.
- B. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 2023.
- C. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2017 (Reapproved 2022).
- D. ASTM C514 - Standard Specification for Nails for the Application of Gypsum Board; 2004 (Reapproved 2020).
- E. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2023.
- F. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.
- G. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2023.
- H. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2022.
- I. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2022.
- J. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base; 2019.
- K. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2017.
- L. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel; 2018.
- M. ASTM C1278/C1278M - Standard Specification for Fiber-Reinforced Gypsum Panel; 2017.
- N. ASTM C1288 - Standard Specification for Fiber-Cement Interior Substrate Sheets; 2023.
- O. ASTM C1325 - Standard Specification for Fiber-Mat Reinforced Cementitious Backer Units; 2022, with Editorial Revision (2023).
- P. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.

092116
GYPSUM BOARD ASSEMBLIES

- Q. ASTM C1629/C1629M - Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels; 2023.
- R. ASTM C1658/C1658M - Standard Specification for Glass Mat Gypsum Panels; 2019, with Editorial Revision (2020).
- S. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.
- T. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- U. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.
- V. ASTM E413 - Classification for Rating Sound Insulation; 2022.
- W. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).
- X. GA-216 - Application and Finishing of Gypsum Panel Products; 2024.
- Y. GA-226 - Application of Gypsum Board to Form Curved Surfaces; 2019.
- Z. UL (FRD) - Fire Resistance Directory; Current Edition.
- AA. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate the installation of gypsum board assemblies with size, location, and installation of service utilities.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- C. Sequencing: Install service utilities in an orderly and expeditious manner.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on gypsum board, accessories, and joint finishing system.
 - 1. Provide data on gypsum board, accessories, and joint finishing system.
- C. Shop Drawings: Indicate special details associated with acoustic seals and firestopping at head of partitions.
- D. Installer's Qualification Statement.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing gypsum board installation and finishing, with minimum 5 years of experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store gypsum products and accessories indoors and keep above freezing. Elevate boards above floor, on nonwicking supports, in accordance with manufacturer's recommendations.
- B. Store metal products to prevent corrosion.

PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES

- A. Provide completed assemblies complying with ASTM C840 and GA-216.
- B. Shaft Walls at HVAC Shafts: Provide completed assemblies with the following characteristics:

092116

GYPSUM BOARD ASSEMBLIES

1. Air Pressure Within Shaft: Sustained loads of 5 lbf/sq ft with maximum mid-span deflection of L/240.
2. Acoustic Attenuation: STC of 35-39 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
- C. Fire-Resistance-Rated Assemblies: Provide completed assemblies as indicated on drawings
 1. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL (FRD).

2.02 BOARD MATERIALS

- A. Manufacturers - Gypsum-Based Board:
 1. American Gypsum Company: www.americangypsum.com/#sle.
 2. CertainTeed Corporation: www.certainteed.com/#sle.
 3. Georgia-Pacific Gypsum: www.gpgypsum.com/#sle.
 4. National Gypsum Company: www.nationalgypsum.com/#sle.
 5. USG Corporation: www.usg.com/#sle.
 6. Substitutions: See Section 016000 - Product Requirements.
- B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
 1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 - a. Mold-resistant board is required whenever board is being installed before the building is enclosed and conditioned.
 - b. Mold resistant board is required where indicated on drawings..
 3. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
 4. Thickness:
 - a. Vertical Surfaces: .
 - b. Ceilings: 1/2 inch unless otherwise indicated on drawings..
 - c. Multi-Layer Assemblies: Thicknesses as indicated on drawings.
 5. Paper-Faced Products:
 - a. American Gypsum Company; LightRoc Gypsum Wallboard: www.americangypsum.com/#sle.
 - b. American Gypsum Company; FireBloc Type X Gypsum Wallboard: www.americangypsum.com/#sle.
 - c. American Gypsum Company; FireBloc Type C Gypsum Wallboard: www.americangypsum.com/#sle.
 - d. CertainTeed Corporation; Type C Drywall: www.certainteed.com/#sle.
 - e. CertainTeed Corporation; Type X Drywall: www.certainteed.com/#sle.
 - f. Georgia-Pacific Gypsum; ToughRock: www.gpgypsum.com/#sle.
 - g. Georgia-Pacific Gypsum; ToughRock Fireguard X: www.gpgypsum.com/#sle.
 - h. Georgia-Pacific Gypsum; ToughRock Fireguard C: www.gpgypsum.com/#sle.
 - i. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond Fire-Shield Gypsum Board: www.goldbondbuilding.com/#sle.
 - j. USG Corporation; Sheetrock Brand EcoSmart Panels Firecode X 5/8 in. (15.9 mm): www.usg.com/#sle.
 - k. USG Corporation; Sheetrock Brand Firecode X Panels 5/8 in. (15.9 mm): www.usg.com/#sle.
 - l. Substitutions: See Section 016000 - Product Requirements.
 6. Mold-Resistant, Paper-Faced Products:
 - a. American Gypsum Company; M-Bloc: www.americangypsum.com/#sle.
 - b. American Gypsum Company; M-Bloc Type X: www.americangypsum.com/#sle.
 - c. American Gypsum Company; M-Bloc Type C: www.americangypsum.com/#sle.

092116

GYPSUM BOARD ASSEMBLIES

- d. CertainTeed Corporation; M2Tech 5/8" Type X Moisture & Mold Resistant Drywall: www.certainteed.com/#sle.
 - e. Georgia-Pacific Gypsum; ToughRock Mold-Guard: www.gpgypsum.com/#sle.
 - f. Georgia-Pacific Gypsum; ToughRock Fireguard X Mold-Guard: www.gpgypsum.com/#sle.
 - g. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond XP Gypsum Board: www.goldbondbuilding.com/#sle.
 - h. USG Corporation; Sheetrock Brand EcoSmart Panels Mold Tough Firecode X 5/8 in. (15.9 mm): www.usg.com/#sle.
 - i. Substitutions: See Section 016000 - Product Requirements.
- C. Backing Board For Wet Areas: One of the following products:
- 1. Application: Surfaces behind tile in wet areas including where indicated on drawings..
 - 2. Application: Horizontal surfaces behind tile in wet areas including countertops and where indicated on drawings.
 - 3. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 - 4. ANSI Cement-Based Board: Non-gypsum-based; aggregated Portland cement panels with glass fiber mesh embedded in front and back surfaces complying with ANSI A118.9 or ASTM C1325.
 - a. Thickness: 5/8 inch.
 - b. Products:
 - 1) Custom Building Products: www.custombuildingproducts.com/#sle.
 - 2) PermaBASE Building Products, LLC provided by National Gypsum Company; PermaBase Cement Board: www.goldbondbuilding.com/#sle.
 - 3) USG Corporation; Fiberock Brand Aqua-Tough AR Interior Panels Regular 5/8 in. (15.9 mm): www.usg.com/#sle.
 - 4) Substitutions: See Section 016000 - Product Requirements.
- D. Backing Board For Non-Wet Areas: Water-resistant gypsum backing board as defined in ASTM C1396/C1396M; sizes to minimum joints in place; ends square cut.
- 1. Application: Vertical surfaces behind thinset tile, except in wet areas.
 - 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 - 3. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
 - 4. Type: Regular and Type X, in locations indicated.
 - 5. Type X Thickness: As indicated for partition type
 - 6. Regular Board Thickness: As indicated for partition type.
 - 7. Edges: Tapered.
 - 8. Products:
 - a. American Gypsum Company; M-Bloc: www.americangypsum.com/#sle.
 - b. American Gypsum Company; M-Bloc Type X: www.americangypsum.com/#sle.
 - c. Georgia-Pacific Gypsum; ToughRock Mold-Guard Gypsum Board: www.gpgypsum.com/#sle.
 - d. Georgia-Pacific Gypsum; DensArmor Plus: www.gpgypsum.com/#sle.
 - e. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond XP Fire-Shield Gypsum Board: www.goldbondbuilding.com/#sle.
 - f. Substitutions: See Section 016000 - Product Requirements.
- E. Ceiling Board: Special sag resistant gypsum ceiling board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
- 1. Application: Ceilings, unless otherwise indicated.
 - 2. Thickness: 1/2 inch.
 - 3. Edges: Tapered.
 - 4. Products:

092116

GYPSUM BOARD ASSEMBLIES

- a. CertainTeed Corporation; Interior Ceiling Drywall: www.certainteed.com/#sle.
 - b. USG Corporation; Sheetrock Brand UltraLight Panels 1/2 in. (12.7 mm): www.usg.com/#sle.
 - c. Substitutions: See Section 016000 - Product Requirements.
- F. Shaftwall and Coreboard: Type X; 1 inch thick by 24 inches wide, beveled long edges, ends square cut.
- 1. Paper-Faced Type: Gypsum shaftliner board or gypsum coreboard as defined ASTM C1396/C1396M; water-resistant faces.
 - 2. Paper-Faced Products:
 - a. American Gypsum Company; M-Bloc Shaft Liner: www.americangypsum.com/#sle.
 - b. CertainTeed Corporation; M2Tech Type X Shaftliner: www.certainteed.com/#sle.
 - c. Georgia-Pacific Gypsum; ToughRock Shaftliner: www.gpgypsum.com/#sle.
 - d. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond Shaftliner XP: www.goldbondbuilding.com/#sle.
 - e. Substitutions: See Section 016000 - Product Requirements.

2.03 GYPSUM BOARD ACCESSORIES

- A. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced. Thickness: To match partition thickness.
- B. Sound Isolation Tape: Elastomeric foam tape for sound decoupling.
- 1. Surface Burning Characteristics: Provide assemblies with flame spread index of 75 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
 - 2. Tape Thickness: 1/4 inch.
 - 3. Products:
 - a. Armacell LLC; ArmaComfort MTD: www.armacell.us/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.
- C. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.
- 1. Products:
 - a. Franklin International, Inc; Titebond Acoustical Smoke & Sound Sealant: www.titebond.com/#sle.
 - b. Liquid Nails, a brand of PPG Architectural Coatings: www.liquidnails.com/#sle.
 - c. Specified Technologies Inc; Smoke N Sound Acoustical Sealant: www.stifirestop.com/#sle.
 - d. Substitutions: See Section 016000 - Product Requirements.
- D. Finishing Accessories: ASTM C1047, extruded aluminum alloy (6063 T5) or galvanized steel sheet ASTM A924/A924M G90, unless noted otherwise.
- 1. Types: As detailed or required for finished appearance.
 - 2. Special Shapes: In addition to conventional corner bead and control joints, provide U-bead at exposed panel edges.
 - 3. Products:
 - a. Same manufacturer as framing materials.
 - b. Phillips Manufacturing Co: www.phillipsmfg.com/#sle.
 - c. Trim-tex, Inc: www.trim-tex.com/#sle.
 - d. Substitutions: See Section 016000 - Product Requirements.
- E. Decorative Metal Trim:
- 1. Material: Extruded aluminum alloy 6063-T5 temper.
 - 2. Finish: Anodized, clear.
 - 3. Type: Profile as selected from manufacturer's standard range.
 - 4. Corner Trim:

092116
GYPSUM BOARD ASSEMBLIES

- a. Products:
 - 1) As indicated on drawings..
 - 2) Schluter Systems.
 - 3) Substitutions: See Section 016000 - Product Requirements.
- 5. Reveal Trim:
 - a. Products:
 - 1) As indicated on drawings..
 - 2) Schluter Systems.
 - 3) Substitutions: See Section 016000 - Product Requirements.
- 6. Molding:
 - a. Products:
 - 1) As indicated on Drawings.
 - 2) Schluter Systems.
 - 3) Substitutions: See Section 016000 - Product Requirements.
- F. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
 - 1. Fiberglass Tape: 2 inch wide, coated glass fiber tape for joints and corners, except as otherwise indicated.
 - 2. Paper Tape: 2 inch wide, creased paper tape for joints and corners, except as otherwise indicated.
 - 3. Products:
 - a. Continental Building Products: www.continental-bp.com/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.
 - 4. Joint Compound: Drying type, vinyl-based, ready-mixed.
 - a. Products:
 - 1) Continental Building Products: www.continental-bp.com/#sle.
 - 2) Substitutions: See Section 016000 - Product Requirements.
 - 5. Joint Compound: Setting type, field-mixed.
- G. Finishing Compound: Surface coat and primer, takes the place of skim coating.
 - 1. Products:
 - a. CertainTeed Corporation; Quick Prep Plus Interior Prep Coat: www.certainteed.com/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.
- H. High Build Drywall Surfer: Vinyl acrylic latex-based coating for spray application, designed to take the place of skim coating and separate paint primer in achieving Level 5 finish.
 - 1. Products:
 - a. CertainTeed Corporation; Level V Wall and Ceiling Primer/Surfer with M2Tech: www.certainteed.com/#sle.
 - b. USG Corporation; USG Sheetrock Brand Tuff-Hide Primer-Surfer: www.usg.com/#sle.
 - c. Substitutions: See Section 016000 - Product Requirements.
- I. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inches in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion-resistant.
- J. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws, corrosion-resistant.
- K. Nails for Attachment to Wood Members: ASTM C514.
- L. Anchorage to Substrate: Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.

092116
GYPSUM BOARD ASSEMBLIES

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that project conditions are appropriate for work of this section to commence.
- B. Shaft Wall Liner: Cut panels to accurate dimensions and install sequentially between special friction studs.
 - 1. Seal perimeter of shaft wall and penetrations with acoustical sealant.

3.02 ACOUSTIC ACCESSORIES INSTALLATION

- A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
- B. Sound Isolation Tape: Apply to vertical studs and top and bottom tracks/runners in accordance with manufacturer's instructions.
- C. Acoustic Sealant: Install in accordance with manufacturer's instructions.
 - 1. Place continuous bead at perimeter of each layer of gypsum board.
 - 2. Seal around all penetrations by conduit, pipe, ducts, and rough-in boxes, except where firestopping is provided.

3.03 BOARD INSTALLATION

- A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
- B. Single-Layer Nonrated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.
 - 1. Exception: Tapered edges to receive joint treatment at right angles to framing.
- C. Double-Layer, Nonrated: Use gypsum board for first layer, placed parallel to framing or furring members, with ends and edges occurring over firm bearing. Place second layer perpendicular to framing or furring members. Offset joints of second layer from joints of first layer.
- D. Fire-Resistance-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
- E. Exposed Gypsum Board in Interior Wet Areas: Seal joints, cut edges, and holes with water-resistant sealant.
- F. Cementitious Backing Board: Install over steel framing members and plywood substrate where indicated, in accordance with ANSI A108.11 and manufacturer's instructions.
- G. Installation on Metal Framing: Use screws for attachment of gypsum board except face layer of nonrated double-layer assemblies, which may be installed by means of adhesive lamination.
- H. Installation on Wood Framing: For rated assemblies, comply with requirements of listing authority. For nonrated assemblies, install as follows:
 - 1. Single-Layer Applications: Screw attachment.
- I. Curved Surfaces: Apply gypsum board to curved substrates in accordance with GA-226.

3.04 INSTALLATION OF TRIM AND ACCESSORIES

- A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
 - 1. Not more than 30 feet apart on walls and ceilings over 50 feet long.
- B. Corner Beads: Install at external corners, using longest practical lengths.
- C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.
- D. Decorative Trim: Install at locations shown on drawings and in accordance with manufacturer's instructions.

092116
GYPSUM BOARD ASSEMBLIES

3.05 JOINT TREATMENT

- A. Glass Mat Faced Gypsum Board and Exterior Glass Mat Faced Sheathing: Use fiberglass joint tape, embed and finish with setting type joint compound.
- B. Paper Faced Gypsum Board: Use paper joint tape, embed with drying type joint compound and finish with drying type joint compound.
- C. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
 - 1. Level 5: Walls and ceilings to receive semi-gloss or gloss paint finish and other areas specifically indicated.
 - 2. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
 - 3. Level 3: Walls to receive textured wall finish.
 - 4. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
 - 5. Level 1: Fire-resistance-rated wall areas above finished ceilings, whether or not accessible in the completed construction.
- D. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
 - 1. Feather coats of joint compound so that camber is maximum 1/32 inch.
- E. Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.
- F. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

3.06 TOLERANCES

- A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

END OF SECTION 092116

**SECTION 092216
NON-STRUCTURAL METAL FRAMING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Metal partition, ceiling, and soffit framing.
- B. Framing accessories.

1.02 RELATED REQUIREMENTS

- A. Section 055000 - Metal Fabrications: Metal fabrications attached to stud framing.
- B. Section 061000 - Rough Carpentry: Wood blocking within stud framing.
- C. Section 079200 - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.
- D. Section 083100 - Access Doors and Panels.
- E. Section 092116 - Gypsum Board Assemblies: Execution requirements for anchors for attaching work of this section.

1.03 REFERENCE STANDARDS

- A. AISI S220 - North American Standard for Cold-Formed Steel Nonstructural Framing; 2020.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- D. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members; 2015.
- E. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories; 2020.
- F. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.
- G. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2022.
- H. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.
- I. ASTM E413 - Classification for Rating Sound Insulation; 2022.

1.04 SUBMITTALS

- A. See Section 013300 - Submittal Procedures.
- B. Shop Drawings:
 - 1. Indicate prefabricated work, component details, stud layout, framed openings, anchorage to structure, acoustic details, type and location of fasteners, accessories, items of other related work, and ceiling suspension system.
 - 2. Describe method for securing studs to tracks, splicing, and for blocking and reinforcement of framing connections.
- C. Product Data: Provide data describing framing member materials and finish, product criteria, load charts, and limitations.
- D. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this section with minimum five years documented experience and approved by manufacturer.

092216
NON-STRUCTURAL METAL
FRAMING

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Metal Framing, Connectors, and Accessories:
 - 1. ClarkDietrich: www.clarkdietrich.com/#sle.
 - 2. Marino: www.marinoware.com/#sle.
 - 3. Substitutions: See Section 016000 - Product Requirements.

2.02 FRAMING MATERIALS

- A. Fire-Resistance-Rated Assemblies: Comply with applicable code and as indicated on drawings.
- B. Loadbearing Studs: As specified in Section 054000.
- C. Steel Sheet: ASTM A1003/A1003M, subject to the ductility limitations indicated in AISI S220.
 - 1. Structural Grade: As required to meet design criteria.
 - 2. Corrosion Protection Coating Designation: G40, or equivalent in accordance with AISI S220.
- D. Non-Loadbearing Framing System Components: AISI S220; sheet steel, of size and properties necessary for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf.
 - 1. Studs: C-shaped with flat faces.
 - a. Products:
 - 1) ClarkDietrich; ProSTUD: www.clarkdietrich.com/#sle.
 - 2) MarinoWARE; ViperStud Drywall Framing: www.marinoware.com/#sle.
 - 3) Super Stud Building Products, Inc; The EDGE: www.buysuperstud.com/#sle.
 - 4) Substitutions: See Section 016000 - Product Requirements.
 - 2. Runners: U-shaped, sized to match studs.
 - 3. Ceiling Channels: C-shaped.
 - 4. Furring: Hat-shaped sections, minimum depth of 7/8 inch.
 - 5. Resilient Furring Channels: Single or double leg configuration; 1/2 inch channel depth.
 - a. Products:
 - 1) ClarkDietrich; RC Deluxe Resilient Channel: www.clarkdietrich.com/#sle.
 - 2) Substitutions: See Section 016000 - Product Requirements.
- E. Shaft Wall Studs and Accessories: AISI S220; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 and specified performance requirements.
 - 1. Products:
 - a. Same manufacturer as other framing materials.
- F. Partition Head to Structure Connections: Provide track fastened to structure with legs of sufficient length to accommodate deflection, for friction fit of studs cut short and braced with continuous bridging on both sides.
- G. Deflection and Firestop Track: Intumescent strip factory-applied to track flanges expands when exposed to heat or flames to provide a perimeter joint seal.
 - 1. Products:
 - a. ClarkDietrich; BlazeFrame Firestop Deflection Track: www.clarkdietrich.com/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.
- H. Preformed Top Track Firestop Seal:
 - 1. Provide components UL-listed for use in UL-listed fire-resistance-rated head of partition joint systems indicated on drawings.
 - 2. Products:
 - a. Hilti, Inc; Top Track Seal CFS TTS: www.us.hilti.com/#sle.

092216
NON-STRUCTURAL METAL
FRAMING

- b. Specified Technologies Inc; SpeedFlex TTG Track Top Gasket:
www.stfirestop.com/#sle.
- c. Substitutions: See Section 016000 - Product Requirements.
- I. Non-Loadbearing Framing Accessories:
 - 1. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
 - 2. Partial Height Wall Framing Support: Provides stud reinforcement and anchored connection to floor.
 - a. Materials: ASTM A36/A36M formed sheet steel support member with factory-welded ASTM A1003/A1003M steel plate base.
 - b. Height: 35-3/4 inches.
 - c. Products:
 - 1) ClarkDietrich; Pony Wall (PW): www.clarkdietrich.com/#sle.
 - 2) Substitutions: See Section 016000 - Product Requirements.
 - 3. Bracing and Bridging: ASTM A653/A653M G90 galvanized steel; for lateral bracing of wall studs with slots for engaging on-module studs.
 - a. Products:
 - 1) Simpson Strong-Tie; DBR Drywall Spacer Bracer: www.strongtie.com/#sle.
 - 4. Framing Connectors: ASTM A653/A653M steel clips; secures cold rolled channel to wall studs for lateral bracing.
 - a. Products:
 - 1) ClarkDietrich; FastBridge Clip (FB33): www.clarkdietrich.com/#sle.
 - 2) Substitutions: See Section 016000 - Product Requirements.
 - 5. Flexible Wood Backing: Fire-retardant-treated wood with sheet steel connectors.
 - a. Products:
 - 1) ClarkDietrich; Danback: www.clarkdietrich.com/#sle.
 - 2) Substitutions: See Section 016000 - Product Requirements.
 - 6. Sheet Metal Backing: 0.0395 inch thick.
 - 7. Fasteners: ASTM C1002 self-piercing self-tapping screws.
 - 8. Anchorage Devices: Powder actuated.

2.03 FABRICATION

- A. Fabricate assemblies of framed sections to sizes and profiles required.
- B. Fit, reinforce, and brace framing members to suit design requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that rough-in utilities are in proper location.

3.02 INSTALLATION OF STUD FRAMING

- A. Install non-structural members in accordance with ASTM C754.
- B. Extend partition framing to structure where indicated and to ceiling in other locations.
- C. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
- D. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.
- E. Fire-Resistance-Rated Construction: Install framing and accessories in accordance with requirements of fire-resistance-rated assembly and to GA-600 requirements.

092216
NON-STRUCTURAL METAL
FRAMING

- F. Align and secure top and bottom runners at 16 inches on center.
- G. At partitions indicated with an acoustic rating:
 - 1. Provide components and install as required to produce STC ratings as indicated, based on published tests by manufacturer conducted in accordance with ASTM E90 with STC rating calculated in accordance with ASTM E413.
 - 2. Place one bead of acoustic sealant between runners and substrate , studs and adjacent construction.
 - 3. Place one bead of acoustic sealant between studs and adjacent vertical surfaces.
 - 4. Sound Isolation Tape: Apply to vertical studs and top and bottom tracks/runners in accordance with manufacturer's instructions.
- H. Fit runners under and above openings; secure intermediate studs to same spacing as wall studs.
- I. Install studs vertically at spacing indicated on drawings.
- J. Align stud web openings horizontally.
- K. Secure studs to tracks using fastener method. Do not weld.
- L. Stud splicing is not permissible.
- M. Fabricate corners using a minimum of three studs.
- N. Install double studs at wall openings, door and window jambs, not more than 2 inches from each side of openings.
- O. Brace stud framing system rigid.
- P. Coordinate erection of studs with requirements of door frames; install supports and attachments.
- Q. Coordinate installation of bucks, anchors, and blocking with electrical, mechanical, and other work to be placed within or behind stud framing.
- R. Blocking: Use wood blocking secured to studs. Provide blocking for support of plumbing fixtures, toilet partitions, wall cabinets, toilet accessories, hardware, and opening frames.
- S. Furring: Install at spacing and locations shown on drawings. Lap splices a minimum of 6 inches.
- T. Use sheet metal backing for reinforcement where indicated on drawings..

3.03 CEILING AND SOFFIT FRAMING

- A. Comply with requirements of ASTM C754.
- B. Install furring after work above ceiling or soffit is complete. Coordinate the location of hangers with other work.
- C. Install furring independent of walls, columns, and above-ceiling work.
- D. Securely anchor hangers to structural members or embed them in structural slab. Space hangers as required to limit deflection to criteria indicated. Use rigid hangers at exterior soffits.
- E. Space main carrying channels at maximum 72 inches on center, and not more than 6 inches from wall surfaces. Lap splice securely.
- F. Securely fix carrying channels to hangers to prevent turning or twisting and to transmit full load to hangers.
- G. Place furring channels perpendicular to carrying channels, not more than 2 inches from perimeter walls, and rigidly secure. Lap splices securely.
- H. Reinforce openings in suspension system that interrupt main carrying channels or furring channels with lateral channel bracing. Extend bracing minimum 24 inches past each opening.

092216
NON-STRUCTURAL METAL
FRAMING

- I. Laterally brace suspension system.

3.04 TOLERANCES

- A. Maximum Variation From True Position: 1/8 inch in 10 feet.
- B. Maximum Variation From Plumb: 1/8 inch in 10 feet.

END OF SECTION 092216

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West Campus Renovations
092216 - 6

092216
NON-STRUCTURAL METAL
FRAMING

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**SECTION 093000
TILING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Tile for floor applications.
- B. Tile for wall applications.
- C. Cementitious backer board as tile substrate.
- D. Non-ceramic trim.

1.02 REFERENCE STANDARDS

- A. ANSI A108/A118/A136 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium); 2024.
- B. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar; 2023.
- C. ANSI A108.1b - Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set, Modified Dry-Set, or Improved Modified Dry-Set Cement Mortar; 2023.
- D. ANSI A108.1c - Contractor's Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set, Modified Dry-Set, or Improved Modified Dry-Set Cement Mortar; 2023.
- E. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesive or Water Cleanable Tile-Setting Epoxy Adhesive; 2023.
- F. ANSI A108.5 - Setting of Ceramic Tile with Dry-Set Cement Mortar, Modified Dry-Set Cement Mortar, EGP (Exterior Glue Plywood) Modified Dry-Set Cement Mortar, or Improved Modified Dry-Set Cement Mortar; 2023.
- G. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grout Epoxy; 2023.
- H. ANSI A108.8 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout; 1999 (Reaffirmed 2024).
- I. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout; 2023.
- J. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework; 2017 (Reaffirmed 2022).
- K. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2023.
- L. ANSI A108.12 - Installation of Ceramic Tile with EGP (Exterior Glue Plywood) Modified Dry-Set Mortar; 2023.
- M. ANSI A108.13 - American National Standard for Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone; 2005 (Reaffirmed 2021).
- N. ANSI A108.19 - American National Standard Specifications for Interior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs by the Thin-Bed Method Bonded with Modified Dry-Set Cement Mortar or Improved Modified Dry-Set Cement Mortar; 2020.
- O. ANSI A108.20 - American National Standard Specifications for Exterior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs; 2020.
- P. ANSI A118.3 - American National Standard Specifications for Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy and Water Cleanable Tile-Setting Epoxy Adhesive; 2021.

093000
TILING

- Q. ANSI A118.4 - American National Standard Specifications for Modified Dry-Set Cement Mortar; 2023.
- R. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 2023.
- S. ANSI A118.10 - American National Standard Specifications for Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation; 2023.
- T. ANSI A118.12 - American National Standard Specifications for Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation; 2014 (Reaffirmed 2024).
- U. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2022.
- V. ASTM C373 - Standard Test Methods for Determination of Water Absorption and Associated Properties by Vacuum Method for Pressed Ceramic Tiles and Glass Tiles and Boil Method for Extruded Ceramic Tiles and Non-tile Fired Ceramic Whiteware Products; 2018 (Reapproved 2023).
- W. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2025.
- X. TCNA (HB-GP) - Handbook for Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs Installation; 2023.

1.03 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.
- C. Samples: Verification samples at least 4 inches by 4 inches.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.
 - 2. Extra Tile: 10 square feet of each size, color, and surface finish combination.

1.04 QUALITY ASSURANCE

- A. Maintain one copy of ANSI A108/A118/A136, TCNA (HB), and TCNA (HB-GP) on-site.
- B. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum five years of documented experience.
- C. Installer Qualifications: Natural Stone Institute (NSI) Accredited Commercial B Contractor (light commercial): www.naturalstoneinstitute.org/#sle.

PART 2 PRODUCTS

2.01 TILE

- A. Manufacturers: All products by the same manufacturer.
 - 1. American Olean Corporation: www.americanolean.com/#sle.
 - 2. Dal-Tile Corporation: www.daltile.com/#sle.
 - 3. Crossville Inc.; www.crossvilleinc.com/#sle.
 - 4. Substitutions: See Section 016000 - Product Requirements.
- B. Glazed Wall Tile: ANSI A137.1 standard grade.
 - 1. Moisture Absorption: 7.0 to 20.0 percent as tested in accordance with ASTM C373.
 - 2. Edges: Square.
 - 3. Surface Finish: As indicated on drawings.
 - 4. Color(s): As indicated on drawings.
 - 5. Pattern: As indicated on drawings.
 - 6. Products:
 - a. Dal-Tile Corporation; Color Wheel Classic: www.daltile.com/#sle. Basis of Design.
 - b. Crossville Inc.; Shades 2.0: www.crossvilleinc.com/#sle. Basis of Design.

093000
TILING

- c. Substitutions: See Section 016000 - Product Requirements.
- C. Porcelain Tile: ANSI A137.1 standard grade.
 - 1. Moisture Absorption: 0 to 0.5 percent as tested in accordance with ASTM C373.
 - 2. Size: 12 by 12 inch, nominal.
 - 3. Thickness: 3/8 inch.
 - 4. Edges: Square.
 - 5. Surface Finish: Unglazed.
 - 6. Color(s): As indicated on drawings.
 - 7. Products:
 - a. Crossville Inc.; Color Blox 2.0: www.crossvilleinc.com/#sle. Basis of Design.
 - b. Substitutions: See Section 016000 - Product Requirements.

2.02 TRIM AND ACCESSORIES

- A. Non-Ceramic Trim: Satin natural anodized extruded aluminum, style and dimensions to suit application, set with tile mortar or adhesive.
 - 1. Applications:
 - a. Open edges of wall and floor tile.
 - b. Inside and outside wall corners.
 - c. Transition between floor finishes of different heights.
 - d. Thresholds at door openings.
 - e. Floor-to-wall joints.
 - f. Borders and other trim as indicated on drawings.
 - 2. Products:
 - a. LATICRETE International, Inc: www.laticrete.com/#sle.
 - b. Schluter-Systems; Basis of Design: www.schluter.com/#sle.
 - c. Profilitec; www.profilitec.com/#sle.
 - d. Substitutions: See Section 016000 - Product Requirements.

2.03 SETTING MATERIALS

- A. Provide setting and grout materials from same manufacturer.
- B. Manufacturers:
 - 1. Custom Building Products: www.custombuildingproducts.com/#sle.
 - 2. LATICRETE International, Inc; Basis of Design: www.laticrete.com/#sle.
 - 3. Mapei Corporation: www.mapei.com/#sle.
 - 4. Substitutions: See Section 016000 - Product Requirements.
- C. Latex-Portland Cement Mortar Bond Coat: ANSI A118.4.
 - 1. Applications: Use this type of bond coat where indicated, and where no other type of bond coat is indicated.
 - 2. Products:
 - a. LATICRETE International, Inc; TRI-LITE: www.laticrete.com/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.

2.04 GROUTS

- A. Provide setting and grout materials from same manufacturer.
- B. Manufacturers:
 - 1. Custom Building Products: www.custombuildingproducts.com/#sle.
 - 2. LATICRETE International, Inc; Basis of Design: www.laticrete.com/#sle.
 - 3. Mapei Corporation: www.mapei.com/#sle.
- C. Epoxy Grout: ANSI A118.3 chemical resistant and water-cleanable epoxy grout.
 - 1. Color(s): As indicated on drawings.
 - 2. Products:

093000
TILING

- a. LATICRETE International, Inc; LATICRETE SPECTRALOCK PRO Premium Grout:
www.laticrete.com/#sle.
- b. Substitutions: See Section 016000 - Product Requirements.

2.05 ACCESSORY MATERIALS

- A. Concrete Floor Slab Crack Isolation Membrane: Material complying with ANSI A118.12; not intended as waterproofing.
 - 1. Crack Resistance: No failure at 1/8 inch gap, minimum.
 - 2. Fluid or Trowel Applied Type:
 - a. Thickness: 20 mils, maximum.
 - b. Products:
 - 1) LATICRETE International, Inc; LATICRETE FRACTURE BAN SC:
www.laticrete.com/#sle.
 - 2) Substitutions: See Section 016000 - Product Requirements.
- B. Waterproofing Membrane at Floors: Specifically designed for bonding to cementitious substrate under thick mortar bed or thin-set tile; complying with ANSI A118.10.
 - 1. Crack Resistance: No failure at 1/16 inch gap, minimum; comply with ANSI A118.12.
 - 2. Fluid or Trowel Applied Type:
 - a. Products:
 - 1) LATICRETE International, Inc; LATICRETE HYDRO BAN:
www.laticrete.com/#sle.
 - 2) Substitutions: See Section 016000 - Product Requirements.
- C. Backer Board: Cementitious type complying with ANSI A118.9; high density, glass fiber reinforced, 7/16 inch thick; 2 inch wide coated glass fiber tape for joints and corners.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.
- C. Verify that subfloor surfaces are dust free and free of substances that could impair bonding of setting materials to subfloor surfaces.
- D. Cementitious Subfloor Surfaces: Verify that substrates are ready for tiling installation by testing for moisture and alkalinity (pH).
 - 1. Test in accordance with Section 090561.
 - 2. Obtain instructions if test results are not within limits recommended by tiling material manufacturer and setting material manufacturer.
- E. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

- A. Protect surrounding work from damage.
- B. Vacuum clean surfaces and damp clean.
- C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.
- D. Install backer board in accordance with ANSI A108.11 and board manufacturer's instructions. Tape joints and corners, cover with skim coat of setting material to a feather edge.
- E. Prepare substrate surfaces for adhesive installation in accordance with adhesive manufacturer's instructions.

**093000
TILING**

3.03 INSTALLATION - GENERAL

- A. Install tile, thresholds, and stair treads and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.20, manufacturer's instructions, and TCNA (HB) or TCNA (HB-GP) recommendations, as applicable.
- B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.
- C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.
- D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.
- E. Form internal angles square and external angles bullnosed.
- F. Install non-ceramic trim in accordance with manufacturer's instructions.
- G. Sound tile after setting. Replace hollow sounding units.
- H. Keep control and expansion joints free of mortar, grout, and adhesive.
- I. Prior to grouting, allow installation to completely cure; minimum of 48 hours.
- J. Grout tile joints unless otherwise indicated. Use standard grout unless otherwise indicated.
- K. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

3.04 INSTALLATION - FLOORS - THIN-SET METHODS

- A. Over interior concrete substrates, install in accordance with TCNA (HB) Method F113, dry-set or latex-Portland cement bond coat, with epoxy grout.
 - 1. Where waterproofing membrane is indicated, install in accordance with TCNA (HB) Method F122, with latex-Portland cement grout.

3.05 INSTALLATION - WALL TILE

- A. Over cementitious backer units on studs, install in accordance with TCNA (HB) Method W244, using membrane at toilet rooms.

3.06 CLEANING

- A. Clean tile and grout surfaces.

3.07 PROTECTION

- A. Do not permit traffic over finished floor surface for 4 days after installation.

END OF SECTION 093000

093000
TILING

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**SECTION 095100
ACOUSTICAL CEILINGS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Suspended metal grid ceiling system.
- B. Acoustical units.

1.02 REFERENCE STANDARDS

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- B. ASTM C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2022.
- C. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2023.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
- B. Do not install acoustical units until after interior wet work is dry.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on suspension system components and acoustical units.
- C. Samples: Submit two samples 6 by 6 inch in size illustrating material and finish of acoustical units.
- D. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.
 - 2. Extra Acoustical Units: Quantity equal to 5 percent of total installed.

1.05 QUALITY ASSURANCE

- A. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- B. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.06 FIELD CONDITIONS

- A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acoustic Tiles/Panels:
 - 1. Armstrong World Industries, Inc; Basis of Design: www.armstrongceilings.com/#sle.
 - 2. Certainteed Architectural: www.certainteed.com/ceilings-and-walls/#sle.
 - 3. USG Corporation: www.usg.com/ceilings/#sle.
 - 4. Substitutions: See Section 016000 - Product Requirements.
- B. Suspension Systems:
 - 1. Same as for acoustical units.
 - 2. Substitutions: See Section 016000 - Product Requirements.

095100
ACOUSTICAL CEILINGS

2.02 ACOUSTICAL UNITS

- A. Acoustical Panels: Mineral fiber with membrane-faced overlay, with the following characteristics:
 - 1. Classification: ASTM E1264 Type IV.
 - a. Form: 2, water felted.
 - b. Pattern: "E" - lightly textured.
 - 2. Size: 24 by 24 inches.
 - 3. Thickness: 7/8 inch.
 - 4. Light Reflectance: 87 percent, determined in accordance with ASTM E1264.
 - 5. NRC Range: .75 to .80, determined in accordance with ASTM E1264.
 - 6. Articulation Class (AC): 170, determined in accordance with ASTM E1264.
 - 7. Ceiling Attenuation Class (CAC): 35, determined in accordance with ASTM E1264.
 - 8. Panel Edge: Square.
 - 9. Tile Edge: Beveled.
 - 10. Color: White.
 - 11. Suspension System: Exposed grid.
 - 12. Products:
 - a. Armstrong World Industries, Inc; Ultima: www.armstrongceilings.com/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.
- B. Acoustical Panels: Glass fiber with membrane-faced overlay, with the following characteristics:
 - 1. Classification: ASTM E1264 Type XII.
 - a. Pattern: "E" - lightly textured.
 - 2. Size: 24 by 48 inches.
 - 3. Thickness: 3/4 inch.
 - 4. Light Reflectance: 88 percent, determined in accordance with ASTM E1264.
 - 5. NRC Range: .90 to .95, determined in accordance with ASTM E1264.
 - 6. Articulation Class (AC): 190, determined in accordance with ASTM E1264.
 - 7. Panel Edge: Square.
 - 8. Tile Edge: Beveled.
 - 9. Color: As indicated on drawings.
 - 10. Suspension System: Exposed.
 - 11. Products:
 - a. Armstrong World Industries, Inc; Lyra: www.armstrongceilings.com/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.

2.03 SUSPENSION SYSTEM(S)

- A. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, hold down clips, stabilizer bars, clips, and splices as required.
 - 1. Materials:
 - a. Steel Grid: ASTM A653/A653M, G30 coating, unless otherwise indicated.
- B. Concealed Suspension System: Hot-dip galvanized steel grid and cap.
 - 1. Structural Classification: Intermediate-duty, when tested in accordance with ASTM C635/C635M.
 - 2. Profile: Tee; 9/16 inch face width.
 - 3. Finish: Baked enamel.
 - 4. Color: As indicated on drawings.
 - 5. Products:
 - a. Armstrong World Industries, Inc; Suprafine: www.armstrongceilings.com/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.

095100
ACOUSTICAL CEILINGS

2.04 ACCESSORIES

- A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.
- B. Hanger Wire: 12 gauge, 0.08 inch galvanized steel wire.
- C. Perimeter Moldings: Same metal and finish as grid.
- D. Metal Edge Trim for Suspension Systems: Steel or extruded aluminum; provide attachment clips, splice plates, and preformed corner pieces for complete trim system.
 - 1. Trim Height: 6 inches.
 - 2. Finish: Baked enamel.
 - 3. Color: As indicated on drawings.
 - 4. Products:
 - a. Armstrong World Industries, Inc; AXIOM Classic: www.armstrongceilings.com/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that layout of hangers will not interfere with other work.

3.02 PREPARATION

- A. Install after major above-ceiling work is complete.
- B. Coordinate the location of hangers with other work.

3.03 INSTALLATION - SUSPENSION SYSTEM

- A. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
- B. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
 - 1. Use longest practical lengths.
- C. Suspension System, Non-Seismic: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
- D. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
- E. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- F. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.
- G. Do not eccentrically load system or induce rotation of runners.

3.04 INSTALLATION - ACOUSTICAL UNITS

- A. Install acoustical units in accordance with manufacturer's instructions.
- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Fit border trim neatly against abutting surfaces.
- D. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- E. Cutting Acoustical Units:
 - 1. Make field cut edges of same profile as factory edges.

095100
ACOUSTICAL CEILINGS

- F. Where round obstructions occur, provide preformed closures to match perimeter molding.
- G. Install hold-down clips on panels within 20 ft of an exterior door.

3.05 TOLERANCES

- A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.
- B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

3.06 CLEANING

END OF SECTION 095100

**SECTION 096500
RESILIENT FLOORING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Resilient sheet flooring.
- B. Resilient tile flooring.
- C. Resilient base.
- D. Resilient stair accessories.
- E. Installation accessories.

1.02 RELATED REQUIREMENTS

- A. Section 090561 - Common Work Results for Flooring Preparation: Removal of existing floor coverings, cleaning, and preparation.
- B. Section 090561 - Common Work Results for Flooring Preparation: Concrete slab moisture and alkalinity testing and remediation procedures.

1.03 REFERENCE STANDARDS

- A. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2023.
- B. ASTM F1344 - Standard Specification for Rubber Floor Tile; 2021a.
- C. ASTM F1700 - Standard Specification for Solid Vinyl Floor Tile; 2020.
- D. ASTM F1861 - Standard Specification for Resilient Wall Base; 2021.
- E. ASTM F1913 - Standard Specification for Vinyl Sheet Floor Covering Without Backing; 2019.
- F. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; 2023.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- C. Shop Drawings: Indicate seaming plans and floor patterns.
- D. Verification Samples: Submit two samples, 6 by 6 inch in size illustrating color and pattern for each resilient flooring product specified.
- E. Manufacturer's Qualification Statement.
- F. Installer's Qualification Statement.
- G. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.
 - 2. Extra Flooring Material: 40 square feet of each type and color.
 - 3. Extra Wall Base: 20 linear feet of each type and color.
 - 4. Extra Stair Materials: Quantity equivalent to 5 percent of each type and color.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing specified flooring with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in installing specified flooring with minimum three years documented experience.

096500
RESILIENT FLOORING

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.
- B. Store all materials off of the floor in an acclimatized, weather-tight space.
- C. Maintain temperature in storage area between 55 degrees F and 90 degrees F.
- D. Protect roll materials from damage by storing on end.
- E. Do not double stack pallets.

1.07 FIELD CONDITIONS

- A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

PART 2 PRODUCTS

2.01 SHEET FLOORING

- A. Vinyl Sheet Flooring: Homogeneous without backing, with color and pattern throughout full thickness.
 - 1. Manufacturers:
 - a. Armstrong Flooring: www.armstrongflooring.com/#sle.
 - b. Mannington Commercial: www.manningtoncommercial.com/#sle.
 - c. Tarkett Company; iQ Granit: www.commercial.tarkett.com/#sle.
 - d. Substitutions: See Section 016000 - Product Requirements.
 - 2. Minimum Requirements: Comply with ASTM F1913.
 - 3. Thickness: 0.080 inch nominal.
 - 4. Seams: Chemically bonded using seam sealer.
 - 5. Integral coved base with cap strip.
 - 6. Color: As indicated on drawings.

2.02 TILE FLOORING

- A. Vinyl Tile: Printed film type, with transparent or translucent wear layer; acoustic interlayer or backing.
 - 1. Manufacturers:
 - a. Mannington Commercial: www.manningtoncommercial.com/#sle.
 - b. Miliken: www.miliken.com/#sle. Basis of Design.
 - c. Interface: www.interface.com/
 - d. Substitutions: See Section 016000 - Product Requirements.
 - 2. Minimum Requirements: Comply with ASTM F1700, Class III.
 - 3. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648.
 - 4. Plank Tile Size: 7 by 48 inch.
 - 5. Wear Layer Thickness: 0.020 inch.
 - 6. Total Thickness: 0.20 inch.
 - 7. Color: As indicated on drawings.
- B. Rubber Tile: Homogeneous, color and pattern throughout thickness.
 - 1. Manufacturers:
 - a. Tarkett Company; Color Splash: www.johnsonite.com/#sle. Basis of Design.
 - b. Mannington Commercial; _____: www.manningtoncommercial.com/#sle.
 - c. Roppe Corporation; Rubber Tile: www.roppe.com/#sle.
 - d. Substitutions: See Section 016000 - Product Requirements.

096500
RESILIENT FLOORING

2. Minimum Requirements: Comply with ASTM F1344, of Class corresponding to type specified.
3. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.
4. Size: As indicated on drawings.
5. Total Thickness: 0.125 inch.
6. Texture: Hammered.
7. Color: As indicated on drawings.

2.03 STAIR COVERING

- A. Stair Treads with Integral Risers: Rubber; full height of riser, full width and depth of tread in one piece; tapered thickness.
 1. Manufacturers:
 - a. Tarkett Company; Color Splash: www.johnsonite.com. Basis of Design.
 - b. Mannington Commercial: www.manningtoncommercial.com#sle.
 - c. Roppe Corporation: www.roppe.com/#sle.
 - d. Substitutions: See Section 016000 - Product Requirements.
 2. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.
 3. Nosing: Square.
 4. Striping: 2 inch wide contrasting color abrasive strips.
 5. Tread Texture: Hammered.
 6. Color: As indicated on drawings.

2.04 RESILIENT BASE

- A. Resilient Base: ASTM F1861, Type TS, rubber, vulcanized thermoset; style as scheduled.
 1. Manufacturers:
 - a. Johnsonite, a Tarkett Company; Baseworks: www.johnsonite.com/#sle. Basis of Design.
 - b. Mannington Commercial: www.manningtoncommercial.com#sle.
 - c. Roppe Corporation: www.roppe.com/#sle.
 2. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.
 3. Height: 4 inches.
 4. Thickness: 0.125 inch.
 5. Finish: Satin.
 6. Length: Roll.
 7. Color: As indicated on drawings.

2.05 ACCESSORIES

- A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.
- B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.
- C. Filler for Coved Base: Plastic.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- B. Cementitious Subfloor Surfaces: Verify that substrates are ready for resilient flooring installation by testing for moisture and alkalinity (pH).

096500
RESILIENT FLOORING

1. Test in accordance with Section 090561.
 2. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.
- C. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

- A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
- B. Remove subfloor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with subfloor filler to achieve smooth, flat, hard surface.
- C. Prohibit traffic until filler is fully cured.

3.03 INSTALLATION - GENERAL

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install in accordance with manufacturer's written instructions.

3.04 INSTALLATION - SHEET FLOORING

- A. Lay flooring with joints and seams parallel to longer room dimensions, to produce minimum number of seams. Lay out seams to avoid widths less than 1/3 of roll width; match patterns at seams.
- B. Chemically bond seams using seam sealer where indicated.
- C. Coved Base: Install as detailed on drawings, using coved base filler as backing at floor to wall junction. Extend sheet flooring vertically to height indicated, and cover top edge with metal cap strip.

3.05 INSTALLATION - TILE FLOORING

- A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.
- B. Lay flooring with joints and seams parallel to building lines to produce symmetrical pattern.
- C. Install plank tile with a random offset of at least 6 inches from adjacent rows.

3.06 INSTALLATION - RESILIENT BASE

- A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.
- B. Miter internal corners. At external corners, use premolded units. At exposed ends, use premolded units.
- C. Install base on solid backing. Bond tightly to wall and floor surfaces.
- D. Scribe and fit to door frames and other interruptions.

3.07 INSTALLATION - STAIR COVERINGS

- A. Adhere over entire surface. Fit accurately and securely.

3.08 CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean in accordance with manufacturer's written instructions.

3.09 PROTECTION

- A. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION 096500

**SECTION 096813
TILE CARPETING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Carpet tile, fully adhered.
- B. Removal of existing carpet tile.

1.02 RELATED REQUIREMENTS

- A. Section 090561 - Common Work Results for Flooring Preparation: Removal of existing floor coverings, cleaning, and preparation.

1.03 REFERENCE STANDARDS

- A. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2023.
- B. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; 2023.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.
- C. Samples: Submit two carpet tiles illustrating color and pattern design for each carpet color selected.
- D. Operation and Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.
 - 2. Extra Carpet Tiles: Quantity equal to 5 percent of total installed of each color and pattern installed.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in installing carpet tile with minimum three years documented experience and approved by carpet tile manufacturer.

1.06 FIELD CONDITIONS

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Tile Carpeting:
 - 1. Interface, Inc; Drfitwood: www.interface.com/#sle. Basis of Design
 - 2. Milliken & Company: www.milliken.com/#sle.
 - 3. Mohawk Group: www.mohawkgroup.com/#sle.

2.02 MATERIALS

- A. Tile Carpeting: Tufted, manufactured in one color dye lot.
 - 1. Tile Size: 10 by 36 inch, nominal.
 - 2. Color: As indicated on drawings.
 - 3. Critical Radiant Flux: Minimum of 0.22 watts/sq cm, when tested in accordance with ASTM E648 or NFPA 253.

2.03 ACCESSORIES

- A. Subfloor Filler: White premix latex; type recommended by flooring material manufacturer.
- B. Edge Strips: Embossed aluminum, color as selected by Architect.

096813
TILE CARPETING

- C. Carpet Tile Adhesive: Recommended by carpet tile manufacturer; releasable type.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that subfloor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.
- B. Cementitious Subfloor Surfaces: Verify that substrates are ready for flooring installation by testing for moisture and alkalinity (pH).
 - 1. Test in accordance with Section 090561.
 - 2. Obtain instructions if test results are not within limits recommended by flooring material manufacturer and adhesive materials manufacturer.
- C. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

- A. Remove existing carpet tile.
- B. Prepare floor substrates for installation of flooring in accordance with Section 090561.

3.03 INSTALLATION

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install carpet tile in accordance with manufacturer's instructions.
- C. Blend carpet from different cartons to ensure minimal variation in color match.
- D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.
- E. Lay carpet tile in square pattern, with pile direction parallel to next unit, set parallel to building lines.
- F. Locate change of color or pattern between rooms under door centerline.
- G. Fully adhere carpet tile to substrate.
- H. Trim carpet tile neatly at walls and around interruptions.
- I. Complete installation of edge strips, concealing exposed edges.

3.04 CLEANING

- A. Remove excess adhesive without damage, from floor, base, and wall surfaces.
- B. Clean and vacuum carpet surfaces.

END OF SECTION 096813

**SECTION 099000
PAINTING AND COATING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface preparation.
- B. Interior painting and coating systems.
- C. Scope:
 - 1. Finish surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
 - a. Interior:
 - 1) Metal: Aluminum and galvanized.
 - 2) Metal: Structural steel columns, joists, trusses, beams, miscellaneous and ornamental iron, structural iron, and other ferrous metal.
 - 3) Wood: Walls, ceilings, doors, and trim.
 - 4) Drywall: Walls, ceilings, gypsum board, and similar items.

1.02 RELATED REQUIREMENTS

- A. Section 055000 - Metal Fabrications: Shop-primed items.

1.03 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; Current Edition.
- B. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board; 2020.
- C. SCAQMD 1113 - Architectural Coatings; 1977, with Amendment (2016).
- D. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).
- E. SSPC-SP 2 - Hand Tool Cleaning; 2024.
- F. SSPC-SP 3 - Power Tool Cleaning; 2024.
- G. SSPC-SP 6/NACE No.3 - Commercial Blast Cleaning; 2006.
- H. SSPC-SP 13/NACE No.6 - Surface Preparation of Concrete; 2018.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide complete list of products to be used, with the following information for each:
 - 1. Product characteristics.
 - 2. Surface preparation instructions and recommendations.
 - 3. Primer requirements and finish specification.
 - 4. Storage and handling requirements and recommendations.
 - 5. Application methods.
 - 6. Clean-up information.
- C. Samples: Submit four paper draw down samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
- D. Maintenance Data: Submit coating maintenance manual including finish schedule showing where each product/color/finish was used, product technical data sheets, safety data sheets (SDS), care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements for additional provisions.

099000

PAINTING AND COATING

2. Extra Paint and Finish Materials: 1 gallon of each color; from the same product run, store where directed.
3. Label each container with color in addition to manufacturer's label.

1.05 QUALITY ASSURANCE

- A. Applicator Qualifications: Company specializing in performing the type of work specified with minimum 3 years experience and approved by manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, product name, product code, color designation, VOC content, batch date, environmental handling, surface preparation, application, and use instructions.
- C. Paint Materials: Store at a minimum of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.07 FIELD CONDITIONS

- A. Do not apply materials when environmental conditions are outside the ranges required by manufacturer.
- B. Follow manufacturer's recommended procedures for producing the best results, including testing substrates, moisture in substrates, and humidity and temperature limitations.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design Products: Subject to compliance with requirements, provide Sherwin-Williams Company (The) products indicated; www.sherwin-williams.com/#sle.
- B. Comparable Products: Products of approved manufacturers will be considered in accordance with 016000 - Product Requirements, and the following:
 1. Products that meet or exceed performance and physical characteristics of basis of design products.
 2. Other Acceptable Manufacturers:
 - a. Behr: www.behr.com
 - b. Benjamin Moore: www.benjaminmoore.com

2.02 PAINTINGS AND COATINGS

- A. General:
 1. Provide factory-mixed coatings unless otherwise indicated.
 2. Do not reduce, thin, or dilute coatings or add materials to coatings unless specifically indicated in manufacturer's instructions.
- B. Volatile Organic Compound (VOC) Content:
 1. Provide paints and finishes that comply with the most stringent requirements specified in the following:
 - a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
 - b. SCAQMD 1113 Rule.
- C. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

2.03 PAINT SYSTEMS - INTERIOR

- A. Metal: Aluminum and galvanized.
 1. Latex Systems:
 - a. Semi-Gloss Finish:

099000

PAINTING AND COATING

- 1) 1st Coat: Sherwin-Williams Pro Industrial Pro-Cryl Universal Primer, B66-1310
Series: www.sherwin-williams.com/#sle.
(a) 5 mils wet, 2 mils dry per coat.
 - 2) 2nd and 3rd Coat: Sherwin-Williams Pro Industrial Acrylic Semi-Gloss, B66-650
Series: www.sherwin-williams.com/#sle.
(a) 2 to 4 mils dry per coat.
- B. Metal: Structural steel columns, joists, trusses, beams, miscellaneous and ornamental iron, structural iron, and ferrous metal.
1. Latex Systems:
 - a. Semi-Gloss Finish:
 - 1) 1st Coat: Sherwin-Williams Pro Industrial Pro-Cryl Universal Primer, B66-1310
Series: www.sherwin-williams.com/#sle.
(a) 5 mils wet, 2 mils dry per coat.
 - 2) 2nd and 3rd Coat: Sherwin-Williams Pro Industrial Acrylic Semi-Gloss, B66-650
Series: www.sherwin-williams.com/#sle.
(a) 2 to 4 mils dry per coat.
 2. Dryfall Waterborne Topcoat:
 - a. Flat Finish:
 - 1) 1st Coat: Sherwin-Williams Pro Industrial Pro-Cryl Universal Primer, B66-1310
Series: www.sherwin-williams.com/#sle.
(a) 5 mils wet, 2 mils dry per coat.
 - 2) 2nd and 3rd Coat: Sherwin-Williams Pro Industrial Waterborne Acrylic Dryfall, B42-181 Series: www.sherwin-williams.com/#sle.
(a) 6 mils wet, 1.7 mils dry per coat.
- C. Wood: Walls, ceilings, doors, and trim.
1. Latex Systems:
 - a. Semi-Gloss Finish:
 - 1) 1st Coat: Sherwin-Williams Premium Wall and Wood Primer, B28W8111:
www.sherwin-williams.com/#sle.
(a) 4 mils wet, 1.8 mils dry per coat.
 - 2) 2nd and 3rd Coat: Sherwin-Williams ProClassic Waterborne Acrylic Semi-Gloss, B31 Series: www.sherwin-williams.com/#sle.
(a) 4 mils wet, 1.3 mils dry per coat.
- D. Drywall: Walls, ceilings, gypsum board, and similar items.
1. Latex Systems:
 - a. Eg-Shel Finish:
 - 1) 1st Coat: Sherwin-Williams ProMar 200 Zero VOC Interior Latex Primer, B28W2600: www.sherwin-williams.com/#sle.
(a) 4 mils wet, 1.5 mils dry per coat.
 - 2) 2nd and 3rd Coat: Sherwin-Williams ProMar 200 Zero VOC Eg-Shel, B20-2600 Series: www.sherwin-williams.com/#sle.
(a) 4 mils wet, 1.7 mils dry per coat.
 - b. Flat Finish:
 - 1) 1st Coat: Sherwin-Williams ProMar 200 Zero VOC Interior Latex Primer, B28W2600: www.sherwin-williams.com/#sle.
(a) 4 mils wet, 1.5 mils dry per coat.
 - 2) 2nd and 3rd Coat: Sherwin-Williams ProMar 200 Zero VOC Latex Flat, B30-2600 Series: www.sherwin-williams.com/#sle.
(a) 4 mils wet, 1.6 mils dry per coat.
 2. Epoxy Systems, Water-Based:
 - a. Eg-Shel/Low Luster Finish:

099000

PAINTING AND COATING

- 1) 1st Coat: Sherwin-Williams ProMar 200 Zero VOC Interior Latex Primer, B28W2600: www.sherwin-williams.com/#sle.
(a) 4 mils wet, 1.5 mils dry per coat.
- 2) 2nd and 3rd Coat: Sherwin-Williams Pro Industrial Pre-Catalyzed Waterbased Epoxy, K45 Series: www.sherwin-williams.com/#sle.
(a) 4 mils wet, 1.5 mils dry per coat.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

3.02 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Gypsum Board: Fill minor defects with filler compound; sand smooth and remove dust prior to painting.
- D. Wood: Remove dust, grit, and foreign matter. Scrape, sand, and spot prime knots and pitch streaks. Fill nail holes and imperfections with wood filler and sand smooth.

3.03 APPLICATION

- A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- B. Apply products in accordance with manufacturer's written instructions.
- C. Apply coatings at spread rate required to achieve manufacturer's recommended dry film thickness.

3.04 PRIMING

- A. Apply primer to all surfaces unless specifically not required by coating manufacturer. Apply in accordance with coating manufacturer's instructions.
- B. Primers specified in painting schedules may be omitted on items factory primed or factory finished items if acceptable to top coat manufacturers.

3.05 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.
- B. Clean surfaces immediately of overspray, splatter, and excess material.
- C. After coating has cured, clean and replace finish hardware, fixtures, and fittings previously removed.

3.06 PROTECTION

- A. Protect finished coatings from damage until completion of project.
- B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION 099000

SECTION 101423 PANEL SIGNAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Panel signage.

1.02 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

1.03 SUBMITTALS

- A. See Section 13300-Submittal Procedures.
- B. Product Data: Manufacturer's product literature for each type of panel sign, indicating styles, font, foreground and background colors, locations, and overall dimensions of each sign.
- C. Shop Drawings:
 - 1. Include dimensions, locations, elevations, materials, text and graphic layout, attachment details, and schedules.
 - 2. Schedule: Provide information sufficient to completely define each panel sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
 - a. When room numbers to appear on signs differ from those on drawings, include the drawing room number on schedule.
 - b. When content of signs is indicated to be determined later, request such information from Owner through Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
 - c. Submit for approval by Owner through Architect prior to fabrication.
- D. Selection Samples: Where colors, materials, and finishes are not specified, submit two sets of color selection charts or chips.
- E. Manufacturer's qualification statement.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Package signs as required to prevent damage before installation.
- B. Package room and door signs in sequential order of installation, labeled by floor or building.
- C. Store tape adhesive at normal room temperature.

1.06 FIELD CONDITIONS

- A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.
- B. Maintain minimum ambient temperature during and after installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Panel Signage:
 - 1. Inpro Corporation: www.inprocorp.com/#sle.
 - 2. Takeform: www.takeform.net/#sle.
 - 3. Gemini Inc.: www.geminimade.com

101423
PANEL SIGNAGE

2.02 REGULATORY REQUIREMENTS

- A. Accessibility Requirements: Comply with ADA Standards and ICC A117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most restrictive requirements.

2.03 PANEL SIGNAGE

- A. Panel Signage:
 - 1. Application: Room and door signs.
 - 2. Description: Flat signs with engraved panel media, tactile characters.
 - 3. Sign Size: As indicated on drawings.
 - 4. Total Thickness: 1/8 inch.
 - 5. Sign Edges: Squared.
 - 6. Corners: Squared.
 - 7. Color and Font, unless otherwise indicated:
 - a. Character Font: Helvetica, Arial, or other sans serif font.
 - b. Character Case: Upper and lower case (title case).
 - c. Background Color: As selected by Architect from Manufacturers full range.
 - d. Character Color: Contrasting color.
 - 8. Material: Laminated colored plastic engraved through face to expose core as background color.
 - 9. Profile: Flat panel without frame.
 - 10. Tactile Letters: Raised 1/32 inch minimum.
 - 11. Braille: Grade II, ADA-compliant.

2.04 SIGNAGE APPLICATIONS

- A. Room and Door Signs:
 - 1. Office Doors: Identify with room names and numbers to be determined later, not those indicated on drawings; provide "window" section for replaceable occupant name.
 - 2. Conference and Meeting Rooms: Identify with room names and numbers to be determined later, not those indicated on drawings.
 - 3. Service Rooms: Identify with room names and numbers to be determined later, not those indicated on drawings.
 - 4. Rest Rooms: Identify with pictograms, the names "MEN" and "WOMEN", room numbers to be determined later, and braille.

2.05 ACCESSORIES

- A. Tape Adhesive: Double-sided tape, permanent adhesive.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.
- B. Notify Architect if conditions are not suitable for installation of signs; do not proceed until conditions are satisfactory.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install with horizontal edges level.
- C. Locate panel signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.

END OF SECTION 101423

**SECTION 102113.17
PHENOLIC TOILET COMPARTMENTS - ASI**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Phenolic toilet compartments.
- B. Phenolic urinal screens.

1.02 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- D. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
- E. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.03 SUBMITTALS

- A. See Section 013300 - Submittal Procedures.
- B. Product Data: Provide data on panel construction, hardware, accessories, and finishes.
- C. Shop Drawings:
 - 1. Indicate plans, elevations, and dimensions. Include door swings, toilet fixture centerlines, and floor drains on plans.
- D. Samples:
 - 1. For Verification: Submit two samples of partition materials, 3 by 3 inches in size, indicating color.
- E. Manufacturer's qualification statement.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least three years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. See Section 017419 - Construction Waste Management and Disposal for packaging waste requirements.
- B. Deliver, store, handle materials and products in accordance with manufacturer's instructions, recommendations, and industry standards.

1.06 FIELD CONDITIONS

- A. Ambient Conditions: Maintain environmental conditions such as temperature, humidity, and ventilation within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.07 WARRANTY

- A. See Section 017700-Closeout Procedures for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. ASI Accurate Partitions: www.asi-accuratepartitions.com/#sle.
- B. ASI Global Partitions: www.asi-globalpartitions.com/#sle.
- C. Basis of Design: General Partitions MFG. Co.: generalpartitions.com.
- D. Substitutions: See Section 016000 - Product Requirements.

102113.17
PHENOLIC TOILET
COMPARTMENTS - ASI

2.02 PHENOLIC TOILET COMPARTMENTS

- A. Toilet Compartments: Black core phenolic.
 - 1. Standard floor-anchored, overhead-braced mounting.
- B. Urinal Screens: Black core phenolic, wall hung.
- C. Design Criteria:
 - 1. Accessibility: Design compartments indicated on drawings to comply with ICC A117.1 and ADA Standards.
 - 2. Black Core Phenolic Surface Burning Characteristics: Provide assemblies with flame spread index of 75 or less and smoke developed index of 450 or less, Class B, when tested in accordance with ASTM E84.
- D. Fabrication:
 - 1. Fabricate toilet compartment components to sizes indicated.
 - 2. Coordinate requirements and provide cutouts for through-partition toilet accessories and solid blocking within panel where required for attachment of toilet accessories.
 - 3. Provide shoes and caps at pilasters and posts to conceal anchorage, supports, and leveling mechanisms.
 - 4. Provide manufacturer's standard corrosion-resistant supports, leveling mechanisms, anchors, and anchoring assemblies for pilasters and posts.
 - 5. Floor-Anchored, Overhead-Braced Units: Provide supports, leveling mechanisms, Easy-Stall shoes, and anchors at pilasters to suit floor conditions.

2.03 COMPONENTS

- A. Doors, Panels, and Pilasters: Phenolic-resin impregnated, wood-based product core with melamine-impregnated decorative surface papers and transparent, protective topcoat; NEMA LD 3 Compact Laminate.
 - 1. Finish: Matte.
 - 2. Black Core Phenolic Color: As selected from manufacturer's color card.
- B. Standard Door and Panel Dimensions:
 - 1. Door Thickness: 3/4 inch.
 - 2. Standard:
 - a. Door Panel Height: 58 inches.
 - b. Door Height above Floor: 12 inches.
 - 3. Urinal and Entrance Screen Panel Height: 48 inches.
 - 4. Urinal and Entrance Screen Panel Height above Floor: 12 inches.
- C. Standard Pilasters: 3/4 inch thick, of sizes required to suit compartment width and spacing.
 - 1. Pilaster Height: 82 inches.
 - 2. Easy-Stall Pilaster Shoes: Formed 20 gauge, 0.0359 inch ASTM A666 Type 304 stainless steel with No.4 finish, 3 inches high, concealing floor fastenings and leveling bolts; secured to pilaster with stainless steel tamper-resistant screws; secured to floor with concrete anchors.
 - 3. Pilaster Anchors: Manufacturer's standard mounting bars attached to pilaster and secured to building structure.

2.04 MATERIALS

- A. Phenolic Panels: Monolithic core of phenolic resin, reinforced with cellulose fibers, manufactured under high pressure and at high temperatures, with melamine-impregnated decorative surface papers; NEMA LD 3, Compact Laminate.

2.05 HARDWARE AND ACCESSORIES

- A. Brackets:

102113.17
PHENOLIC TOILET
COMPARTMENTS - ASI

1. Stirrup Type: Brushed stainless steel.
- B. Standard Door Hardware: Brushed stainless steel:
 1. Hinges: Brushed stainless steel vault hinges, gravity type, adjustable for door close positioning; two per door.
 2. Latch and Keeper: Brushed stainless steel Alpaco latch with occupancy indicator
 3. Coat Hook: Manufacturer's standard coat hook with rubber bumper; one per compartment, mounted on door.
 4. Door Pull: Provide door pull for outswinging doors. Provide on both sides of doors designated as accessible.
- C. Attachments, Screws, and Bolts: Stainless steel, tamper-resistant type.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that field measurements are as indicated.
- C. Verify correct spacing of and between plumbing fixtures.
- D. Verify correct location of built-in framing, anchorage, and bracing.

3.02 INSTALLATION

- A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's written instructions.
- B. Attach panel brackets securely to walls using anchor devices.
- C. Attach panels and pilasters to brackets. Locate head rail joints at pilaster centerlines.
- D. Field touch-up of scratches or damaged finish not permitted. Replace damaged or scratched materials with new materials.

3.03 TOLERANCES

- A. Maximum Variation from True Position: 1/4 inch.
- B. Maximum Variation from Plumb: 1/8 inch.

3.04 ADJUSTING

- A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch.
- B. Adjust adjacent components for consistency of line or plane.

3.05 CLEANING

- A. Clean partition and screen surfaces with materials and cleansers in accordance with manufacturer's recommendations.

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West Campus Renovations
102113.17 - 4

**102113.17
PHENOLIC TOILET
COMPARTMENTS - ASI**

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**SECTION 102123
CUBICLE CURTAINS AND TRACK**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface mounted overhead curtain track and guides.
- B. Cubicle curtains.

1.02 RELATED REQUIREMENTS

- A. Section 055000 - Metal Fabrications : Track supports above ceiling.

1.03 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- B. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2023, with Errata.

1.04 SUBMITTALS

- A. See Section 013300 - Submittal Procedures.
- B. Product Data: Provide data for curtain fabric characteristics and track components..
- C. Shop Drawings: Indicate a reflected ceiling plan view of curtain track, hangers and suspension points, attachment details, schedule of curtain sizes.
- D. Samples: Submit 12 by 12 inch sample patch of curtain cloth with representative top, bottom, and edge hem stitch detail, heading with reinforcement and carrier attachment to curtain header.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.
 - 2. Extra Curtains: One of each type and size.
 - 3. Extra Carriers: twenty.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Accept curtain materials on site and inspect for damage.
- B. Store curtain materials on site and deliver to Owner for installation when requested.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Cubicle Track and Curtains:
 - 1. Construction Specialties, Inc; Track Systems: www.c-sgroup.com/#sle.
 - 2. Imperial Fastener Co., Inc: www.imperialfastener.com/#sle.
 - 3. Inpro; Optitrac: www.inprocorp.com - Basis-of-Design.
 - 4. Substitutions: See Section 016000 - Product Requirements.

2.02 TRACKS AND TRACK COMPONENTS

- A. Tracks: Extruded aluminum sections; one piece per track run.
 - 1. Profile: Channel.
 - 2. Mounting: Surface.
 - 3. Structural Performance: Capable of supporting vertical test load of 50 lbs without visible deflection of track or damage to supports, safely supporting moving loads, and sufficiently rigid to resist visible deflection and without permanent set.
 - 4. Track End Stop: To fit track section.
 - 5. Track Bends: Minimum 12 inch radius; fabricated without deformation of track section or impeding movement of carriers.
 - 6. Finish on Exposed Surfaces: White enamel.

CUBICLE CURTAINS AND TRACK

- B. Curtain Carriers: Nylon rollers, size and type compatible with track; designed to eliminate bind when curtain is pulled; fitted to curtain to prevent accidental curtain removal.
- C. Wand: Aluminum 42 inches long, attached to lead carrier, for pull-to-close action.
- D. Installation Accessories: Types required for specified mounting method and substrate conditions.

2.03 CURTAINS

- A. Cubicle Curtains:
 - 1. Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
 - 2. Inherently flame resistant or flameproofed; capable of passing NFPA 701 test.
 - 3. Color/Pattern: Refer to Finish Schedule on Interior Drawings..
 - 4. Open Mesh Cloth: Open weave to permit air circulation; flameproof material, manufacturer's standard color.
 - 5. Attachment of Curtain Fabric to Open Mesh Cloth: Manufacturer's standard sewn seam.
- B. Curtain Fabrication:
 - 1. Width of curtain to be 15 percent wider than track length.
 - 2. Length of curtain to end 15 inches above finished floor.
 - 3. Pattern match fabric with vertical seams.
 - 4. Include open mesh cloth at top 20 inches of curtain for room air circulation, attached to curtain as specified above.
 - 5. Seams and Hems: Manufacturer's standard fabrication method for securely sewn and finished seams and hems.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces and supports above ceiling are ready to receive work of this Section.
- B. Verify that field measurements are as indicated.

3.02 INSTALLATION

- A. Install curtain track to be secure, rigid, and true to ceiling line.
- B. See Section 055000 for track supports above ceiling.
- C. Install end cap and stop device.
- D. Install curtains on carriers ensuring smooth operation.

END OF SECTION 102123

**SECTION 102600
WALL AND DOOR PROTECTION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Bumper rails.
- B. Crash rails.
- C. Corner guards.

1.02 REFERENCE STANDARDS

- A. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics; 2023, with Editorial Revision.
- B. ASTM D543 - Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents; 2021.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- D. ASTM F476 - Standard Test Methods for Security of Swinging Door Assemblies; 2023.

1.03 SUBMITTALS

- A. See Section 013300- Submittal Procedures.
- B. Product Data: Indicate physical dimensions, features, wall mounting brackets with mounted measurements, anchorage details, and rough-in measurements.
- C. Shop Drawings: Include plans, elevation, sections, and attachment details. Show design and spacing of supports for protective corridor handrails, required to withstand structural loads.
- D. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project:
 - 1. See Section 016000 - Product Requirements, for additional provisions.
- F. Maintenance Data: Manufacturer's instructions for care and cleaning of each type of product. Include information about both recommended and potentially detrimental cleaning materials and methods.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver wall and door protection items in original, undamaged protective packaging. Label items to designate installation locations.
- B. Protect work from moisture damage.
- C. Protect work from UV light damage.
- D. Store products in either horizontal or vertical position, in compliance with manufacturer's instructions.

1.05 WARRANTY

- A. See Section 017700 - Closeout Procedures for additional warranty requirements.
- B. Manufacturer Warranty: Provide 5-year manufacturer warranty for metal crash rails. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Bumper Rails, Crash Rails, and Corner Guards:
 - 1. Construction Specialties, Inc; Acrovyn Solid Color and Chameleon Crash Rails: www.csgroup.com/#sle. Basis of Design.
 - 2. Inpro: www.inprocorp.com/#sle.

102600
WALL AND DOOR
PROTECTION

3. Koroseal Interior Products: www.koroseal.com/#sle.
4. Substitutions: See Section 016000 - Product Requirements.

2.02 PERFORMANCE CRITERIA

- A. Impact Strength: Unless otherwise noted, provide protection products and assemblies that have been successfully tested for compliance with applicable provisions of ASTM D256 and/or ASTM F476.
- B. Chemical and Stain Resistance: Unless otherwise noted, provide protection products and assemblies with chemical and stain resistance complying with applicable provisions of ASTM D543.

2.03 PRODUCT TYPES

- A. Bumper Rails: Factory- or shop-fabricated, with preformed end caps and internal and external corners and aluminum retainers:
 1. Performance of Installed Assembly:
 - a. Support vertical live load of 100 lb/lineal ft with deflection not to exceed 1/50 of span between supports.
 - b. Resist lateral force of 250 lbs at any point without damage or permanent set.
 2. Material: High impact vinyl, color as indicated.
 3. Material: Metal; 6063-T3 Aluminum for retainers..
 4. Surface Burning Characteristics: Provide assemblies with flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
 5. Mounting: Surface.
 6. Return rail to wall.
- B. Corner Guards - Flush Mounted:
 1. Material: High impact vinyl with full height extruded aluminum retainer.
 2. Performance: Resist lateral impact force of 100 lbs at any point without damage or permanent set.
 3. Surface Burning Characteristics: Provide assemblies with flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
 4. Width of Wings: 3 inches.
 5. Corner: Square.
 6. Color: As indicated.
 7. Length: One piece.

2.04 FABRICATION

- A. Fabricate components with tight joints, corners and seams.

2.05 SOURCE QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Provide wall and door protection systems of each type from a single source and manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that rough openings, concealed blocking, and anchors are correctly sized and located.
- B. Verify that field measurements are as indicated on drawings.
- C. Start of installation constitutes acceptance of project conditions.

102600
WALL AND DOOR
PROTECTION

3.02 INSTALLATION

- A. Position top of bumper rail 36 inches from finished floor.
- B. Position corner guard 4 inches above finished floor to ____ inches high.
- C. Terminate rails 1 inch short of door openings and intersecting walls.

3.03 TOLERANCES

- A. Maximum Variation From Required Height: 1/4 inch.
- B. Maximum Variation From Level or Plane For Visible Length: 1/4 inch.

3.04 CLEANING

- A. Clean wall and door protection items of excess adhesive, dust, dirt, and other contaminants.

END OF SECTION 102600

**102600
WALL AND DOOR
PROTECTION**

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**SECTION 102800
TOILET, BATH, AND LAUNDRY ACCESSORIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Commercial toilet accessories.

1.02 RELATED REQUIREMENTS

- A. Section 005500: Concealed supports for accessories, including in wall framing and plates.
- B. Section 224000 - Plumbing Fixtures: Under-lavatory pipe and supply covers.

1.03 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- C. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2022.
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- E. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
- F. ASTM B86 - Standard Specification for Zinc and Zinc-Aluminum (ZA) Alloy Foundry and Die Castings; 2023.
- G. ASTM B456 - Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium; 2017 (Reapproved 2022).
- H. ASTM C1036 - Standard Specification for Flat Glass; 2021.
- I. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with the placement of internal wall reinforcement and concealed ceiling supports to receive anchor attachments.

1.05 SUBMITTALS

- A. See Section 013300 - Submittal Procedures.
- B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Commercial Toilet, Shower, and Bath Accessories:
 - 1. American Specialties, Inc: www.americanspecialties.com/#sle.
 - 2. Bradley Corporation: Basis of design: www.bradleycorp.com/#sle.
 - 3. Bobrick Washroom Equipment.
 - 4. Substitutions: Section 016000 - Product Requirements.
- B. Provide products of each category type by single manufacturer.

2.02 MATERIALS

- A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
 - 1. Grind welded joints smooth.
 - 2. Fabricate units made of metal sheet of seamless sheets with flat surfaces.

102800
TOILET, BATH, AND LAUNDRY
ACCESSORIES

- B. Keys: Provide four keys for each accessory to Owner; master key lockable accessories.
- C. Stainless Steel Sheet: ASTM A666, Type 304.
- D. Stainless Steel Tubing: ASTM A269/A269M, Grade TP304 or TP316.
- E. Galvanized Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating.
- F. Zinc Alloy: Die cast, ASTM B86.
- G. Mirror Glass: Tempered safety glass, ASTM C1048; and ASTM C1036 Type I, Class 1, Quality Q2, with silvering as required.
- H. Adhesive: Two component epoxy type, waterproof.
- I. Fasteners, Screws, and Bolts: Hot dip galvanized; tamper-proof; security type.
- J. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.

2.03 FINISHES

- A. Stainless Steel: Satin finish, unless otherwise noted.
- B. Chrome/Nickel Plating: ASTM B456, SC 2, satin finish, unless otherwise noted.
- C. Baked Enamel: Pretreat to clean condition, apply one coat primer and minimum two coats epoxy baked enamel.
- D. Powder-Coated Steel: Clean, degrease, and neutralize. Follow immediately with a phosphatizing treatment, prime coat, and two finish coats of powder coat enamel.
- E. Galvanizing for Items Other than Sheet: Comply with ASTM A123/A123M; galvanize ferrous metal and fastening devices.
- F. Back paint components where contact is made with building finishes to prevent electrolysis.

2.04 COMMERCIAL TOILET ACCESSORIES

- A. Mirrors: Stainless steel framed, 1/4 inch thick tempered safety glass; ASTM C1048.
 - 1. Size: As indicated on Drawings. Custom sizes required for large mirrors.
 - 2. Frame: 0.05 inch angle shapes, with mitered and welded and ground corners, and tamperproof hanging system; satin finish.
 - 3. Backing: Full-mirror sized, minimum 0.03 inch galvanized steel sheet and nonabsorptive filler material.
 - 4. Products:
 - a. Bradley Corporation: B-2908 Series; Basis of Design: www.bobrick.com/#sle
 - b. Substitutions: Section 016000 - Product Requirements.
- B. Grab Bars: Stainless steel, textured surface.
 - 1. Standard Duty Grab Bars:
 - a. Push/Pull Point Load: 250 pound-force, minimum.
 - b. Dimensions: 1-1/2 inch outside diameter, minimum 0.05 inch wall thickness, concealed flange mounting, 1-1/2 inch clearance between wall and inside of grab bar.
 - c. Finish: Satin.
 - d. Length and Configuration: As indicated on drawings.
 - e. Products:
 - 1) Bradley Corporation: B-812 Series; Basis of Design: www.bobrick.com/#sle
 - 2) Substitutions: Section 016000 - Product Requirements.
 - 2. Grab Bars: Stainless steel, textured surface, fold-down type.
 - a. Standard Duty Grab Bars:
 - 1) Push/Pull Point Load: 250 pound-force, minimum.

102800
TOILET, BATH, AND LAUNDRY
ACCESSORIES

- 2) Dimensions: 1-1/2 inch outside diameter, minimum 0.05 inch wall thickness, concealed flange mounting, 1-1/2 inch clearance between wall and inside of grab bar.
- 3) Finish: Satin.
- 4) Hinge: Spring hinge, keeps grab bar upright when not in use.
- 5) Products:
 - (a) Bradley Corporation: 8370-10100; Basis of Design: www.bobrick.com/#sle
 - (b) Substitutions: Section 016000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify exact location of accessories for installation.
- C. For electrically-operated accessories, verify that electrical power connections are ready and in the correct locations.
- D. Verify that field measurements are as indicated on drawings.
- E. See Section 005500 for installation of blocking, reinforcing plates, and concealed anchors in walls.

3.02 PREPARATION

- A. Deliver inserts and rough-in frames to site for timely installation.
- B. Provide templates and rough-in measurements as required.

3.03 INSTALLATION

- A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.
- B. Install plumb and level, securely and rigidly anchored to substrate.
- C. Mounting Heights: As required by accessibility regulations, and as indicated on Drawings.

3.04 PROTECTION

- A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION 102800

**102800
TOILET, BATH, AND LAUNDRY
ACCESSORIES**

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**SECTION 104400
FIRE PROTECTION SPECIALTIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fire extinguisher cabinets.
- B. Fire extinguisher brackets.
- C. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 092216: Roughed-in wall openings.

1.03 REFERENCE STANDARDS

- A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2023a.

1.04 SUBMITTALS

- A. See Section 013300 - Submittal Procedures.
- B. Product Data: Provide extinguisher operational features.
- C. Shop Drawings: Indicate locations of cabinets and cabinet physical dimensions.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Fire Extinguisher Cabinets and Accessories:
 - 1. Activar Construction Products Group, Inc. - JL Industries; Ambassador Series: www.activarcpg.com/#sle.
 - 2. Kidde, a unit of United Technologies Corp: www.kidde.com/#sle.
 - 3. Larsen's Manufacturing Co: www.larsensmfg.com/#sle.
 - 4. Substitutions: See Section 016000 - Product Requirements.

2.02 FIRE EXTINGUISHER CABINETS

- A. Fire Rating: Listed and labeled in accordance with ASTM E814 requirements for fire resistance rating of walls where being installed.
- B. Cabinet Configuration: Semi-recessed type to match existing cabinets.
 - 1. Size to accommodate Class A:B:C Extinguisher.
 - 2. Projected Trim: Returned to wall surface, with 1/2 inch projection, and 1-1/2 inch wide face.
 - 3. Provide cabinet enclosure with right angle inside corners and seams, and with formed perimeter trim and door stiles.
- C. Door: 0.036 inch metal thickness, reinforced for flatness and rigidity with lock and breakable window access. Hinge doors for 180 degree opening with continuous piano hinge.
- D. Door Glazing: Tempered glass, clear, 1/8 inch thick, and set in resilient channel glazing gasket.
- E. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.
- F. Fabrication: Weld, fill, and grind components smooth.
- G. Finish of Cabinet Interior: White colored enamel.

2.03 ACCESSORIES

- A. Extinguisher Brackets: Formed steel, chrome-plated.
- B. Lettering: { } "FIRE EXTINGUISHER" decal, or vinyl self-adhering, pre-spaced red lettering in accordance with authorities having jurisdiction (AHJ).

104400
FIRE PROTECTION
SPECIALTIES

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify rough openings for cabinet are correctly sized and located.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install cabinets and brackets plumb and level.
- C. Secure rigidly in place.

END OF SECTION 104400

SECTION 123600 COUNTERTOPS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Countertops for architectural cabinet work.
- B. Countertops for manufactured casework.
- C. Sinks molded into countertops.

1.02 REFERENCE STANDARDS

- A. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2022.
- B. IAPMO Z124 - Plastic Plumbing Fixtures; 2022, with Editorial Revision.
- C. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.
- D. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.03 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Specimen warranty.
- C. Verification Samples: For each finish product specified, minimum size 6 inches square, representing actual product, color, and patterns.
- D. Test Reports: Chemical resistance testing, showing compliance with specified requirements.
- E. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.06 FIELD CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.01 COUNTERTOPS

- A. Epoxy Resin Countertops: Filled epoxy resin molded into homogenous, non-porous sheets; no surface coating and color and pattern consistent throughout thickness; with integral or adhesively seamed components.
 - 1. Manufacturers:
 - a. Durcon, Inc, Basis of Design: www.durcon.com/#sle.
 - b. Chemtops: www.chemtops.com
 - c. Prime Industries, Inc: www.piilab.com/#sle.
 - d. Substitutions: See Section 016000 - Product Requirements.

123600
COUNTERTOPS

2. Flat Surface Thickness: 1 inch, nominal.
 3. Flammability: Self-extinguishing, when tested in accordance with ASTM D635.
 4. Surface Finish: Smooth, non-glare.
 5. Color: Gray.
 6. Exposed Edge Shape: 3/16 inch radius corner.
 7. Back and End Splashes: Same material, same thickness; separate for field attachment.
 8. Fabricate in accordance with manufacturer's standard requirements.
- B. Solid Surfacing Countertops: Solid surfacing sheet or plastic resin casting over continuous substrate.
1. Flat Sheet Thickness: 1/2 inch, minimum.
 2. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
 - a. Manufacturers:
 - 1) Dupont; Basis of Design: www.corian.com/#sle.
 - 2) Formica Corporation: www.formica.com/#sle.
 - 3) Wilsonart: www.wilsonart.com/#sle.
 - 4) Substitutions: See Section 016000 - Product Requirements.
 - b. Sinks and Bowls: Integral castings; minimum 3/4 inch wall thickness; comply with IAPMO Z124.
 - 1) Model: 815P
 - c. Finish on Exposed Surfaces: Matte, gloss rating of 5 to 20.
 - d. Color and Pattern: As indicated on drawings.
 3. Other Components Thickness: 1/2 inch, minimum.
 4. Back and End Splashes: Same sheet material, square top; minimum 4 inches high.

2.02 MATERIALS

- A. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.
- B. Joint Sealant: Mildew-resistant silicone sealant, clear.

2.03 FABRICATION

- A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
 1. Join lengths of tops using best method recommended by manufacturer.
 2. Fabricate to overhang fronts and ends of cabinets 1 inch except where top butts against cabinet or wall.
 3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.
- B. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
 1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
 2. Height: 4 inches, unless otherwise indicated.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

123600
COUNTERTOPS

- C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

- A. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.
- B. Attach epoxy resin countertops using compatible adhesive.
- C. Seal joint between back/end splashes and vertical surfaces.

3.04 TOLERANCES

- A. Variation From Horizontal: 1/8 inch in 10 feet, maximum.
- B. Offset From Wall, Countertops: 1/8 inch maximum; 1/16 inch minimum.
- C. Field Joints: 1/8 inch wide, maximum.

3.05 CLEANING

- A. Clean countertops surfaces thoroughly.

3.06 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION 123600

123600
COUNTERTOPS

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PROJECT MANUAL ERIE COUNTY COMMUNITY COLLEGE EC3

WEST CAMPUS RENOVATIONS HEALTH LAB

**2403 W. 8th Street
Erie, PA 16505**

VOLUME 2 DIVISIONS 22 - 28

CPL Project Number.: R24.15543
Document Date: 4/4/25

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PROJECT TABLE OF CONTENTS

DIVISION 22 -- PLUMBING

220500	COMMON WORK RESULTS FOR PLUMBING
220517	SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING
220518	ESCUTCHEONS FOR PLUMBING PIPING
220519	METERS AND GAGES FOR PLUMBING PIPING
220523	GENERAL-DUTY VALVES FOR PLUMBING PIPING
220529	HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT
220553	IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT
220719	PLUMBING PIPING INSULATION
221116	DOMESTIC WATER PIPING
221119	DOMESTIC WATER PIPING SPECIALTIES
221316	SANITARY WASTE AND VENT PIPING
221319	SANITARY WASTE PIPING SPECIALTIES
224213	COMMERCIAL WATER CLOSETS
224216	COMMERCIAL LAVATORIES
224217	COMMERCIAL SINKS

DIVISION 23 -- HEATING, VENTILATING, AND AIR CONDITIONING

230500	COMMON WORK RESULTS FOR HVAC
230513	COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT
230553	IDENTIFICATION FOR HVAC
230593	TESTING, ADJUSTING, AND BALANCING FOR HVAC
230713	HVAC DUCT INSULATION
230800	COMMISSIONING FOR HVAC
233113	DUCTWORK
233300	AIR DUCT ACCESSORIES
233400	HVAC FANS
233600	AIR TERMINAL UNITS
233713	DIFFUSERS, REGISTERS, AND GRILLES
237200	100% OUTDOOR AIR ENERGY RECOVERY VENTILATORS
237439	PACKAGED OUTDOOR UNITARY AIR CONDITIONERS
238216	AIR COILS
238249	ELECTRIC UNIT HEATERS

DIVISION 26 -- ELECTRICAL

260500	COMMON WORK RESULTS FOR ELECTRICAL
260519	LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
260526	GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
260529	HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS
260533	RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS
260553	IDENTIFICATION FOR ELECTRICAL SYSTEMS
260573	ELECTRICAL SYSTEM AND PROTECTIVE DEVICE STUDIES
260923	LIGHTING CONTROL DEVICES
262416	PANELBOARDS
262726	WIRING DEVICES
262816	ENCLOSED SWITCHES AND CIRCUIT BREAKERS

262913 ENCLOSED CONTROLLERS
265100 LIGHTING FIXTURES

DIVISION 27 -- COMMUNICATIONS

270500 COMMON WORK RESULTS FOR COMMUNICATIONS
271300 TELECOMMUNICATIONS SYSTEM (TELEPHONE AND DATA NETWORK)

DIVISION 28 -- ELECTRONIC SAFETY AND SECURITY

283111 DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

-- End of Project Table of Contents --

SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following basic plumbing materials and methods to complement other Division 22 Sections.
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Concrete base construction requirements.
 - 3. Dielectric fittings.
 - 4. Flexible connectors.
 - 5. Equipment nameplate data requirements.
 - 6. Labeling and identifying plumbing systems and equipment is specified in Division 22 Section "Identification for Plumbing Piping and Equipment."
 - 7. Nonshrink grout for equipment installations.
 - 8. Field-fabricated metal equipment supports.
 - 9. Installation requirements common to equipment specification sections.
 - 10. Cutting and patching.
 - 11. Touchup painting and finishing.
- B. Pipe and pipe fitting materials are specified in Division 22 piping system Sections.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.4 ACTION SUBMITTALS

- A. Product Data: For dielectric fittings, flexible connectors, mechanical sleeve seals, and firestopping materials.
- B. Shop Drawings: Detail fabrication and installation for metal supports and anchorage for plumbing materials and equipment.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Detail major elements, components, and systems of plumbing equipment and materials in relationship with other systems, installations, and building components. Show space requirements for installation and access. Indicate if sequence and coordination of installations are important to efficient flow of the Work. Include the following:
 - 1. Planned piping layout, including valve and specialty locations and valve-stem movement.
 - 2. Clearances for installing and maintaining insulation.
 - 3. Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly required for periodic maintenance.
 - 4. Equipment and accessory service connections and support details.
 - 5. Exterior wall and foundation penetrations.
 - 6. Fire-rated wall and floor penetrations.
 - 7. Sizes and location of required concrete pads and bases.
 - 8. Scheduling, sequencing, movement, and positioning of large equipment into building during construction.
 - 9. Floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
 - 10. Reflected ceiling plans to coordinate and integrate installation of air outlets and inlets, light fixtures, communication system components, sprinklers, and other ceiling-mounted items.

1.6 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are

appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

- D. Potable-water piping and components shall comply with NSF 14 and NSF/ANSI 61 Annex G and NSF/ANSI 372 for 0.25% maximum lead content requirement. Plastic piping components shall be marked with "NSF-pw."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and prevent entrance of dirt, debris, and moisture.
- B. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.
- C. Protect flanges, fittings, and piping specialties from moisture and dirt.
- D. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.8 SEQUENCING AND SCHEDULING

- A. Coordinate plumbing equipment installation with other building components.
- B. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for plumbing installations.
- C. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed.
- D. Sequence, coordinate, and integrate installations of plumbing materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning before closing in building.
- E. Coordinate connection of plumbing systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
- F. Coordinate requirements for access panels and doors if plumbing items requiring access are concealed behind finished surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Dielectric Unions:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Co.
 - c. Eclipse, Inc.; Rockford-Eclipse Div.
 - d. Epco Sales Inc.
 - e. Hart Industries International, Inc.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Zurn Industries, Inc.; Wilkins Div.
 2. Dielectric Flanges:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Co.
 - c. Epco Sales Inc.
 - d. Watts Industries, Inc.; Water Products Div.
 3. Dielectric-Flange Insulating Kits:
 - a. Calpico, Inc.
 - b. Central Plastics Co.
 4. Dielectric Couplings:
 - a. Calpico, Inc.
 - b. Lochinvar Corp.
 5. Dielectric Nipples:
 - a. Grinnell Corp.; Grinnell Supply Sales Co.
 - b. Perfection Corp.
 - c. Victaulic Co. of America.
 6. Metal, Flexible Connectors:
 - a. ANAMET Industrial, Inc.
 - b. Central Sprink, Inc.
 - c. Flexicraft Industries.
 - d. Flex-Weld, Inc.
 - e. Grinnell Corp.; Grinnell Supply Sales Co.
 - f. Hyspan Precision Products, Inc.
 - g. McWane, Inc.; Tyler Pipe; Gustin-Bacon Div.
 - h. Mercer Rubber Co.

- i. Metraflex Co.
- j. Proco Products, Inc.
- k. Uniflex, Inc.

7. Fire-Stopping:

- a. "Dow Corning Fire Stop Sealant"; Dow Corning Corp.
- b. "3M Fire Barrier Caulk CP-25"; Electrical Products Div./3M.
- c. "RTV 7403"; General Electric Co.
- d. "Fyre Putty"; Standard Oil Engineered Materials Co.

2.2 PIPE AND PIPE FITTINGS

- A. Refer to individual Division 22 piping Sections for pipe and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness, unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32.
 - 1. Alloy Sn95 or Alloy Sn94: Approximately 95 percent tin and 5 percent silver, with 0.10 percent lead content.
 - 2. Alloy E: Approximately 95 percent tin and 5 percent copper, with 0.10 percent maximum lead content.
 - 3. Alloy HA: Tin-antimony-silver-copper zinc, with 0.10 percent maximum lead content.
 - 4. Alloy HB: Tin-antimony-silver-copper nickel, with 0.10 percent maximum lead content.

5. Alloy Sb5: 95 percent tin and 5 percent antimony, with 0.20 percent maximum lead content.
- F. Brazing Filler Metals: AWS A5.8.
 1. BCuP Series: Copper-phosphorus alloys.
 2. BAg1: Silver alloy.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Flanged, Ductile-Iron Pipe Gasket, Bolts, and Nuts: AWWA C110, rubber gasket, carbon-steel bolts and nuts.
- I. Couplings: Iron-body sleeve assembly, fabricated to match OD of plain-end, pressure pipes.
 1. Sleeve: ASTM A 126, Class B, gray iron.
 2. Followers: ASTM A 47 malleable iron or ASTM A 536 ductile iron.
 3. Gaskets: Rubber.
 4. Bolts and Nuts: AWWA C111.
 5. Finish: Enamel paint.

2.4 DIELECTRIC FITTINGS

- A. General: Assembly or fitting with insulating material isolating joined dissimilar metals, to prevent galvanic action and stop corrosion.
- B. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld-neck end types and matching piping system materials.
- C. Insulating Material: Suitable for system fluid, pressure, and temperature.
- D. Dielectric Unions: Factory-fabricated, union assembly, for 150-psig minimum working pressure at 180 deg F.
- E. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150-psig minimum working pressure as required to suit system pressures.
- F. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 1. Provide separate companion flanges and steel bolts and nuts for 150-psig minimum working pressure as required to suit system pressures.
- G. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 150-psig minimum working pressure at 225 deg F.

- H. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 150-psig minimum working pressure at 225 deg F.

2.5 FLEXIBLE CONNECTORS

- A. General: Fabricated from materials suitable for system fluid and that will provide flexible pipe connections. Include 125-psig minimum working-pressure rating, unless higher working pressure is indicated, and ends according to the following:
 - 1. 2-Inch NPS and Smaller: Threaded.
 - 2. 2-1/2-Inch NPS and Larger: Flanged.
- B. Stainless-Steel-Hose/Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include steel nipples or flanges, welded to hose.

2.6 GROUT

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

2.7 FIRE-STOPPING

- A. Fire-Resistant Sealant: Provide one-part elastomeric sealant formulated for use in a through-penetration fire-stop system for filling openings around piping penetrations through walls and floors, having fire-resistance ratings equal to or greater than adjacent construction and as established by testing identical assemblies per ASTM E 814 by Underwriters Laboratory, Inc.
- B. Fire-Stop Pipe Sleeves: At the option of the Contractor and if approved by local codes, prefabricated fire-stop pipe sleeves also may be utilized. Pipe sleeves shall be UL Listed and tested in accordance with ASTM E 814. Sleeves shall be adjustable and shall be filled with ceramic fiber material to provide insulation and fire stopping. Sleeves shall provide a 2-hour fire rating.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install piping as described below, unless piping Sections specify otherwise. Individual Division 22 piping Sections specify unique piping installation requirements.

- B. General Locations and Arrangements: 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. Due to the small scale of the drawings, it is not practical to indicate offsets, fittings, valves or similar items, to make a complete operating system. The drawings are generally diagrammatic and indicative of the work to be installed. The Contractor shall carefully investigate conditions affecting his work and shall install his work in such a manner that interference between pipes, conduit, ducts, equipment, architectural and structural features will be avoided and shall furnish and install such offsets or fittings to meet the conditions at the building, so as to avoid interference without additional cost to the Contracting Officer.
- C. Install piping at indicated or required slope.
- D. Install components with pressure rating equal to or greater than system operating pressure.
- E. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas.
- F. Install piping free of sags and bends.
- G. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.
- H. Install piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.
- I. Install piping to allow application of insulation plus 1-inch (25-mm) clearance around insulation.
- J. Locate groups of pipes parallel to each other, spaced to permit valve servicing.
- K. Install fittings for changes in direction and branch connections.
- L. Install couplings according to manufacturer's written instructions.
- M. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestopping materials.
- N. Verify final equipment locations for roughing-in.
- O. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- P. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping specification Sections:
 - 1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
 3. Soldered Joints: Construct joints according to AWS's "Soldering Manual," Chapter "The Soldering of Pipe and Tube"; or CDA's "Copper Tube Handbook."
 4. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
 5. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - a. Note internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
 - b. Apply appropriate tape or thread compound to external pipe threads, unless dry seal threading is specified.
 - c. Align threads at point of assembly.
 - d. Tighten joint with wrench. Apply wrench to valve end into which pipe is being threaded.
 - e. 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.
 6. Welded Joints: Construct joints according to AWS D10.12, "Recommended Practices and Procedures for Welding Low Carbon Steel Pipe," using qualified processes and welding operators according to "Quality Assurance" Article.
 7. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.
- Q. Piping Connections: Make connections according to the following, unless otherwise indicated:
1. Install unions, in piping 2-inch NPS and smaller, adjacent to each valve and at final connection to each piece of equipment with 2-inch NPS or smaller threaded pipe connection.
 2. Install flanges, in piping 2-1/2-inch NPS and larger, adjacent to flanged valves and at final connection to each piece of equipment with flanged pipe connection.
 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.2 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to provide maximum possible headroom, if mounting heights are not indicated.

- B. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to Contracting Officer's Representative.
- C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- D. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- E. Install equipment giving right of way to piping installed at required slope.
- F. Install flexible connectors on equipment side of shutoff valves, horizontally and parallel to equipment shafts if possible.

3.3 PAINTING AND FINISHING

- A. Refer to Division 09 Section "Painting - Exterior and Interior" for paint materials, surface preparation, and application of paint.
- B. Refer to Division 22 Section "Identification for Plumbing Piping and Equipment" for plumbing color schemes.
- C. Apply paint to exposed piping according to the following, unless otherwise indicated:
 - 1. Interior, Ferrous Piping: Use semigloss, acrylic-enamel finish. Include finish coat over enamel undercoat and primer.
 - 2. Interior, Galvanized-Steel Piping: Use semigloss, acrylic-enamel finish. Include two finish coats over galvanized metal primer.
 - 3. Interior, Ferrous Supports: Use semigloss, acrylic-enamel finish. Include finish coat over enamel undercoat and primer.
 - 4. Exterior, Ferrous Piping: Use semigloss, acrylic-enamel finish. Include two finish coats over rust-inhibitive metal primer.
 - 5. Exterior, Galvanized-Steel Piping: Use semigloss, acrylic-enamel finish. Include two finish coats over galvanized metal primer.
 - 6. Exterior, Galvanized-Steel Supports: Use semigloss, acrylic-enamel finish. Include two finish coats over galvanized metal primer.
- D. Do not paint piping specialties with factory-applied finish.
- E. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit. Follow supported equipment manufacturer's

setting templates for anchor bolt and tie locations. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

- B. Coordinate size of housekeeping bases with actual unit sizes provided.
- C. Form concrete bases with steel channels co to ASTM A 36. Miter and weld corner and provide cross bracing. Anchor or key to floor slab.
- D. Install reinforcing bars, tied to frame, and place anchor bolts and sleeves to facilitate securing units.
- E. Place concrete and allow to cure before installing units. Use portland cement conforming to ASTM C 150, 3000-psi compressive strength, and normal-weight aggregate.
- F. Clean exposed steel form according to SSPC-SP 2 or SSPC-SP 3 and apply 2 coats of rust-preventive metal primer.

3.5 ERECTION OF METAL SUPPORTS AND ANCHORAGE

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials, piping, ductwork and equipment.
- C. Field Welding: Comply with AWS D1.1, "Structural Welding Code--Steel."
- D. Structural steel members installed at the exterior of the building or in damp or wet locations shall be hot dipped galvanized after fabrication. Conform to ASTM A123. Where exterior structural steel members are cut, drilled or welded, or galvanizing is damaged, repair with a cold galvanizing repair compound with dry film containing not less than 93 percent zinc dust by weight, and complying with DOD-P-21035A or SSPC-Paint 20, as manufactured by ZRC Products Company, or equivalent.

3.6 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for plumbing installations. Perform cutting by skilled mechanics of trades involved.
- B. Repair cut surfaces to match adjacent surfaces.

3.7 GROUTING

- A. Install nonmetallic, nonshrink, grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix grout according to manufacturer's written instructions.

- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placing of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases to provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout according to manufacturer's written instructions.

END OF SECTION 220500

SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Sleeves.
 - 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. Stack-sleeve fittings in this article can be used in concrete floor and roof slabs, but are without seepage holes; therefore, they cannot be used as replacements for floor drains.

Using grout, fill the annular space between fitting and slab opening. These fittings are available in NPS 1-1/2 to NPS 12.

- B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Smith, Jay R. Mfg. Co.
 - 2. Zurn Industries, LLC.
- C. 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. Sleeve-seal systems in this article are used for piping penetrations in slabs-on-grade and below grade in exterior walls. These systems are available for NPS 1/2 to NPS 48 piping.
- B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Metraflex Company (The).
 - 2. Proco Products, Inc.
- C. 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: Stainless steel.
 - 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

- A. Sleeve-seal fittings in this article are used for piping penetrations in slabs-on-grade and in exterior walls. These fittings are made to match piping OD, so they must be selected to match the penetrating piping size. They are available for NPS 1/2 to NPS 6 piping.
- B. Products: Subject to compliance with requirements, provide the following:
 - 1. HOLDRITE.
- C. 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.
 - 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 - 2. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
 - 3. 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:
 - a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves or Sleeve-seal fittings.

- b. Piping NPS 6 and Larger: Cast-iron wall sleeves.
- 2. Exterior Concrete Walls below Grade:
 - a. Piping All Sizes: Cast-iron wall sleeves with sleeve-seal system.
 - 1) 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:
 - a. Piping All Sizes: Cast-iron wall sleeves with sleeve-seal system.
 - 1) 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:
 - a. Piping All Sizes: Galvanized-steel-pipe sleeves.
- 5. Interior Partitions:
 - a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
 - b. Piping NPS 6 and Larger: Galvanized-steel-sheet sleeves.

END OF SECTION 220517

SECTION 220518 - ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Escutcheons.
 - 2. Floor plates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

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.
- E. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed hinge, and spring-clip fasteners.

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. Chrome-Plated Piping: One-piece, cast-brass type with polished, chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish; or one-piece, stamped-steel type.
 - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish; or one-piece, stamped-steel type.
 - f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished, chrome-plated or rough-brass finish; one-piece, stamped-steel type.
 - g. Bare Piping in Equipment Rooms: One-piece, cast-brass type with polished, chrome-plated rough-brass finish; or one-piece, stamped-steel type.
 - 2. Escutcheons for Existing Piping:
 - a. Chrome-Plated Piping: Split-casting brass type with polished, chrome-plated finish.
 - b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish; or 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; or split-plate, stamped-steel type with concealed hinge.
 - e. Bare Piping in Unfinished Service Spaces: Split-casting brass type with polished, chrome-plated or rough-brass finish, or split-plate, stamped-steel type with concealed hinge.
 - f. Bare Piping in Equipment Rooms: Split-casting brass type with polished, chrome-plated finish, or split-plate, stamped-steel type with concealed hinge.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. 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 220518

SECTION 220519 - METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes meters and gages for plumbing systems.
- B. Related Sections include the following:
 - 1. Plumbing equipment Sections that specify meters and gages as part of factory-fabricated equipment.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of meter and gage, from manufacturer.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Potable-water piping and components shall comply with NSF 14 and NSF/ANSI 61 Annex G and NSF/ANSI/372 for 0.25% maximum lead content requirement. Plastic piping components shall be marked with "NSF-pw."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Liquid-in-Glass Thermometers:

- a. Dresser Industries, Inc.; Instrument Div.; Weksler Instruments Operating Unit.
- b. Ernst Gage Co.
- c. Miljoco Corp.
- d. Trerice: H. O. Trerice Co.
- e. Weiss Instruments, Inc.

2. Pressure Gages:

- a. Dresser Industries, Inc.; Instrument Div.; Ashcroft Commercial Sales Operation.
- b. Dresser Industries, Inc.; Instrument Div.; Weksler Instruments Operating Unit.
- c. Ernst Gage Co.
- d. Miljoco Corp.
- e. Trerice: H. O. Trerice Co.
- f. Weiss Instruments, Inc.

2.2 THERMOMETERS, GENERAL

- A. Scale Range: Temperature ranges for services listed are as follows:

- 1. Domestic Hot Water: 30 to 240 deg F, with 2-degree scale divisions.
- 2. Domestic Cold Water: 0 to 100 deg F, with 2-degree scale divisions.
- 3. Hot Water: 30 to 300 deg F, with 2-degree scale divisions.

- B. Accuracy: Plus or minus 1 percent of range span or plus or minus one scale division to maximum of 1.5 percent of range span.

2.3 LIQUID-IN-GLASS THERMOMETERS

- A. Description: ASTM E 1.
- B. Case: Die cast and aluminum finished in baked-epoxy enamel, glass front, spring secured, 9 inches long.
- C. Adjustable Joint: Finish to match case, 180-degree adjustment in vertical plane, 360-degree adjustment in horizontal plane, with locking device.
- D. Tube: Red or blue reading, inorganic liquid-filled with magnifying lens.

- E. Scale: Satin-faced nonreflective aluminum with permanently etched markings.
- F. Stem: Copper-plated steel, aluminum, or brass for separable socket; of length to suit installation.

2.4 SEPARABLE SOCKETS

- A. Description: Fitting with protective socket for installation in threaded pipe fitting to hold fixed thermometer stem.
 - 1. Material: Brass, for use in copper piping.
 - 2. Material: Stainless steel, for use in steel piping.
 - 3. Extension-Neck Length: Nominal thickness of 2 inches, but not less than thickness of insulation. Omit extension neck for sockets for piping not insulated.
 - 4. Insertion Length: To extend 2 inches into pipe.
 - 5. Cap: Threaded, with chain permanently fastened to socket.
 - 6. Heat-Transfer Fluid: Oil or graphite.

2.5 THERMOMETER WELLS

- A. Description: Fitting with protective well for installation in threaded pipe fitting to hold test thermometer.
 - 1. Material: Brass, for use in copper piping.
 - 2. Material: Stainless steel, for use in steel piping.
 - 3. Extension-Neck Length: Nominal thickness of 2 inches, but not less than thickness of insulation. Omit extension neck for wells for piping not insulated.
 - 4. Insertion Length: To extend 2 inches into pipe.
 - 5. Cap: Threaded, with chain permanently fastened to socket.
 - 6. Heat-Transfer Fluid: Oil or graphite.

2.6 PRESSURE GAGES

- A. Description: ASME B40.1, phosphor-bronze bourdon-tube type with bottom connection; dry type, unless liquid-filled-case type is indicated.
- B. Case: Drawn steel, brass, or aluminum with 4-1/2-inch-diameter, glass lens.
- C. Connector: Brass, NPS 1/4.
- D. Scale: White-coated aluminum with permanently etched markings.
- E. Accuracy: Grade A, plus or minus 1 percent of middle 50 percent of scale.
- F. Range: Comply with the following:
 - 1. Fluids under Pressure: Two times the operating pressure.
 - 2. Vacuum: 30 inches Hg of vacuum to two times the operating pressure.

2.7 PRESSURE-GAGE FITTINGS

- A. Valves: NPS 1/4 brass or stainless-steel needle type.
- B. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant porous-metal disc of material suitable for system fluid and working pressure.

PART 3 - EXECUTION

3.1 METER AND GAGE INSTALLATION, GENERAL

- A. Install meters, gages, and accessories according to manufacturer's written instructions for applications where used.

3.2 THERMOMETER INSTALLATION

- A. Install thermometers and adjust vertical and tilted positions.
- B. Install in the following locations:
 - 1. Inlet and outlet of hydronic coils in air handling units.
 - 2. Elsewhere as indicated on the drawings.
- C. Install separable sockets in vertical position in piping tees where fixed thermometers are indicated.
 - 1. Install with socket extending a minimum of 2 inches into fluid.
 - 2. Fill sockets with oil or graphite and secure caps.
- D. Install thermometer wells in vertical position in piping tees where test thermometers are indicated.
 - 1. Install with stem extending a minimum of 2 inches into fluid.
 - 2. Fill wells with oil or graphite and secure caps.

3.3 PRESSURE-GAGE INSTALLATION

- A. Install pressure gages in piping tees with pressure-gage valve located on pipe at most readable position.
- B. Install dry-type pressure gages in the following locations:
 - 1. Building water-service entrance.
- C. Install liquid-filled-type pressure gages at suction and discharge of each pump. Provide compound type liquid-filled gauges on the suction side of pumps.
- D. Install pressure-gage needle valve and snubber in piping to pressure gages.

3.4 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties. The following are specific connection requirements:
 - 1. Install meters and gages adjacent to machines and equipment to allow service and maintenance.

3.5 ADJUSTING AND CLEANING

- A. Calibrate meters according to manufacturer's written instructions, after installation.
- B. Adjust faces of meters and gages to proper angle for best visibility.
- C. Clean windows of meters and gages and clean factory-finished surfaces. Replace cracked and broken windows, and repair scratched and marred surfaces with manufacturer's touchup paint.

END OF SECTION 220519

SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes general duty valves common to plumbing piping systems.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Special purpose valves are specified in Division 22 piping system Sections.
 - 2. Valve tags and charts are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

1.3 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 01 Specification Sections.
- B. Product Data for each valve type. Include body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions. Include list indicating valve and its application.
- C. Maintenance data for valves to include in the operation and maintenance manual specified in Division 01. Include detailed manufacturer's instructions on adjusting, servicing, disassembling, and repairing.

1.4 QUALITY ASSURANCE

- A. Single-Source Responsibility: Comply with the requirements specified in Division 01 Section "Materials and Equipment," under "Source Limitations" Paragraph.
- B. ASME Compliance: Comply with ASME B31.9 for building services piping and ASME B31.1 for power piping.
- C. MSS Compliance: Comply with the various MSS Standard Practice documents referenced.

- D. Potable-water piping and components shall comply with NSF 14 and NSF/ANSI 61 Annex G and NSF/ANSI 372 for 0.25% maximum lead content requirement. Plastic piping components shall be marked with "NSF-pw."

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set ball valves open to minimize exposure of functional surfaces.
 - 4. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store indoors and maintain valve temperature higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use a sling to handle large valves. Rig to avoid damage to exposed parts. Do not use handwheels and stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
 - 1. Ball Valves:
 - a. Conbraco Industries, Inc.; Apollo Division.
 - b. NIBCO Inc.
 - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - d. Hammond Valves.
 - 2. Swing Check Valves:
 - a. Milwaukee Valve Company, Inc.
 - b. NIBCO Inc.
 - c. Stockham Valves & Fittings, Inc.

2.2 BASIC, COMMON FEATURES

- A. Design: Rising stem or rising outside screw and yoke stems, except as specified below.

1. Nonrising stem valves may be used only where headroom prevents full extension of rising stems.
- B. Pressure and Temperature Ratings: As indicated in the "Application Schedule" of Part 3 of this Section and as required to suit system pressures and temperatures.
 1. Use only cast steel valves on high pressure steam system applications where pressures exceed 125 psig.
- C. Sizes: Same size as upstream pipe, unless otherwise indicated.
- D. Operators: Use specified operators and handwheels, except provide the following special operator features:
 1. Handwheels: For valves other than quarter turn.
 2. Lever Handles: For quarter-turn valves 6 inches and smaller.
- E. Extended Stems: Where insulation is indicated or specified, provide extended stems arranged to receive insulation.
- F. Bypass and Drain Connections: Comply with MSS SP-45 bypass and drain connections.
- G. Threads: ASME B1.20.1.
- H. Flanges: ASME B16.1 for cast iron, ASME B16.5 for steel, and ASME B16.24 for bronze valves.
- I. Solder Joint: ASME B16.18.
 1. Caution: Where soldered end connections are used, use solder having a melting point below 840 deg F for gate, globe, and check valves; below 421 deg F for ball valves.

2.3 BALL VALVES

- A. Ball Valves, 4 Inches and Smaller: MSS SP-110, Class 150, 600-psi CWP, ASTM B 584 bronze body and bonnet, 2-piece construction; chrome-plated brass ball, standard port for 1/2-inch valves and smaller and conventional port for 3/4-inch valves and larger; blowout proof; bronze or brass stem; teflon seats and seals; threaded or soldered end connections:
 1. Operator: Vinyl-covered steel lever handle.
 2. Stem Extension: For valves installed in insulated piping.
 3. Memory Stop: For operator handles.

2.4 CHECK VALVES

- A. Swing Check Valves, 2 Inches and Smaller: MSS SP-80; Class 125, 200-psi CWP, or Class 150, 300-psi CWP; horizontal swing, Y-pattern, ASTM B 62 cast-bronze body and

cap, rotating bronze disc with rubber seat or composition seat, threaded or soldered end connections:

- B. Swing Check Valves, 2-1/2 Inches and Larger: MSS SP-71, Class 125, 200-psi CWP, ASTM A 126 cast-iron body and bolted cap, horizontal-swing bronze disc, flanged or grooved end connections.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance of valves. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- C. Operate valves from fully open to fully closed positions. Examine guides and seats made accessible by such operation.
- D. Examine threads on valve and mating pipe for form and cleanliness.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 INSTALLATION

- A. Install valves as indicated, according to manufacturer's written instructions.
- B. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties.
- C. Install valves with unions or flanges at each piece of equipment arranged to allow servicing, maintenance, and equipment removal without system shutdown.
- D. Locate valves for easy access and provide separate support where necessary.
- E. Install valves in horizontal piping with stem at or above the center of the pipe.
- F. Install valves in a position to allow full stem movement.
- G. Installation of Check Valves: Install for proper direction of flow as follows:
 - 1. Swing Check Valves: Horizontal position with hinge pin level.

3.3 SOLDERED CONNECTIONS

- A. Cut tube square and to exact lengths.
- B. Clean end of tube to depth of valve socket with steel wool, sand cloth, or a steel wire brush to a bright finish. Clean valve socket.
- C. Apply proper soldering flux in an even coat to inside of valve socket and outside of tube.
- D. Remove the cap and disc holder of swing check valves having composition discs.
- E. Insert tube into valve socket, making sure the end rests against the shoulder inside valve. Rotate tube or valve slightly to ensure even distribution of the flux.
- F. Apply heat evenly to outside of valve around joint until solder melts on contact. Feed solder until it completely fills the joint around tube. Avoid hot spots or overheating valve. Once the solder starts cooling, remove excess amounts around the joint with a cloth or brush.

3.4 THREADED CONNECTIONS

- A. Note the internal length of threads in valve ends and proximity of valve internal seat or wall to determine how far pipe should be threaded into valve.
- B. Align threads at point of assembly.
- C. Apply appropriate tape or thread compound to the external pipe threads, except where dry seal threading is specified.
- D. Assemble joint, wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.

3.5 VALVE END SELECTION

- A. Select valves with the following ends or types of pipe/tube connections:
 - 1. Copper Tube: Solder or threaded ends.

3.6 APPLICATION SCHEDULE

- A. General Application: Use gate, ball, and butterfly valves for shutoff duty; globe, ball, and butterfly for throttling duty. Refer to piping system Specification Sections for specific valve applications and arrangements. Provide valves suitable for working pressures encountered in each system.
- B. Domestic Water Systems: Use the following valve types:
 - 1. Ball Valves: Class 150, 600-psi CWP, with stem extension.
 - 2. Check Valves: Class 125, swing type.

3.7 ADJUSTING

- A. Adjust or replace packing after piping systems have been tested and put into service, but before final adjusting and balancing. Replace valves if leak persists.

END OF SECTION 220523

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes hangers and supports for plumbing system piping and equipment.
- B. Related Sections include the following:
 - 1. Division 05 Section "Metal Fabrications" for materials for attaching hangers and supports to building structure.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

- A. Design channel support systems for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design heavy-duty steel trapezes for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of pipe hanger, channel support system component, and thermal-hanger shield insert indicated.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer for multiple piping supports and trapeze hangers. Include design calculations and indicate size and characteristics of components and fabrication details.

1.6 INFORMATIONAL SUBMITTALS

- A. Welding Certificates: Copies of certificates for welding procedures and operators.

1.7 QUALITY ASSURANCE

- A. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- B. Engineering Responsibility: Design and preparation of Shop Drawings and calculations for each multiple pipe support and trapeze by a qualified professional engineer.
 - 1. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of hangers and supports that are similar to those indicated for this Project in material, design, and extent.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Pipe Hangers:
 - a. Anvil International, Inc.
 - b. Modern Pipe Hanger Co., Inc.
 - c. National Pipe Hanger Corp.
 - d. Penn Pipe Hanger Corp.
 - 2. Channel Support Systems:
 - a. Anvil International, Inc.; Power-Strut Unit.
 - b. National Pipe Hanger Corp.
 - c. Thomas & Betts Corp.
 - d. Unistrut Corp.
 - 3. Thermal-Hanger Shield Inserts:
 - a. Carpenter & Patterson, Inc.
 - b. Pipe Shields, Inc.
 - c. Value Engineered Products, Inc.

4. Powder-Actuated Fastener Systems:

- a. Hilti, Inc.
- b. ITW Ramset/Red Head.

2.2 MANUFACTURED UNITS

- A. Pipe Hangers, Supports, and Components: MSS SP-58, factory-fabricated components. Refer to "Hanger and Support Applications" Article in Part 3 for where to use specific hanger and support types.
 - 1. Galvanized, Metallic Coatings: For piping and equipment that will not have field-applied finish. All piping hangers, supports, hardware and accessories exposed to weather shall be hot-dipped galvanized, no exceptions.
 - 2. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- B. Channel Support Systems: MFMA-2, factory-fabricated components for field assembly.
 - 1. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated. All channel support systems and accessories exposed to weather shall be hot-dipped galvanized, no exceptions.
 - 2. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- C. Thermal-Hanger Shield Inserts: 100-psi minimum compressive-strength insulation, encased in galvanized sheet metal shield.
 - 1. Material for Cold Piping: ASTM C 552, Type I cellular glass or water-repellent-treated, ASTM C 533, Type I calcium silicate with vapor barrier.
 - 2. Material for Hot Piping: ASTM C 552, Type I cellular glass or water-repellent-treated, ASTM C 533, Type I calcium silicate.
 - 3. Material for Hot Piping: Water-repellent-treated, ASTM C 533, Type I calcium silicate.
 - 4. For Trapeze or Clamped System: Insert and shield cover entire circumference of pipe.
 - 5. For Clevis or Band Hanger: Insert and shield cover lower 180 degrees of pipe.
 - 6. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.3 MISCELLANEOUS MATERIALS

- A. Powder-Actuated Drive-Pin Fasteners: Powder-actuated-type, drive-pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.

- C. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized. All structural steel members, plates, shapes, and bars exposed to weather shall be hot-dipped galvanized, no exceptions.
- D. Grout: ASTM C 1107, Grade B, factory-mixed and -packaged, nonshrink and nonmetallic, dry, hydraulic-cement grout.
 - 1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
 - 2. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 3. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger requirements are specified in Sections specifying equipment and systems.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Specification Sections.
- C. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
 - 1. Adjustable Swivel Split- or Solid-Ring Hangers (GSA WW-H-171b): For suspension of insulated stationary pipes, including all rain water conductor piping, NPS 2 to NPS 12.
 - 2. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
 - 3. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
 - 4. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
 - 5. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
 - 6. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
 - 7. Adjustable Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.
 - 8. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 - 9. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 - 10. Adjustable Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
 - 11. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.

12. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
 13. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
 14. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 15. 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.
 16. 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 and with U-bolt to retain pipe.
 17. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
 18. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
 19. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.
 20. 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.
 21. 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.
 22. 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.
 23. Copper plated band ring hangers (Figure 48 or 49 as manufactured by Modern Pipe Supports) will be acceptable for copper tubing installations. Insulation shall be installed over top of the ring. Hanger attachments shall be copper plated.
- D. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- E. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Specification 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. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 4. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

- F. Building Attachments: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. 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. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where head room is limited.
- G. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Specification Sections, install factory fabricated saddles and shields with edges rolled and ground smooth, of 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 by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe, 360-degree insert of high-density, 100-psi minimum compressive-strength, water-repellent-treated calcium silicate or cellular-glass pipe insulation, same thickness as adjoining insulation with vapor barrier and encased in 360-degree sheet metal shield.
- H. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Pipe Hanger and Support Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Channel Support System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems.
 1. Field assemble and install according to manufacturer's written instructions.
- C. Heavy-Duty Steel Trapeze Installation: Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated, heavy-duty trapezes.
 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D-1.1.
- D. Install building attachments within concrete slabs or attach to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, and expansion joints, 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.
- E. Install powder-actuated drive-pin fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
- F. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- G. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

- I. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- J. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping," are not exceeded.
- K. Insulated Piping: Comply with the following:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits according to ASME B31.9.
 - 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 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.
 - 5. Insert Material: Length at least as long as protective shield.
 - 6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure above or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

3.4 METAL FABRICATION

- A. Cut, drill, and fit miscellaneous metal fabrications for heavy-duty steel trapezes and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.6 PAINTING

- A. Touching Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 220529

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following plumbing identification materials and their installation:
 - 1. Equipment nameplates.
 - 2. Equipment markers.
 - 3. Equipment signs.
 - 4. Pipe markers.
 - 5. Valve tags.
 - 6. Valve schedules.
 - 7. Warning tags.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Valve numbering scheme.
- D. Valve Schedules: For each piping system. Furnish extra copies (in addition to mounted copies) to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

1.5 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 location of access panels and doors.

- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Brady Corporation.
 - 2. Marking Services Inc.
 - 3. Seton Identification Products.

2.2 EQUIPMENT IDENTIFICATION DEVICES

- A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.
 - 1. Data:
 - a. Manufacturer, product name, model number, and serial number.
 - b. Capacity, operating and power characteristics, and essential data.
 - c. Labels of tested compliances.
 - 2. Location: Accessible and visible.
 - 3. Fasteners: As required to mount on equipment.
- B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.
 - 1. Terminology: Match schedules as closely as possible.
 - 2. Data:
 - a. Name and plan number.
 - b. Equipment service.
 - c. Design capacity.
 - d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.
 - 3. Size: 2-1/2 by 4 inches for control devices, and valves; 4-1/2 by 6 inches for equipment.
- C. Equipment Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.
 - 1. Data: Instructions for operation of equipment and for safety procedures.

2. Engraving: Manufacturer's standard letter style, of sizes and with terms to match equipment identification.
 3. Thickness: 1/16 inch for units up to 20 sq. in. or 8 inches in length, and 1/8 inch for larger units.
 4. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.
- D. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.
1. Colors: Comply with ASME A13.1, unless otherwise indicated.
 2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
 3. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers extending 360 degrees around pipe at each location.
 4. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
 5. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.
- E. Pretensioned Pipe Markers: Precoiled semirigid plastic formed to cover full circumference of pipe and to attach to pipe without adhesive.
- F. Shaped Pipe Markers: Preformed semirigid plastic formed to partially cover circumference of pipe and to attach to pipe with mechanical fasteners that do not penetrate insulation vapor barrier.
- G. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.
- H. Plastic Tape: Continuously printed, vinyl tape at least 3 mils thick with pressure-sensitive, permanent-type, self-adhesive back.
1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches: 3/4 inch minimum.
 2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

2.3 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers, with numbering scheme. Provide 5/32-inch hole for fastener.
1. Material: 0.0375-inch- thick stainless steel.
 2. Size: 1-1/2" diameter, unless otherwise indicated.
 3. Valve-Tag Fasteners: Brass Stainless steel beaded chain or S-hook.

2.4 VALVE SCHEDULES

- A. Valve Schedules: For each piping system, on standard-size 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-Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include mounting screws.
 - 2. Frame: Extruded aluminum.
 - 3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

2.5 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags; of plasticized card stock with matte finish suitable for writing.
 - 1. Size: 3 by 5-1/4 inches minimum.
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.
 - 4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 APPLICATIONS, GENERAL

- A. Products specified are for applications referenced in other Division 15 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.2 EQUIPMENT IDENTIFICATION

- A. Install and permanently fasten equipment nameplates on each major item of plumbing equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:
 - 1. Fuel-burning units, including water heater units.
 - 2. Pumps, compressors, and similar motor-driven units.
- B. Install equipment signs with screws or permanent adhesive on or near each major item of plumbing equipment. Locate signs where accessible and visible.
 - 1. Letter Size: Minimum 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-fourths the size of principal lettering.

2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
3. Include signs for the following general categories of equipment:
 - a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
 - b. Fuel-burning water heaters.
 - c. Pumps, compressors, and similar motor-driven units.
 - d. Tanks and pressure vessels.
 - e. Strainers, filters, and similar equipment.

3.3 PIPING IDENTIFICATION

- A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.
 1. Pipes with OD, Including Insulation, Less Than 6 Inches: Pretensioned pipe markers. Use size to ensure a tight fit.
 2. Pipes with OD, Including Insulation, Less Than 6 Inches: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 3/4 inch wide, lapped at least 1-1/2 inches at both ends of pipe marker, and covering full circumference of pipe.
 3. Pipes with OD, Including Insulation, 6 Inches and Larger: Shaped pipe markers. Use size to match pipe and secure with fasteners.
 4. Pipes with OD, Including Insulation, 6 Inches and Larger: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 1-1/2 inches wide, lapped at least 3 inches at both ends of pipe marker, and covering full circumference of pipe.
- B. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed locations as follows:
 1. Near each valve and control device.
 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 3. Near penetrations through walls, floors, ceilings, and nonaccessible 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 markers.

3.4 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; plumbing fixture supply stops; faucets; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following:
 - 1. Valve-Tag Size and Shape:
 - a. Cold Water: 1-1/2 inches, round.
 - b. Hot Water: 1-1/2 inches, round.
 - c. Natural Gas: 1-1/2 inches, round.
 - d. Compressed Air: 1-1/2 inches, round.
 - 2. Valve-Tag Color:
 - a. Cold Water: Natural.
 - b. Hot Water: White.
 - c. Natural Gas: Yellow.
 - d. Compressed Air: Blue
 - 3. Letter Color:
 - a. Cold Water: Black.
 - b. Hot Water: Black.
 - c. Gas: Black.
 - d. Compressed Air: White.

3.5 VALVE-SCHEDULE INSTALLATION

- A. Mount valve schedule on wall in accessible location in each major equipment room.

3.6 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

3.7 ADJUSTING

- A. Relocate plumbing identification materials and devices that have become visually blocked by other work.

3.8 CLEANING

- A. Clean faces of identification devices and glass frames of valve schedules.

END OF SECTION 220553

SECTION 220719 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes preformed, rigid and flexible pipe insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.
- B. Related Sections include the following:
 - 1. Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe insulation shields and protection saddles.

1.3 ACTION SUBMITTALS

- A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details for the following:
 - 1. Application of protective, saddles, and inserts at pipe hangers for each type of insulation and hanger.
 - 2. Attachment and covering of heat trace inside insulation.
 - 3. Insulation application at pipe expansion joints for each type of insulation.
 - 4. Insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 5. Removable insulation at piping specialties and equipment connections.
 - 6. Application of field-applied jackets.
- C. Samples: For each type of insulation and jacket. Identify each Sample, describing product and intended use. Submit Samples in the following sizes:
 - 1. Preformed Pipe Insulation Materials: 12 inches long by NPS 2.
 - 2. Sheet Form Insulation Materials: 12 inches square.
 - 3. Jacket Materials: 12 inches long by NPS 2.
 - 4. Manufacturer's Color Charts: Show the full range of colors available for each type of field-applied finish material indicated.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed a craft training program offered by the Contractor or by insulation material manufacturers and relating to the installation of pipe insulation for commercial, industrial and institutional applications.
- B. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.
 - 1. Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.

1.7 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements for insulation application.

1.8 SCHEDULING

- A. Schedule insulation application after testing piping systems. Insulation application may begin on segments of piping that have satisfactory test results.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Mineral-Fiber Insulation:
 - a. Johns Manville Corp.
 - b. Knauf FiberGlass GmbH.
 - c. Owens-Corning Fiberglas Corp.
 2. Flexible Elastomeric Thermal Insulation:
 - a. Armacell LLC (Type AP Armaflex).

2.2 INSULATION MATERIALS

- A. Mineral-Fiber Insulation: Glass fibers bonded with a thermosetting resin complying with the following:
1. Preformed Pipe Insulation: Comply with ASTM C 547, Type 1, with factory-applied, all-purpose, vapor-retarder jacket.
 2. Blanket Insulation: Comply with ASTM C 553, Type II, 1-1/2 PCF density, without facing.
 3. Fire-Resistant Adhesive: Comply with MIL-A-3316C in the following classes and grades:
 - a. Class 1, Grade A for bonding glass cloth and tape to unfaced glass-fiber insulation, for sealing edges of glass-fiber insulation, and for bonding lagging cloth to unfaced glass-fiber insulation.
 - b. Class 2, Grade A for bonding glass-fiber insulation to metal surfaces.
 4. Vapor-Retarder Mastics: Fire- and water-resistant, vapor-retarder mastic for indoor applications. Comply with MIL-C-19565C, Type II.
 5. Mineral-Fiber Insulating Cements: Comply with ASTM C 195.
 6. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
- B. Flexible Elastomeric Thermal Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials. 25/50 flame spread and smoke developed rating in accordance with ASTM E84-91a.
1. Adhesive: As recommended by insulation material manufacturer.
 2. Ultraviolet-Protective Coating: As recommended by insulation manufacturer.

- C. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 and ASTM C 585 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

2.3 FIELD-APPLIED JACKETS

- A. General: ASTM C 921, Type 1, unless otherwise indicated.
- B. Foil and Paper Jacket: Laminated, glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil.
- C. PVC Jacket: High-impact, ultraviolet-resistant PVC; 20 mils thick; roll stock ready for shop or field cutting and forming.
 - 1. Adhesive: As recommended by insulation material manufacturer.
 - 2. PVC Jacket Color: White.
- D. PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 30-mil-thick, high-impact, ultraviolet-resistant PVC.
 - 1. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories for the disabled.
 - 2. Adhesive: As recommended by insulation material manufacturer.

2.4 ACCESSORIES AND ATTACHMENTS

- A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, presized a minimum of 8 oz./sq. yd.
 - 1. Tape Width: 4 inches.
- B. Bands: 3/4 inch wide, in one of the following materials compatible with jacket:
 - 1. Stainless Steel: ASTM A 666, Type 304; 0.020 inch thick.
 - 2. Aluminum: 0.007 inch thick.
- C. Wire: 0.080-inch, nickel-copper alloy; 0.062-inch, soft-annealed, stainless steel; or 0.062-inch, soft-annealed, galvanized steel.

2.5 VAPOR RETARDERS

- A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry pipe and fitting surfaces. Remove materials that will adversely affect insulation application.

3.3 GENERAL APPLICATION REQUIREMENTS

- A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each piping system.
- C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Apply insulation with longitudinal seams at top and bottom of horizontal pipe runs.
- E. Apply 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. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- H. Keep insulation materials dry during application and finishing.
- I. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- J. Apply insulation with the least number of joints practical.
- K. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to special instructions for applying insulation over fittings, valves, and specialties.

- L. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.
 - 1. Apply insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor retarders are indicated, extend insulation on anchor legs at least 12 inches from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
 - 3. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.
- M. Insulation Terminations: For insulation application where vapor retarders are indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
- N. Apply adhesives and mastics at the manufacturer's recommended coverage rate.
- O. Apply insulation with integral jackets as follows:
 - 1. Pull jacket tight and smooth.
 - 2. Circumferential Joints: Cover with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip and spaced 4 inches o.c.
 - 3. Longitudinal Seams: Overlap jacket seams at least 1-1/2 inches. Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
 - a. Exception: Do not staple longitudinal laps on insulation having a vapor retarder.
 - 4. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings.
 - 5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor-retarder mastic.
- P. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and floors.
- Q. Fire-Rated Wall and Partition Penetrations: Apply insulation continuously through penetrations of fire-rated walls and partitions. Seal with firestop material.
- R. Floor Penetrations: Apply insulation continuously through floor assembly.
 - 1. For insulation with vapor retarders, seal insulation with vapor-retarder mastic where floor supports penetrate vapor retarder.

3.4 MINERAL-FIBER INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:

1. Secure each layer of preformed pipe insulation to pipe with wire, tape, or bands without deforming insulation materials.
2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic. Apply vapor retarder to ends of insulation at intervals of 15 to 20 feet to form a vapor retarder between pipe insulation segments.
3. For insulation with factory-applied jackets, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.

B. Apply insulation to fittings and elbows as follows:

1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When premolded insulation elbows and fittings are not available, apply mitered sections of pipe insulation to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire, tape, or bands.
3. Cover fittings with PVC fitting covers. Overlap PVC covers on pipe insulation jackets at least 1 inch at each end. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.

C. Apply insulation to valves and specialties as follows:

1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to strainer basket without disturbing insulation.
3. Apply insulation to flanges as specified for flange insulation application.
4. Use preformed PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
5. For larger sizes where PVC fitting covers are not available, seal insulation with canvas jacket and sealing compound recommended by the insulation material manufacturer.

3.5 FLEXIBLE ELASTOMERIC THERMAL INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:

1. Follow manufacturer's written instructions for applying insulation.

2. Seal longitudinal seams and end joints with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.
- B. Apply insulation to fittings and elbows as follows:
1. Apply mitered sections of pipe insulation.
 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.
- C. Apply insulation to valves and specialties as follows:
1. Apply preformed valve covers manufactured of the same material as pipe insulation and attached according to the manufacturer's written instructions.
 2. Apply cut segments of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, fabricate removable sections of insulation arranged to allow access to strainer basket.
 3. Apply insulation to flanges as specified for flange insulation application.
 4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

3.6 FIELD-APPLIED JACKET APPLICATION

- A. Apply PVC jacket for all interior piping exposed to view in finished areas of the building. Jacketing shall be adhered to insulation with contact adhesive and 1-1/2" wide tape at all seams. Tightly butt sections together and seal joints with mastic to visually conceal joints. Use long sections to keep joints to a minimum. Conform to manufacturer's installation recommendations. Install jacketing so that seams are concealed from view.

3.7 FINISHES

- A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of the insulation manufacturer's recommended protective coating.
- B. Color: Final color as selected by Owner's Representative. Vary first and second coats to allow visual inspection of the completed Work.

3.8 PIPING SYSTEM APPLICATIONS

- A. Insulation materials and thicknesses are specified in schedules at the end of this Section.
- B. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:
1. Flexible connectors.

2. Vibration-control devices.
3. Chrome-plated pipes and fittings, unless potential for personnel injury.

3.9 FIELD QUALITY CONTROL

- A. Inspection: Perform the following field quality-control inspections, after installing insulation materials, jackets, and finishes, to determine compliance with requirements:
 1. Inspect fittings and valves randomly selected by Owner's Representative.
- B. Insulation applications will be considered defective if sample inspection reveals non-compliance with requirements. Remove defective Work and replace with new materials according to these Specifications.
- C. Reinstall insulation and covers on fittings and valves uncovered for inspection according to these Specifications.

3.10 INSULATION APPLICATION SCHEDULE, GENERAL

- A. Refer to insulation application schedules for required insulation materials, vapor retarders, and field-applied jackets.
- B. Application schedules identify piping system and indicate pipe size ranges and material, thickness, and jacket requirements.

3.11 INTERIOR INSULATION APPLICATION SCHEDULE

- A. Service: Domestic hot and recirculated hot water.
 1. Operating Temperature: 60 to 140 deg F.
 2. Insulation Material: Mineral fiber.
 3. Insulation Thickness, All Sizes 1-inch.
 4. Field-Applied Jacket: PVC, where exposed in finished spaces only.
 5. Vapor Retarder Required: No.
 6. Finish: None.
- B. Service: Domestic cold water.
 1. Operating Temperature: 35 to 60 deg F.
 2. Insulation Material: Mineral fiber or flexible elastomeric.
 3. Insulation Thickness: 1/2 inch.
 4. Field-Applied Jacket: PVC, where exposed in finished spaces only.
 5. Vapor Retarder Required: Yes.
 6. Finish: None.

C. Service: Condensate drain piping.

1. Operating Temperature: 35 to 75 deg F.
2. Insulation Material: Flexible elastomeric.
3. Insulation Thickness: 1/2 inch.
4. Field-Applied Jacket: None.
5. Vapor Retarder Required: Yes.
6. Finish: None.

D. Service: Rain water conductors.

1. Operating Temperature: 32 to 100 deg F.
2. Insulation Material: Mineral fiber.
3. Insulation Thickness: 1 inch.
4. Field-Applied Jacket: None.
5. Vapor Retarder Required: Yes.
6. Finish: None.

END OF SECTION 220719

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Water distribution piping inside the building from 5'-0" outside the building, into the building with extension to plumbing fixtures and equipment throughout the facility.

1.3 DEFINITIONS

- A. Water Service Piping: Water piping outside building that conveys water to building (by Site Subcontractor).
- B. Service Entrance Piping: Water piping at entry into building between water service piping and water distribution piping (by Plumbing Subcontractor, beginning at 5'-0" outside of building).
- C. Water Distribution Piping: Water piping inside building that conveys water to fixtures and equipment throughout the building.

1.4 SYSTEM PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing piping systems with the following minimum working-pressure ratings, unless otherwise indicated:
 - 1. Service Entrance Piping: 160 psig.
 - 2. Water Distribution Piping: 125 psig.

1.5 SUBMITTALS

- A. Product Data: For the following products:
 - 1. Specialty valves.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Flexible connectors.

- B. Water Samples: Specified in "Cleaning" Article.
- C. Coordination Drawings: For piping in equipment rooms and other congested areas, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Fire-suppression-water piping.
 - 2. Domestic water piping.
 - 3. HVAC hydronic piping.
- D. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Potable-water piping and components shall comply with NSF 14 and NSF/ANSI 61 Annex G and NSF/ANSI 372 for 0.25% maximum lead content requirement. Plastic piping components shall be marked with "NSF-pw."

1.7 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 DUCTILE-IRON PIPE AND FITTINGS (Underground Domestic and Fire Service Lines from 5'-0" outside of building and into building to locations indicated on drawings)

- A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
 - 1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - 2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

2.3 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
 - 1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
 - 2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 - 3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
 - 4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
 - 5. Grooved-Joint Copper-Tube Appurtenances:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Anvil International.
 - 2) Shurjoint Piping Products.
 - 3) Victaulic Company.
 - b. Copper Grooved-End Fittings: ASTM B 75 copper tube or ASTM B 584 bronze castings.

2.4 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Copper, Grooved-End Fittings: ASTM B 75 copper tube or ASTM B 584 bronze castings.

2.5 SPECIALTY VALVES

- A. Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty metal valves.
- B. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves, drain valves, backflow preventers, and vacuum breakers.

2.6 TRANSITION FITTINGS

A. General Requirements:

1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

2.7 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Hart Industries International, Inc.
 - d. Jomar International Ltd.
 - e. Matco-Norca, Inc.
 - f. McDonald, A. Y. Mfg. Co.
 - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - h. Wilkins; a Zurn company.
2. Description:
 - a. Standard: ASSE 1079.
 - b. Pressure Rating: 125 psig minimum at 180 deg F.
 - c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Matco-Norca, Inc.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - e. Wilkins; a Zurn company.

2. Description:

- a. Standard: ASSE 1079.
- b. Factory-fabricated, bolted, companion-flange assembly.
- c. Pressure Rating: 125 psig minimum at 180 deg F.
- d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Advance Products & Systems, Inc.
- b. Calpico, Inc.
- c. Central Plastics Company.
- d. Pipeline Seal and Insulator, Inc.

2. Description:

- a. Nonconducting materials for field assembly of companion flanges.
- b. Pressure Rating: 150 psig.
- c. Gasket: Neoprene or phenolic.
- d. Bolt Sleeves: Phenolic or polyethylene.
- e. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Elster Perfection.
- b. Grinnell Mechanical Products.
- c. Matco-Norca, Inc.
- d. Precision Plumbing Products, Inc.
- e. Victaulic Company.

2. Description:

- a. Standard: IAPMO PS 66
- b. Electroplated steel nipple. complying with ASTM F 1545.
- c. Pressure Rating: 300 psig at 225 deg F.
- d. End Connections: Male threaded or grooved.
- e. Lining: Inert and noncorrosive, propylene.

2.8 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Flex-Hose Co., Inc.
 - 2. Flexicraft Industries.
 - 3. Flex-Weld, Inc.
 - 4. Hyspan Precision Products, Inc.
 - 5. Mercer Rubber Co.
 - 6. Metraflex, Inc.
 - 7. Proco Products, Inc.
- B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
 - 1. Working-Pressure Rating: Minimum 200 psig.
 - 2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
 - 3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.
- C. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
 - 1. Working-Pressure Rating: Minimum 200 psig.
 - 2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
 - 3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for

pressure gages and Division 22 Section "Domestic Water Piping Specialties" for drain valves and strainers.

- D. Install shutoff valve immediately upstream of each dielectric fitting.
- E. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.
- F. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- G. 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.
- H. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- I. Install piping adjacent to equipment and specialties to allow service and maintenance.
- J. Install piping to permit valve servicing.
- K. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.
- L. Install piping free of sags and bends.
- M. Install fittings for changes in direction and branch connections.
- N. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- O. Install pressure gages on suction and discharge piping from each plumbing pump. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages.
- P. Install thermostats in hot-water circulation piping. Comply with requirements in Division 22 Section "Domestic Water Pumps" for thermostats.
- Q. Install thermometers on outlet piping from each water heater. Install thermometers on the inlet and outlet side of the heat exchanger. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.
- R. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."
- S. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."

- T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."

3.3 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 pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- E. Copper-Tubing Grooved Joints: Roll groove end of tube. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-end fittings according to AWWA C606 for roll-grooved joints.
- F. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.4 VALVE INSTALLATION

- A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.
- B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.
- C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."
 - 1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
 - 2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.

- D. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for calibrated balancing valves.

3.5 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
 - 1. NPS 1-1/2 and Smaller: Fitting-type coupling.
 - 2. NPS 2 and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

3.6 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings, nipples, or unions.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges or flange kits.

3.7 FLEXIBLE CONNECTOR INSTALLATION

- A. Install flexible connectors in suction and discharge piping connections to each domestic water pump.
- B. Install bronze-hose flexible connectors in copper domestic water tubing.
- C. Install stainless-steel-hose flexible connectors in steel domestic water piping.

3.8 HANGER AND SUPPORT INSTALLATION

- A. Pipe hanger and support devices are specified in Division 22 Section "Plumbing Hangers and Supports." Install the following:
 - 1. Riser Clamps: MSS Type 8 or Type 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs: According to the following:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet: MSS Type 49, spring cushion rolls, if indicated.
- B. Install supports according to Division 22 Section "Plumbing Hangers and Supports."

- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced 1 size for double-rod hangers, to a minimum of 3/8 inch.
- E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
 - 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
 - 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 - 4. NPS 2-1/2: 108 inches with 1/2-inch rod.
 - 5. NPS 3 to NPS 4: 10 feet with 1/2-inch rod.
- F. Install supports for vertical copper tubing every 10 feet.

3.9 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 - 1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
 - 2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 3. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.
 - 4. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.10 IDENTIFICATION

- A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.
- B. Label pressure piping with system operating pressure.

3.11 FIELD QUALITY CONTROL

- A. Perform tests and inspections.

B. Piping Inspections:

1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

C. Piping Tests:

1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
2. Test for leaks and defects in new piping. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
3. Leave new domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
4. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and for corrective action required.

D. Domestic water piping will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.12 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.

4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Adjust calibrated balancing valves to flows indicated.
5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.13 CLEANING

A. Clean and disinfect potable and non-potable domestic water piping as follows:

1. Purge new piping before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

B. Clean non-potable domestic water piping as follows:

1. Purge new piping before using.
2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.14 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- D. Underground, Site Water Service Piping (Service into Building): Use the following:
 - 1. Ductile iron, with mechanical joints, as indicated in Part 2 of this specification.
- E. Aboveground domestic water piping, All Sizes, may be the following:
 - 1. Hard copper tube, ASTM B 88, Type L; wrought-copper solder-joint fittings; and soldered joints.
- F. Aboveground domestic water piping, 2" and Larger, may be the following:
 - 1. Hard copper tube, ASTM B 88, Type L; grooved-joint, copper-tube appurtenances; and grooved joints.

3.15 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Shutoff Duty: Use ball or gate valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.
 - 2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
 - 3. Hot-Water Circulation Piping, Balancing Duty: Calibrated balancing valves.
 - 4. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Vacuum breakers.
 - 2. Backflow preventers.
 - 3. Water pressure-reducing valves.
 - 4. Balancing valves.
 - 5. Temperature-actuated, water mixing valves.
 - 6. Strainers.
 - 7. Outlet box
 - 8. Hose bibbs.
 - 9. Wall hydrants.
 - 10. Drain valves.
 - 11. Air Vents
 - 12. Water-hammer arresters.
 - 13. Trap-seal primer valves.
 - 14. Water filters.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For domestic water piping specialties.
 - 1. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

- A. Potable-water piping and components shall comply with NSF 61 and NSF 14.

2.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.3 VACUUM BREAKERS

- A. Hose-Connection Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Conbraco Industries, Inc.
 - b. Prier Products, Inc.
 - c. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - d. Woodford Manufacturing Company; a division of WCM Industries, Inc.
 - e. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.
2. Standard: ASSE 1011.
3. Body: Bronze, nonremovable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Chrome or nickel plated.

- B. Pressure Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Conbraco Industries, Inc.
 - b. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - c. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Standard: ASSE 1020.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 5 psig maximum, through middle third of flow range.
5. Size: As noted or required on drawings.

6. Accessories:
 - a. Valves: Ball type, on inlet and outlet.

2.4 BACKFLOW PREVENTERS

A. Intermediate Atmospheric-Vent Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Conbraco Industries, Inc.
 - b. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - c. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Standard: ASSE 1012.
3. Operation: Continuous-pressure applications.
4. Size: NPS 1/2 or NPS 3/4.
5. Body: Bronze.
6. End Connections: Solder joint.
7. Finish: Chrome plated.

B. Reduced-Pressure-Principle Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Conbraco Industries, Inc.
 - b. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - c. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle third of flow range.
5. Size: As noted on drawings.
6. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved or stainless steel for NPS 2-1/2 and larger.
7. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
8. Configuration: Designed for horizontal, straight-through flow.
9. Accessories:
 - a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.

- b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
- c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

C. Double-Check, Backflow-Prevention Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Conbraco Industries, Inc.
 - b. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - c. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Standard: ASSE 1015.
3. Operation: Continuous-pressure applications unless otherwise indicated.
4. Pressure Loss: 5 psig maximum, through middle third of flow range.
5. Size: As noted on drawings.
6. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved or stainless steel for NPS 2-1/2 and larger.
7. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
8. Configuration: Designed for horizontal, straight-through flow.
9. Accessories:
 - a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
 - b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.

D. Dual-Check-Valve Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Conbraco Industries, Inc.
 - b. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - c. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Standard: ASSE 1024.
3. Operation: Continuous-pressure applications.
4. Size: NPS 1/2 or NPS 3/4.
5. Body: Bronze with union inlet.

2.5 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Conbraco Industries, Inc.
 - b. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - c. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 psig.
4. Size: As noted on drawings.
5. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
6. Valves for Booster Heater Water Supply: Include integral bypass.
7. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

2.6 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armstrong International, Inc.
 - b. ITT Corporation; Bell & Gossett Div.
 - c. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
2. Type: Ball valve with two readout ports and memory-setting indicator.
3. Body: bronze.
4. Size: Same as connected piping, but not larger than NPS 2.
5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

2.7 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Water-Temperature Limiting Devices:

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armstrong International, Inc.
 - b. Conbraco Industries, Inc.
 - c. Leonard Valve Company.
 - d. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - e. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig.
4. Type: Thermostatically controlled, water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded or union inlets and outlet.
7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Valve Finish: Chrome plated.

B. Primary, Thermostatic, Water Mixing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armstrong International, Inc.
 - b. Lawler Manufacturing Company, Inc.
 - c. Leonard Valve Company.
 - d. Powers; a division of Watts Water Technologies, Inc.
2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Type: Exposed-mounted or Cabinet-type, thermostatically controlled, water mixing valve. As noted on drawing.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded or union inlets and outlet.
7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Valve Finish: Chrome plated.
9. Piping Finish: Chrome plated exposed finish spaces and Copper in unfinished spaces or locations.
10. Cabinet: Factory fabricated, stainless steel, for recessed or surface mounting and with hinged, stainless-steel door. As noted on drawing.

2.8 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron[with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and] for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Perforation Size:
 - a. Strainers NPS 2 and Smaller: 0.033 inch.
 - b. Strainers NPS 2-1/2 to NPS 4: 0.062 inch.
 - c. Strainers NPS 5 and Larger: 0.125 inch.
6. Drain: Factory-installed, hose-end drain valve.

2.9 OUTLET BOXES

A. Clothes Washer Outlet Boxes:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
 - a. Acorn Engineering Company.
 - b. Guy Gray Manufacturing Co., Inc.
 - c. IPS Corporation.
 - d. Zurn Plumbing Products Group; Light Commercial Operation.
2. Mounting: Recessed.
3. Material and Finish: Enameled-steel or epoxy-painted-steel box and faceplate.
4. Faucet: Combination, valved fitting or separate hot- and cold-water, valved fittings complying with ASME A112.18.1. Include garden-hose thread complying with ASME B1.20.7 on outlets.
5. Supply Shutoff Fittings: NPS 1/2 ball valves and NPS 1/2 copper, water tubing.
6. Drain: NPS 2 standpipe and P-trap for direct waste connection to drainage piping.
7. Inlet Hoses: Two 60-inch- long, rubber household clothes washer inlet hoses with female, garden-hose-thread couplings. Include rubber washers.
8. Drain Hose: One 48-inch- long, rubber household clothes washer drain hose with hooked end.

2.10 HOSE BIBBS

A. Hose Bibbs "HB-#":

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Chicago Faucets.
 - b. Woodford Manufacturing Company.
 - c. Zurn Plumbing Products Group; Light Commercial Operation.
2. Standard: ASME A112.18.1 for sediment faucets.
3. Body Material: Bronze.
4. Seat: Bronze, replaceable.
5. Supply Connections: NPS 3/4 threaded or solder-joint inlet.
6. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
7. Pressure Rating: 125 psig.
8. Vacuum Breaker: Integral or field-installation, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
9. Finish for Equipment Rooms: Rough bronze, or chrome plated.
10. Finish for Service Areas: Chrome plated.
11. Finish for Finished Rooms: Chrome or nickel plated.
12. Operation for Restrooms: Operating key.
13. Operation for Mechanical Rooms and Service Areas: Lever handle.
14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.
16. Basis of Design Product "HB-1": Chicago Faucet No. 293, or equal to.
17. Basis of Design Product "HB-2": Zurn No. Z-80501, or equal to.

2.11 WALL HYDRANTS

A. Non-freeze Wall Hydrants "WH-1":

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - b. Woodford Manufacturing Company.
 - c. Zurn Plumbing Products Group; Light Commercial Operation.
2. Standard: ASME A112.21.3M for concealed outlet, self-draining wall hydrants.
3. Pressure Rating: 125 psig.
4. Operation: Loose key.
5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 3/4.
7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.

8. Box: Deep, flush mounting with cover.
9. Box and Cover Finish: Polished nickel bronze.
10. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
11. Nozzle and Wall-Plate Finish: Polished nickel bronze.
12. Operating Keys(s): One with each wall hydrant.
13. Basis-of-Design Product: Zurn Model 1300, or equal to.

2.12 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.13 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. MIFAB, Inc.
 - b. Precision Plumbing Products, Inc.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Watts Drainage Products.
 - f. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.14 AIR VENTS

A. Bolted-Construction Automatic Air Vents:

1. Body: Bronze.

2. Pressure Rating and Temperature: 125-psig minimum pressure rating at 140 deg F.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 3/8 NPS 1/2 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

B. Welded-Construction Automatic Air Vents:

1. Body: Stainless steel.
2. Pressure Rating: 150-psig minimum pressure rating.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 3/8 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

2.15 TRAP-SEAL PRIMER DEVICE

A. Supply-Type, Trap-Seal Primer Device:

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. MIFAB, Inc.
 - b. Precision Plumbing Products, Inc.
 - c. Sioux Chief Manufacturing Company, Inc.
2. Standard: ASSE 1018.
3. Pressure Rating: 125 psig minimum.
4. Body: Bronze.
5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
7. Multiple Drain Outlet Distribution Unit: Provide multiple distribution trap primer assembly fitting where multiple traps are service and supplied by common trap primer valve.
8. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

2.16 ELECTRONIC TRAP PRIMING MANIFOLD ASSEMBLY

- A. Furnish and install an electronic trap priming manifold assembly at location shown. Manifold assembly shall be the Precision Plumbing Products, Inc., with 4 to 8 openings on manifold, or approved equal. Unit shall automatically maintain a constant water seal in floor drain traps, and shall be capable of supplying a minimum of 2 ounces of potable water at 20 psig in a 24 hour period. Manifold shall include Type "L" copper tubing, assembled with 95-5 lead-free solder; circuit breaker, pre-set 24 hour clock, manual override switch, UL Listed or recognized solenoid valve; anti-siphon atmospheric vacuum breaker; water hammer arrestor; 14" x 16" x 4" deep 16 gauge steel metal

cabinet; and prime-coated. Complete with water on-off valve. Manifold unit shall be factory assembled and tested, both mechanically and electrically. Manifold shall be special calibrated for equal water distribution to floor drains. Mount manifold in accordance with manufacturer's installation instructions. All wiring will be included under the Electrical Contract.

2.17 ICE MACHINE WATER FILTERS

- A. Filter shall be cartridge-type assemblies suitable for potable water. Include housing, fittings, filter cartridges, and cartridge end caps. Unit shall be wall-mounting type, with housing head section with threaded inlet and outlet, mounting bracket, and removable lower section for 10-inch long filter cartridge. Cartridge shall be activated-charcoal filter media, 10 inches, with 5-micron-particulate removable rating. Filter shall be as manufactured by Cuno, Inc., Ametek, Inc. Plymouth Products Div., or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
 - 1. Locate backflow preventers in same room as connected equipment or system.
 - 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
 - 3. Do not install bypass piping around backflow preventers.
- B. Install water regulators with inlet and outlet shutoff valves and bypass valve. Install pressure gages on inlet and outlet.
- C. Install balancing valves in locations where they can easily be adjusted, set and tested.
- D. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
 - 1. Install cabinet-type units recessed in or surface mounted on wall as specified.
- E. Install Y-pattern strainers for water on supply side of each water pressure-reducing valve and pump.
- F. Install water-hammer arresters in water piping according to PDI-WH 201.
- G. Install air vents at high points of water piping. Install drain piping and discharge onto floor drain.

- H. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

3.2 CONNECTIONS

- A. Comply with requirements for piping specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Comply with requirements for ground equipment in Division 26 Section "Grounding and Bonding for Electrical Systems."
- C. Fire-retardant-treated-wood blocking is specified in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables" for electrical connections.

3.3 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Reduced-pressure-principle backflow preventers.
 - 2. Double-check, backflow-prevention assemblies.
 - 3. Dual-check-valve backflow preventers.
 - 4. Water pressure-reducing valves.
 - 5. Calibrated balancing valves.
 - 6. Primary, thermostatic, water mixing valves.
 - 7. Supply-type, trap-seal primer valves.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Test each pressure vacuum breaker, reduced-pressure-principle backflow preventer, and double-check, backflow-prevention assembly according to authorities having jurisdiction and the device's reference standard.
- B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

END OF SECTION 221119

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipe and fittings.
 - 2. Specialty pipe fittings.

1.3 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10-foot head of water.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

1.7 PROJECT CONDITIONS

- A. Interruption of Existing Sanitary Waste Service During Future Build-Outs: Do not interrupt service to facilities occupied by Owner unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 - 1. Notify Owner no fewer than two days in advance of proposed interruption of sanitary waste service.
 - 2. Do not proceed with interruption of sanitary waste service without Owner's written permission.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
 - 1. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.
 - a. Available Manufacturers:
 - 1) ANACO. "Husky 2000"
 - 2) Clamp-All Corp. "Clamp-All 80"
 - 3) Mission Rubber Co. "Heavyweight"

2.4 COPPER TUBE AND FITTINGS

- A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.

1. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
- B. Hard Copper Tube: ASTM B 88, Types L, water tube, drawn temper.
 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
 2. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
 3. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

2.5 PLASTIC PIPE AND FITTINGS

- A. PVC Plastic Pipe: ASTM D 2665, Schedule 40.
- B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311 drain, waste, and vent pipe patterns.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

- A. Condensate drainage piping shall be the following:
 1. Hard Copper Tube: ASTM B 88, Types L, water tube, drawn temper with ASME B16.22, wrought-copper, solder-joint fittings.
- B. Aboveground within Building, soil and waste piping shall be any of the following:
 1. Hubless cast-iron soil pipe and fittings, heavy-duty shielded stainless-steel couplings; and hubless-coupling joints.
 2. Copper DWV tube, copper drainage fittings, and soldered joints.
 3. Schedule 40 PVC may be used for urinal waste arms only.
 4. Dissimilar Pipe-Material Couplings: Flexible, Shielded, non-pressure pipe couplings for joining dissimilar pipe materials with small difference in OD.
- C. Aboveground, vent piping shall be any of the following:
 1. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.
 2. Copper DWV tube, copper drainage fittings, and soldered joints.
 3. Dissimilar Pipe-Material Couplings: Flexible, Shielded, non-pressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

- D. Underground soil, waste, or vent piping, from inside building to 5' outside of building, shall be any of the following:
 - 1. All Sizes: Schedule 40 PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.

3.3 PIPING INSTALLATION

- A. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- C. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- D. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- E. Install soil and waste drainage and vent piping at slopes per applicable codes.
- F. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- G. Install underground PVC plastic drainage piping according to ASTM D 3034.

3.4 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Join cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- C. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.
- D. PVC Piping Joints: Join drainage piping according to ASTM D 2665.
- E. Handling of Solvent Cements, Primers, and Cleaners: Comply with procedures in ASTM F 402 for safe handling during joining of plastic pipe and fittings.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Refer to Division 22 Section "Plumbing Hangers and Supports" for pipe hanger and support devices. Install the following:
 - 1. Riser clamps, MSS Type 8 or Type 42, for vertical runs.
 - 2. Adjustable steel clevis hangers, MSS Type 1, for individual, straight, horizontal runs 100 feet and less.
 - 3. Adjustable roller hangers, MSS Type 43, for individual, straight, horizontal runs longer than 100 feet.
 - 4. Spring cushion rolls, MSS Type 49, if indicated, for individual, straight, horizontal runs longer than 100 feet.
 - 5. Pipe rolls, MSS Type 44, for multiple, straight, horizontal runs 100 feet or longer. Support pipe rolls on trapeze.
 - 6. Spring hangers, MSS Type 52, for supporting base of vertical runs.
- B. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment".
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.
- E. Install hangers for copper tubing with the following maximum spacing and minimum rod diameters:
 - 1. 1-1/4-Inch NPS: Maximum horizontal spacing, 72 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 10 feet.
 - 2. 1-1/2 and 2-Inch NPS: Maximum horizontal spacing, 96 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 10 feet.
- F. Install hangers for cast-iron soil piping with the following maximum spacing and minimum rod diameters:
 - 1. 1-1/2- and 2-Inch NPS: Maximum horizontal spacing, 60 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 15 feet.
 - 2. 3-Inch NPS: Maximum horizontal spacing, 60 inches with 1/2-inch minimum rod diameter; maximum vertical spacing, 15 feet.
 - 3. 4-Inch NPS: Maximum horizontal spacing, 60 inches with 5/8-inch minimum rod diameter; maximum vertical spacing, 15 feet.
 - 4. Spacing for horizontal pipe in 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- G. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.

- B. Connect soil and waste piping to existing sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect drainage and vent piping to the following:
 - 1. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 - 2. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
 - 3. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

3.7 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of Contacting Officer.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - 2. Final Inspection: Arrange for final inspection by Owner to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If the Owner finds that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by the Owner.
- D. Test sanitary drainage and vent piping according to procedures of the Owner or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
 - 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air

throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.

5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.8 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 221316

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following sanitary drainage piping specialties:

1. Cleanouts.
2. Floor drains.
3. Trench drains.
4. Miscellaneous sanitary drainage piping specialties.
5. Flashing materials.
6. Air admittance valves.
7. Garbage disposal unit.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details for frost-resistant vent terminals.
 1. Wiring Diagrams: Power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control test reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

1.7 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 CLEANOUTS

- A. Exposed Metal Cleanouts:
 - 1. ASME A112.36.2M, Cast-Iron Cleanouts:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Josam Company.
 - 2) MIFAB, Inc.
 - 3) Smith, Jay R. Mfg. Co.
 - 4) Watts Drainage Products.
 - 5) Zurn Plumbing Products Group.
- B. Cleanout Types: Floor level cleanouts, wall cleanouts.
- C. Description: Cast iron body with bronze plug, and polished nickel-bronze or stainless steel top.
- D. Appropriate Standard: ASME A112.36.2.
- E. Shape: Round or Square as hereinafter specified.
- F. Top-Loading Classification: Medium Duty.
- G. In-Line Above Floor Cleanouts: Bronze plugs in wye fittings.
- H. Available Products for All Areas Excluding Toilet Rooms with Tile Floors: For floor level cleanouts, similar to Zurn No. ZN-1400-BP, or equal. Cleanouts in walls, similar to Zurn No. Z-1445-BP, or equal. Cleanouts in carpeting, Zurn No. ZN-1400-BP-CM, or equal. Access covers, similar to Zurn No. ZANB-1460 cover and frame, or equal.
- I. Available Products for Toilet Room Tile Floors: Floor level cleanouts, similar to Zurn No. ZS-1400-BP-T, or equal. NOTE: Installations in Toilet Rooms shall be coordinated with the 2"x 2" floor tile installations. Cleanouts shall be installed adjacent to full size, non-cut tiles surrounding the entire cleanout top. Refer to Architectural drawings for tile layouts.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains "FD-1":

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.
 - d. Watts Drainage Products.
 - e. Zurn Plumbing Products Group.
2. Description: Toilet Room drain.
3. Appropriate Standard: ASME A112.21.1.
4. Material: Cast iron.
5. Shape: Square.
6. Dimension of Strainer: 6" x 6".
7. Top-Loading Classification: Medium Duty.
8. Cover and Body Top Finish: Stainless steel.
9. Available Products: Zurn No. ZS-415-6SS-Y-P, or equal, with 6" x 6" Type "SS" strainer, sediment bucket, clamping collar, bottom outlet. NOTE: Installations in Toilet Rooms shall be coordinated with the 2"x 2" floor tile installations. Drains shall be installed adjacent to full size, non-cut tiles surrounding the entire floor drain strainer. Refer to Architectural drawings for tile layouts. Provide a P-trap at all locations.

B. Cast-Iron Floor Drains "FD-2":

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.
 - d. Watts Drainage Products.
 - e. Zurn Plumbing Products Group.
2. Description: Mechanical Areas, Interior Loading Dock Area, Janitor's Closets.
3. Appropriate Standard: ASME A112.21.1.
4. Shape: Round.
5. Dimension of Top: 9".
6. Top-Loading Classification: Medium duty.
7. Strainer Finish: Cast iron.
8. Available Products: Zurn No. Z-551-Y, or equal, with slotted flat grate and removable sediment bucket, bottom outlet. Provide a P-trap at all locations.
9. Trap Seal Protection: All "FD-2" floor drains shall include a barrier-type trap-seal protection device of type hereinafter in this specification section.

C. Cast-Iron Floor Drains "FD-3":

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.
 - d. Watts Drainage Products.
 - e. Zurn Plumbing Products Group.
2. Description: Mechanical or Janitor's Area.
3. Appropriate Standard: ASME A112.21.1.
4. Shape: Round.
5. Dimension of Top: 9".
6. Top-Loading Classification: Medium duty.
7. Cover and Body Top Finish: Cast iron.
8. Available Products: Zurn No. Z-550-Y, or equal, with combination membrane flashing clamp and frame, slotted flat grate and removable sediment bucket, bottom outlet. All "FD-3" floor drains shall include a barrier-type trap-seal protection device of type hereinafter in this specification section.

2.3 FLOOR SINKS

A. Cast-Iron Floor Sinks "FS-1":

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.
 - d. Watts Drainage Products.
 - e. Zurn Plumbing Products Group.
2. Description: In slab floor sink below raised floors. Floor sinks used as drainage for emergency drains for sprinkler discharge.
3. Appropriate Standard: ASME A112.21.1.
4. Shape: Round.
5. Dimension of Top Opening: 9".
6. Top-Loading Classification: Medium duty.
7. Strainer: Not Required.
8. Available Products: Zurn No. Z-550-Y, or equal, with combination membrane flashing clamp and frame, removable sediment bucket, 4" bottom outlet, modified to NOT include strainer grate. Provide P-traps at all locations at the First Floor level. "FS-1" floor sinks, at First Floor Level only, shall include a barrier-type trap-seal protection device of type hereinafter in this specification section.

2.4 ELEVATOR PIT DRAIN

A. Elevator Pit Drain "EPD-1":

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.
 - d. Watts Drainage Products.
 - e. Zurn Plumbing Products Group.
2. Description: Locate in bottom of elevator pit. Drain provided in the event of water entering the elevator pit.
3. Appropriate Standard: ASME A112.21.1.
4. Shape: Round.
5. Dimension of Top: 9".
6. Top-Loading Classification: Medium duty.
7. Strainer Finish: Cast iron.
8. Available Products: Zurn No. Z-550-Y, or equal, with combination membrane flashing clamp and frame, slotted flat grate and removable sediment bucket, bottom outlet. Provide a P-trap at all locations.
9. Trap Seal Protection: All "EPD-1" pit drains shall include a barrier-type trap-seal protection device of type hereinafter in this specification section.

2.5 TRENCH DRAINS

A. Trench Drain "TD-1":

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.
 - d. Watts Drainage Products.
 - e. Zurn Plumbing Products Group.
2. Description: Centrifugal plant area drains for indirect piping terminations.
3. Clamping Device: Required.
4. Outlet: Bottom.
5. Grate Material: Ductile iron.
6. Body and Grate Finish: Galvanized.
7. Dimensions of Frame and Grate: 6" wide overall, 5-1/2" wide grate.
8. Top Loading Classification: Heavy Duty.

9. Available Products: Josam No. 86004-7-40, or equal to. Include all necessary components for a complete installation as per installation instruction of the manufacturer. Coordinate with the General Contractor for installations. All "TD-1" trench drains shall include a barrier-type trap-seal protection device of type hereinafter in this specification section.

2.6 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Barrier-Type, Drain Trap-Seal Protection Devices:

1. Barrier-type trap seal devices shall be provided to protect seals on all floor drains and floor sinks that include P-traps, and are subject to losing their seal by evaporation. Devices shall conform to ASSE 1072. Devices shall be of size compatible with utilized floor drain or floor sink outlet tailpiece, and shall be installed in accordance with manufacturer's installation instructions. Trap seal devices shall be as manufactured by RectorSeal "Sure-Seal", or equal to. Refer to floor drain specifications for drains, which are to include a trap seal device.

B. Open Drains (Funnel Drains):

1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.
2. Size: As indicated.

C. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.
 - a. NPS 2: 4-inch- minimum water seal.
 - b. NPS 2-1/2 and Larger: 5-inch- minimum water seal.

D. Fixed Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

E. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch above finished floor and

galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.

2. Size: As required for close fit to riser, or stack piping.

F. Expansion Joints:

1. Standard: ASME A112.21.2M.
2. Body: Cast iron with bronze sleeve, packing, and gland.
3. End Connections: Matching connected piping.
4. Size: Same as connected soil, waste, or vent piping.

2.7 GARBAGE DISPOSER UNIT

- A. Disposer shall be the In-Sink-Erator Model "Evolution PRO Essential", or equal to, with "Multigrind" technology for two stages of grinding, and "Soundseal" technology for reduction of noise of standard disposers by a minimum of 40 percent. Unit shall include a 3/4 HP motor, 120 volt, single phase, 60 Hz., and shall include an auto-reverse grind system and stainless steel grind chamber and components, and dishwasher connection. Unit shall include an 8 year warranty.

2.8 AIR-ADMITTANCE VALVES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Durgo, Inc.
 2. Oatey.
 3. Studor, Inc.
- B. Standard: ASSE 1051, Type A for single fixture or Type B for branch piping.
- C. Housing: Plastic.
- D. Operation: Mechanical sealing diaphragm.
- E. Size: Same as connected fixture or branch vent piping.

2.9 FLASHING MATERIALS

- A. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.
- B. Fasteners: Metal compatible with material and substrate being fastened.
- C. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

- D. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 - 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate at each change in direction of piping greater than 45 degrees.
 - 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 - 4. Locate at base of each vertical soil and waste stack.
- C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 - 1. Position floor drains for easy access and maintenance.
 - 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 24 Inches: Slope to floor drain strainer with drain strainer at a 1/4-inch total depression.
 - 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 - 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- F. Assemble open drain fittings and install with top of hub 1 inch above floor.
- G. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- H. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

- I. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- J. Install wood-blocking reinforcement for wall-mounting-type specialties.
- K. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- L. Install garbage disposal units per manufacturer's installation instructions.
- M. Install air admittance valves per manufacturer's installation instructions.
- N. Install barrier-type trap seal devices per manufacturer's installation instructions.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.

3.3 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- C. Set flashing on floors in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."

3.4 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.5 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319

SECTION 224213 - COMMERCIAL WATER CLOSETS

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. Water closets and carriers.
 - 2. Flushometer valves.
 - 3. Toilet seats.

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 water closets.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For flushometer valves and electronic sensors to include in operation and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Flushometer-Valve Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than one of each type.

PART 2 - PRODUCTS

2.1 COMMERCIAL WATER CLOSETS

- A. Water Closets (W-#): Refer to Plumbing Fixture Schedules on the Drawings for specific plumbing fixture basis of design types, details, accessories, notes and additional information. Refer to Plumbing Floor plans for designated fixture locations.
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Sloan.
 - b. American Standard America.
 - c. Kohler Co.
 - d. Zurn Industries, LLC; Commercial Brass and Fixtures
 2. Fixture:
 - a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
 - b. Material: Vitreous china.
 - c. Type: Siphon jet.
 - d. Horizontal Mounting Carriers: Zurn Series Z1201-N4 "EZCarry" for single, Zurn Series Z1201-ND4 "EZCarry" for back-to-back, or equal to.
 - e. Height: Standard or ADA/ Handicapped/elderly accessible, complying with ICC/ANSI A117.1.
 - f. Rim Contour: Elongated.
 - g. Water Consumption: 1.28 gallon per flush.
 - h. Spud Size and Location: NPS 1-1/2; top.
 - i. Color: White.
 3. Bowl-to-Drain Connecting Fitting: ASTM A 1045 or ASME A112.4.3.

2.2 FLUSHOMETER VALVES

- A. Water Closet Flushometer Valves: (W-#) Refer to Plumbing Fixture Schedules on the Drawings for specific plumbing fixture flush valves basis of design types, details, accessories, notes and additional information.
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Sloan Valve Co.
 - b. American Standard America
 - c. Kohler Co.
 - d. Zurn Industries, LLC; Commercial Brass and Fixtures.
 2. Standard: ASSE 1037.

3. Minimum Pressure Rating: 125 psig.
4. Features: Include integral check stop and backflow-prevention device.
5. Material: Brass body with corrosion-resistant components.
6. Exposed Flushometer-Valve Finish: Chrome plated.
7. Style: Exposed.
8. Actuator Type: Manual, Sensor Operated Battery.
9. Consumption: Flush 1.28 gallon per flush.
10. Minimum Inlet: NPS 1.
11. Minimum Outlet: NPS 1-1/4.

2.3 TOILET SEATS

A. Toilet Seats:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Bemis Manufacturing Company.
 - b. Centoco Manufacturing Corporation.
 - c. Church Seats.
 - d. Olsonite Seat Co.
 - e. Sperzel of Lexington.
2. Standard: IAPMO/ANSI Z124.5.
3. Material: Plastic.
4. Type: Commercial (Standard).
5. Shape: Elongated rim, open front.
6. Hinge: Self-sustaining, check.
7. Hinge Material: Non-corroding metal.
8. Seat Cover: Not required.
9. Color: White.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before water-closet installation.
- B. Examine walls and floors for suitable conditions where water closets will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Water-Closet Installation:

1. Install level and plumb according to roughing-in drawings.
2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.
3. Install accessible, wall-mounted water closets at mounting height for handicapped/elderly, according to ICC/ANSI A117.1.

B. Support Installation:

1. Install supports, affixed to building substrate, for floor-mounted water closets.
2. Use carrier supports with waste-fitting assembly and seal.
3. Install floor-mounted water closets attached to building floor substrate, onto waste-fitting seals; and attach to support.

C. Flushometer-Valve Installation:

1. Install flushometer-valve, water-supply fitting on each supply to each water closet.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.
4. Install actuators in locations that are easy for people with disabilities to reach.
5. Install electric transformer, junction boxes and low voltage wiring for electric-powered, electronic-sensor mechanisms.

D. Install toilet seats on water closets.

E. Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.
3. Comply with escutcheon requirements as specified.

F. Joint Sealing:

1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to water-closet color.
3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."
- D. Where installing piping adjacent to water closets, allow space for service and maintenance.

3.4 ADJUSTING

- A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.
- B. Adjust water pressure at flushometer valves to produce proper flow.

3.5 CLEANING AND PROTECTION

- A. Clean water closets and fittings with manufacturers' recommended cleaning methods and materials.
- B. Install protective covering for installed water closets and fittings.
- C. Do not allow use of water closets for temporary facilities unless approved in writing by Owner.

END OF SECTION 224213

SECTION 224216 - COMMERCIAL LAVATORIES

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. Lavatories.
- 2. Faucets.

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 lavatories.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: Include diagrams for power, signal, and control wiring of automatic faucets.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For lavatories and faucets to include in operation and maintenance manuals.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Servicing and adjustments of automatic faucets.

1.5 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. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.

2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.

PART 2 - PRODUCTS

2.1 VITREOUS-CHINA, WALL-MOUNTED LAVATORIES

- A. Lavatory L-[#]: Where plumbing fixtures of this designation are indicated, provide products complying with the following:

2.2 SOLID-BRASS, LAVATORY FAUCETS

- A. Faucets shall comply with NSF 14 and NSF/ANSI 61 Annex G and NSF/ANSI 372 for 0.25% maximum lead content requirement. Plastic piping components shall be marked with "NSF-pw."
- B. Lavatory Faucets: (L-#) Manual 4" Vandal Resistant Color Coded Wrist Blade Handles. Refer to Plumbing Fixture Schedules on the Drawings for specific plumbing fixture faucet basis of design types, details, accessories, notes and additional information. Refer to Plumbing Floor plans for designated fixture locations.

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work:
 - a. Sloan Valve Co.
 - b. American Standard America.
 - c. Moen.
 - d. Zurn Industries. LLC: Commercial Brass and Fixtures.
2. Standards: ASME A112.18.1/CSA B125.1 and UL 1951.
3. 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.
4. General: Coordinate faucet inlets with supplies and countertop hole punching; coordinate outlet with spout and fixture receptor.
5. Body Material: Commercial, brass.
6. Finish: Polished chrome plated.
7. Maximum Flow Rate: 0.5 gpm.
8. Mounting Type: Deck.
9. Spout: Rigid type.
10. Spout Outlet: 0.5 gpm laminar flow aerator.

2.3 SUPPLY FITTINGS

- A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.

- B. Standard: ASME A112.18.1/CSA B125.1.
- C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless-steel wall flange.
- D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
- E. Operation: Loose key.
- F. Risers:
 - 1. NPS 3/8 or NPS 1/2.
 - 2. Chrome-plated, soft-copper flexible tube riser.
 - 3. Exception: Utilize braided risers when included with proposed faucet kits.

2.4 WASTE FITTINGS

- A. Standard: ASME A112.18.2/CSA B125.2.
- B. Drain: Grid type with NPS 1-1/4 offset and straight tailpiece. Waste strainer assembly shall offset to trap location parallel to wall. Trap location shall be beyond the ADA knee clearances resulting in no need for insulation kits on waste fittings.
- C. Trap:
 - 1. Size: NPS 1-1/2 by NPS 1-1/4.
 - 2. Material: Chrome-plated, two-piece, cast-brass or 17 gauge tubular trap with cleanout and swivel elbow with 0.032-inch- thick brass tube to wall; and chrome-plated, brass or steel wall flange.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before lavatory installation.
- B. Examine counters and walls for suitable conditions where lavatories will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install lavatories level and plumb according to roughing-in drawings.
- B. Install supports, affixed to building substrate, for wall-mounted lavatories.

- C. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, according to ICC/ANSI A117.1.
- D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified.
- E. Seal joints between lavatories, counters, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
- F. Install protective shielding pipe covers on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.3 CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

- A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.
- B. Adjust water pressure at faucets to produce proper flow.
- C. Install fresh batteries in battery-powered, electronic-sensor flush valves.

3.5 CLEANING AND PROTECTION

- A. After completing installation of lavatories, inspect and repair damaged finishes.
- B. Clean lavatories, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed lavatories and fittings.

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West Campus Renovations
220517 - 5

- D. Do not allow use of lavatories for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216

SECTION 224217 - COMMERCIAL SINKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Service sinks.
 - 2. Service Receptor Basins
 - 3. Casework sinks.
 - 4. Sink faucets.
 - 5. Laminar-flow, faucet-spout outlets.
 - 6. Supply fittings.
 - 7. Waste fittings.

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 sinks.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted sinks.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sinks to include in 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. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.

PART 2 - PRODUCTS

2.1 MOP SERVICE SINK RECEPTORS

- A. Mop Service Sink Receptors (SS-#): Refer to Plumbing Fixture Schedules on the Drawings for specific plumbing fixture basis of design types, details, accessories, notes and additional information. Refer to Plumbing Floor plans for designated fixture locations.
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Florestone.
 - b. Fiat.
 - c. E. L. Mustee & Sons, Inc.
 - d. Zurn Industries, LLC.
 2. Fixture:
 - a. Standard: IAPMO/ANSI Z124.6.
 - b. Type: Service Receptor Basin – Floor Mounted.
 - c. Material: Cast Polymer – Molded Composite Plastic
 - d. Faucet: Wall Mounted faucet.
 - e. Nominal Size: 24 by 24.
 - f. Color: White.
 - g. Mounting: NPS 3 P-trap standard with grid strainer inlet.
 - h. Rim Guard: On exposed sides.
 3. Faucet: Service Sink faucet – 8" center set, polished chrome-plated cast brass, ceramic cartridge, vacuum breaker, integral check stops, lever handles and wall support brace. Refer to Plumbing Fixture Schedules on the Drawings for specific plumbing fixture faucet basis of design types, details, accessories, notes and additional information. Refer to Plumbing Floor plans or designated fixture locations.

2.2 CASEWORK COUNTERTOP SINKS

- A. Kitchen Sink (S-#): Refer to Plumbing Fixture Schedules on the Drawings for specific plumbing fixture basis of design types, details, accessories, notes and additional information. Refer to Plumbing Floor plans for designated fixture locations.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Fixture:
 - a. Standard: ASME A112.19.3/CSA B45.4. ADA accessible.
 - b. Type: Drop-in, 304 Stainless Steel, countertop mounted.
 - c. Number of Compartments: One.
 - d. Dimensions: Refer to Schedule.
 - e. Compartment:
 - 1) Inside Bowl Dimensions: Refer to Schedule.
 - 2) Drain: Compatible basket strainer with NPS 1-1/2 tailpiece and twist drain.
 - 3) Drain Location: Centered.
3. Faucet:
 - a. Number Required: One.
 - b. Mounting: Deck.
 - c. Flow: 1.0 gpm – laminar flow.
 - d. Lead Free Compliant – polished chrome-plated brass, quarter-turn ceramic cartridges, wrist blade lever handles. Refer to Plumbing Fixture Schedules on the Drawings for specific plumbing fixture faucet basis of design types, details, accessories, notes and additional information. Refer to Plumbing Floor plans for designated fixture locations.
4. Supply Fittings:
 - a. Standard: ASME A112.18.1/CSA B125.1.
 - b. Supplies: Chrome-plated brass compression quarter-turn stop with inlet connection matching water-supply piping type and size.
 - 1) Operation: Wheel handle.
 - 2) Risers: NPS 3/8 or NPS 1/2, chrome-plated, soft-copper flexible tube or braided stainless steel.
5. Waste Fittings:
 - a. Standard: ASME A112.18.2/CSA B125.2.
 - b. Trap:
 - 1) Size: NPS 1-1/2.
 - 2) Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch- thick brass tube to wall and chrome-plated brass or steel wall flange.
6. Mounting: Self-rimming with sealant.

2.3 SINK FAUCETS

- A. Faucets shall comply with NSF 14 and NSF/ANSI 61 Annex G and NSF/ANSI 372 for 0.25% maximum lead content requirement. Plastic piping components shall be marked with "NSF-pw."

2.4 LAMINAR-FLOW, FAUCET-SPOUT OUTLETS

- A. Faucets shall comply with NSF 14 and NSF/ANSI 61 Annex G and NSF/ANSI 372 for 0.25% maximum lead content requirement. Plastic piping components shall be marked with "NSF-pw."
- B. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work to include the following:
 - 1. AM Conservation Group, Inc.
 - 2. Chronomite Laboratories, Inc.
 - 3. NEOPERL, Inc.
- C. Description: Chrome-plated brass, faucet-spout outlet that produces non-aerating, laminar stream. Include external or internal thread that mates with faucet outlet for attachment to faucets where indicated and flow-rate range that includes flow of faucet.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before sink installation.
- B. Examine walls, floors, and counters for suitable conditions where sinks will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install sinks level and plumb according to roughing-in drawings.
- B. Install supports, affixed to building substrate, for wall-hung sinks.
- C. Install water-supply piping with stop on each supply to each sink faucet.
 - 1. Exception: Use ball valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping."

2. Install stops in locations where they can be easily reached for operation.

- D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified.
- E. Seal joints between sinks and counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

- A. Connect sinks with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

- A. Operate and adjust sinks and controls. Replace damaged and malfunctioning sinks, fittings, and controls.
- B. Adjust water pressure at faucets to produce proper flow.

3.5 CLEANING AND PROTECTION

- A. After completing installation of sinks, inspect and repair damaged finishes.
- B. Clean sinks, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed sinks and fittings.
- D. Do not allow use of sinks for temporary facilities unless approved in writing by Owner.

END OF SECTION 224217

SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
 - 1. In the event of a direct conflict with the requirements of this Section and of those contained in Divisions 01, 02, 05, 07, 08, 09, or 26, the requirements of those other Divisions shall take precedence, but only if they are more demanding or restrictive.

1.2 SUMMARY

- A. This Section includes provisions that apply to Division 23 work in its entirety.
- B. This Section includes the following:
 - 1. General Project Requirements
 - a. Definitions
 - b. General Project Coordination and Planning
 - 1) Coordination between Division 23 and Division 26
 - 2) Coordination with the Commissioning Agent
 - c. HVAC System Commissioning
 - d. Owner Instruction
 - e. Delivery, Storage, and Handling
 - f. Sequencing and Scheduling
 - g. Temporary Shutdown of Existing Systems
 - h. Pre-Bid Site Visits
 - i. Interpretation of the Documents
 - j. Basis of Design Products and Substitutions
 - k. Submittals - General Requirements
 - l. Warranties
 - 2. Coordination Drawings
 - 3. Extra Materials
 - 4. Piping materials and installation instructions common to most piping systems
 - 5. Escutcheons
 - 6. Fire- and smoke-stopping materials and systems
 - 7. Materials used in air plenums.
 - 8. Equipment installation requirements common to equipment specification sections
 - 9. Ceiling, wall, and shaft access panels

10. Coordination of communications between factory mounted equipment controls and the building automation system
11. Control wiring
12. Construction during occupancy
13. HVAC demolition
14. Cutting and patching
15. Cleaning and protection
16. Painting and finishing

1.3 DEFINITIONS

- A. Atmosphere: Outside the exterior walls and roof of a building.
- B. Finished Spaces: Areas where drywall is hung or installed with wall coverings and/or painted; or where floors are polished or coverings are installed on the floor; or where the ceiling is plaster/gypsum board and/or suspended acoustic ceiling tile.
- C. Unfinished Space: Spaces other than finished spaces. Typical examples include mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, attics, crawl spaces, garages, and tunnels.
- D. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- E. Exposed, Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- F. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- G. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters or inside equipment enclosures.
- H. Conditioned Space: Spaces within the insulated envelope of the building and provided with both mechanical heating and air conditioning, either directly or indirectly.
 1. Ceiling and floor plenums and ceiling spaces (areas between the finished ceiling and the structural floor or roof slab/deck above) are considered (indirectly) conditioned spaces.
- I. Unconditioned Space: Spaces lacking either mechanical heating or air conditioning, or both, and are outside of the insulated envelope of the building. Examples: Outdoor-air-ventilated crawlspaces and attics.
 1. Mechanical and electrical rooms, and similar spaces, that are only heated and outdoor-air-ventilated, or are only outdoor-air-ventilated, shall be considered unconditioned spaces.

- J. Contractor: The contractor performing the work of the trade drawings or specification division where the use of the term appears, unless a more specific indication is made.
- K. Furnish: Purchase and deliver to project site, ready for unloading, unpacking, assembly, installation, and similar subsequent requirements.
- L. Install: Operations at project site required to place furnished materials and equipment into use, including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, connecting, finishing, curing, protecting, cleaning, adjusting, commissioning, and similar requirements.
- M. Provide: Both furnish and install.
- N. Reinstall: Remove items indicated; clean, service, and otherwise prepare them for reuse; store and protect against damage. Install items in the same locations or in locations indicated.
- O. Relocate: Same meaning as "reinstall".
- P. Remove: Remove items from their current installed condition and legally dispose of those items, except those indicated to be reinstalled/relocated or salvaged or to remain the Owner's property as indicated.
- Q. Demolish: Same meaning as "remove".
- R. Replace: Remove items indicated as defined under "remove" herein and provide new items with matching dimensions, capacities, and all other features in the same location as the items removed, unless explicitly indicated otherwise.
- S. Salvage (and similar terms and phrases such as "Turn Over to Owner"): Items indicated to be salvaged shall remain the Owner's property. Remove, clean, and pack or crate items to protect against damage. Identify contents of containers and deliver to Owner's designated storage area.
- T. Indicated: The term "indicated", "shown," "noted," "scheduled," and "specified" refers to graphic representations, notes, schedules, or other indications on the Drawings; or to other paragraphs or schedules in the Specifications and other similar requirements in the Contract Documents.
- U. May: Indicative of a Contractor's Option, or that which the Contractor is permitted to do, but not required to do.
- V. Shall: Indicative of a mandatory contract requirement, or that which the Contractor has a duty to perform.
- W. Must: Same meaning as "shall".
- X. Will: Unless explicitly identified as associated with the work of, or performed by, another contractor or under a separate contract, or to be future work also outside this contract, "will" shall be taken to mean the same as "shall", (i.e. representative of a mandatory requirement of this contract).

- Y. The terms "approved", "equal", "acceptable", or "proper" and words of a similar meaning shall be understood to mean "meeting the design intent as determined by the Architect or Engineer".
- Z. The terms "Engineer" and "Architect" used in these specifications are used interchangeably, and refer to the same entities - the design professionals of record.
- AA. "Approved": When used to convey Architect's or Engineer's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's or Engineer's duties and responsibilities as stated in the Conditions of the Contract.
- BB. "Directed": A command or instruction by Architect or Engineer. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- CC. "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."
- DD. References to "HC", "Heating Contractor", "HVAC Contractor", and "Mechanical Contractor" on the drawings depicting the HVAC system work shall refer to the Contractor performing the work of Division 23.
- EE. References to "PC", "Plumbing Contractor" shall refer to the Contractor performing the work of Division 22.
- FF. References to "FC", "FPC", "Sprinkler Contractor", and "Fire Protection Contractor" shall refer to the Contractor performing the work of Division 21.
- GG. References to "EC" and "Electrical Contractor" on the drawings depicting the HVAC system work shall refer to the Contractor performing the work of Divisions 26, 27, and 28.
- HH. Withstand, Resist: With respect to wind resistance ratings, "withstand" and "resist" shall mean to be without permanent deformation of components, fasteners and anchors, and be able to continue to function normally without excessive water or air leakage, without excessive vibration, and meeting all scheduled functional performance requirements, after being subjected to the design wind speed from any direction.
- II. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

1.4 ACTION SUBMITTALS

- A. Product Data: Provide for the following:
 - 1. Fire- and smoke-stopping materials
- B. Shop Drawings: Detail fabrication and installation for metal supports and anchorage for HVAC materials and equipment.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Coordination drawings shall be prepared as specified in this Section and as defined in Division 01. Note that the requirements of this Section may be more restrictive and create additional requirements.
1. Refer to the coordination article(s) elsewhere in this Section.
 2. No installation of permanent systems shall proceed until the coordination drawings are reviewed by the Architect / Engineer. No additional compensation shall be allowed for changes required to accommodate installation of systems provided under other Divisions of this Contract.
 3. Coordination drawings shall be developed from individual system shop drawings and contractor fabrication drawings. Electronic or other reproduced engineering design drawings used as coordination drawings are not acceptable.
 4. Coordination drawings shall be initiated by the Contractor responsible for the ductwork installation. That Contractor shall indicate, on the plans, equipment and duct locations and dimensions drawn to scale, taking into consideration and incorporating proper service and access clearances. The drawing shall then be given to the Contractors installing piping, conduit for the inclusion of their work on the coordination drawing. All discrepancies and conflicts with the architectural layout of the building shall be noted on the coordination drawings. The Contractors of the various Divisions shall meet as required to resolve discrepancies with ductwork, piping, and conduit prior and to coordinate those elements on the coordination drawings. The Contractor who initiated the coordination drawings shall submit them for review to the Architect and Engineer. Coordination and installation of work not indicated on the coordination drawing shall be the responsibility of the Contractor responsible for that equipment. Any modifications required by any Contractor for equipment to be installed that is not shown on the coordination drawing shall be the responsibility of the Contractor who failed to indicate that equipment.
 - a. Coordination drawings shall be prepared for each general area, floor level, and roof level and shall be of a scale not less than 1/4 inch per 1 foot. Mechanical and electrical rooms and areas with similar levels of congestion shall be prepared at 1/2 inch per foot.
 - b. Plans and elevations shall be prepared for shafts and chases containing more than one duct or the work of multiple trades at 1/4" per foot.
 - c. Electronic Format: As required by Division 01.
 5. Detail major elements, components, and systems of HVAC equipment and materials in relationship with other systems, installations, and building components. Show space requirements for installation and access. Indicate if sequence and coordination of installations are important to efficient flow of the Work. Include the following:
 - a. Planned ductwork layout, including all duct accessories (dampers, silencers, access doors, etc.) and control devices (airflow measuring stations, sensors, etc.).
 - b. Planned piping layout, including valve and specialty locations, meters and gauges, control devices (control valves, flow meters, sensors, etc.), and valve-stem movement.

- c. Clearances for installing and maintaining insulation.
 - d. Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly required for periodic maintenance.
 - e. Hangers and supports for ductwork, piping, and equipment, including the size and magnitude of all point loads.
 - f. Access paths through mechanical rooms and on roofs.
 - g. Methods for maintaining required roof slope and roof drainage around rooftop installations.
 - h. Equipment and accessory service connections and support details.
 - i. Sizes and locations of access panels in ceilings, shafts, walls, etc.
 - j. Exterior wall and foundation penetrations.
 - k. Fire- and smoke-rated wall and floor penetrations. Indicate UL directory file number for the fire/smoke stopping system proposed at each penetration.
 - l. Sizes and location of required concrete pads and bases.
 - m. Scheduling, sequencing, movement, and positioning of large equipment into building during construction.
 - n. Floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
 - o. Reflected ceiling plans to coordinate and integrate installation of air outlets and inlets, light fixtures, communication system components, sprinklers, and other ceiling-mounted items.
 - p. Requirements for coordination drawings indicated in other Division 23 Sections.
6. Access Panel Schedule: List of sizes, types, locations, and required purpose for all access panels in ceilings, shafts, walls, etc. Coordinate locations of any access panels not indicated on the Architectural Drawings with the Architect prior to installation.

1.6 CLOSEOUT INFORMATIONAL SUBMITTALS

- A. Electronic Files: Provide electronic files of all ductwork and piping shop drawings in an electronic format as specified in Division 01
 - 1. Files shall be submitted on DVDs or flash memory drives (drives will not be returned to the Contractor), unless Division 01 stipulates otherwise.
- B. Operations and Maintenance Manuals: Comply with requirements in Division 01 and requirements detailed elsewhere in other Division 23 Sections. Manuals shall be provided no later than 90 days after Substantial Completion, unless an earlier date is required by Division 01.

1.7 EXTRA MATERIALS

- A. Unless otherwise specified, extra materials (e.g. maintenance material submittals), wherever required by other Division 23 Sections, shall be stored in accordance with the provisions of this paragraph.

1. Spare parts shall be tagged by project equipment number and identified as to part number, equipment manufacturer, and subassembly component (if appropriate).
2. Include copies of relevant installation and operating manuals and contact information for the supplier. Documentation shall be placed in the packaging / storage box.
3. Spare parts subject to deterioration such as ferrous metal items and electrical components shall be properly protected by lubricants or desiccants and encapsulated in sealed plastic wrapping.
4. Spare parts with individual weights less than 5 pounds and dimensions less than 2 feet wide, or 18 inches high, or 3 feet in length shall be furnished in cardboard boxes. A neatly type inventory of spare parts shall be placed in a plastic sleeve and taped to the outside of the box.

1.8 QUALITY ASSURANCE

- A. Code Compliance: All aspects of the Contractor's work shall comply with applicable codes.
- B. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- C. Factory Fabricated HVAC Equipment: Of the type, design, and size that manufacturers currently offer for sale and appears in the manufacturer's current catalogue. Equipment shall be new and fabricated from new materials, and shall be free from defects in materials and workmanship.
- D. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.9 GENERAL PROJECT COORDINATION AND PLANNING

- A. Prior to the ordering of materials or installation of work, coordinate and pre-plan the work to the extent necessary to permit the work to be installed satisfactorily, in accordance with the Contract Documents, and with the least possible interference or delay.
- B. When work is installed without the required coordination and/or planning, changes to the work deemed necessary by the Architect shall be made to correct the conditions without additional cost to the Owner.
- C. The Contractor is advised to furnish complete Contract Documents to all suppliers, sub-contractors, and other agents. Information required by those entities for the proper completion of their work in a coordinated fashion with the work of others will typically appear in multiple places in the Contract Documents.

1. Any failure on the part of a suppliers, sub-contractors, and other agents to improperly interpret the Contractor Documents or to understand other requirements made necessary by the coordination and planning process, is the full responsibility of the Contractor.

1.10 OWNER INSTRUCTION

- A. Comply with the demonstration and instruction requirements indicated in other Division 23 Sections.
- B. Instruction Time: Some Division 23 specification Sections indicate a minimum allowance for instruction time. The length of instruction time will be measured by actual time spent performing demonstration and training in required location. Time spent assembling educational materials, setting up, or cleaning up shall be counted against the time allotment.
- C. Operations and Maintenance Manuals shall be distributed to the Owner no less than one (1) week prior to the instruction periods unless Division 01 stipulates a greater length of time.
- D. Forward to the Architect / Engineer the signatures of all those who attended the instruction sessions.
- E. Refer to Division 01 for additional Owner instruction requirements.

1.11 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 that products are undamaged and properly protected.
- C. Storage:
 1. Provide a secure location and enclosure at Project site for storage of materials and equipment.

2. Store products to allow for inspection and measurement of quantity or counting of units.
 3. Store materials in a manner that will not endanger Project structure.
 4. Store products that are subject to damage by the elements under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation and with adequate protection from wind.
 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.
- D. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and prevent entrance of dirt, debris, and moisture.
- E. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.
- F. Protect flanges, fittings, and piping specialties from moisture and dirt.
- G. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.12 SEQUENCING AND SCHEDULING

- A. Coordinate HVAC equipment and systems installation with other building components.
- B. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for HVAC installations.
- C. Coordinate requirements for access panels and doors if HVAC items such as dampers, valves and other equipment requiring access are concealed behind finished surfaces where no other means of access is available. Provide access panels and doors meeting the applicable requirements of Division 08. Coordinate locations of any access panels not indicated on the Architectural Drawings with the Architect prior to installation.

1.13 TEMPORARY SHUTDOWN OF EXISTING SYSTEMS

- A. Plan installation of new work and connections to existing work to insure minimum interference with regular operation of existing systems. Some temporary shutdown of existing systems may be required to complete the work.
- B. Submit to the Owner in writing for approval, proposed date schedule, time, and duration of necessary temporary shutdowns of existing systems. Submit schedule at least ten (10) working days (exclusive of holidays and weekends) in advance of intended shutdown or as indicated in Division 01. Shutdowns shall be made at such times as shall not interfere with regular operation of existing facilities and only after written approval of Owner. The Owner reserves the right to cancel shutdowns at any time prior to the shutdowns. To minimize conflict with Owner's operation, shutdowns shall be planned to occur on weekends. To insure continuous operation, make necessary

temporary connections between new and existing work. The Contractor shall bear costs resulting from temporary shutdowns and temporary connections. No additional charges shall be allowed for Owner-canceled shutdowns that must be rescheduled.

- C. Refer to Division 01 for additional requirements.

1.14 PRE-BID SITE VISIT

- A. Bidders shall visit the site and become completely familiar with existing conditions prior to submitting their bid. No additional cost to the Owner shall be allowed as a result of existing conditions. To schedule a site visit, contact the Owner at least 48 hours in advance of desired time of visit.

- 1. Contact: **Stephanie DeGroot - Fairmont State University Construction Manager (304) 367-4110 <Stephanie.DeGroot@fairmontstate.edu>**

1.15 INTENT AND REQUIRED INTERPRETATION OF THE CONSTRUCTION DOCUMENTS

- A. Refer to the Article titled "Basis of Design Products and Substitutions" located elsewhere in this Section.
- B. Provide complete and functional systems for the project. The systems shall conform to the details stated in these Specifications and shown on the Drawings. Items or work not shown or specified, but required for complete systems, shall be provided and conform to accepted trade practices.
- C. The Drawings and Specifications are presented to define specific system requirements and serve to expand on the primary contract requirements of providing complete and functional systems. The drawings are diagrammatic and indicate the general arrangement and routing of the systems included in this Contractor's work.
- D. Drawings and Specifications are intended to be complementary to each other, and contract required work only may be indicated in one of these two sources. Inclusion of a scope element in either alone, or both, obligates the Contractor to provide the indicated work.
 - 1. References in specific Specification sections to other Sections or to the Drawings are made for the Contractor's convenience only, and the omission of a potential reference shall not be interpreted by the Contractor as invalidating the other (unreferenced) provisions.
- E. All work indicated in the documents shall be completed using new equipment and materials, unless explicitly indicated otherwise.
- F. The Architect / Engineer shall not be responsible for design changes or modifications except as set forth by the Architect / Engineer in writing. The Contractor shall comply with the Contract Documents except as directed in writing or as required by an applicable code or product/equipment manufacturer's instructions. The Contractor shall not

proceed based on verbal responses by the Architect / Engineer to questions posed by the Contractor.

- G. Do not scale the Drawings. Because of the small scale and diagrammatic nature of the Drawings, it is not possible to indicate offsets, fittings, valves, piping and duct accessories and appurtenances, or similar items which may be required to provide complete operating systems. Carefully investigate conditions affecting the work associated with this project. Check and verify dimensions and existing conditions at the site. Install systems in such a manner that interferences between pipes, conduit, ducts, equipment, architectural and structural features are avoided. Provide items required to meet the project conditions without additional cost to the Owner.
- H. Where the Contractor has been furnished with electronic PDF files of the Drawings or a 3D model that contains layering information (e.g. the PDF has not been 'flattened'), that layering information shall be ignored by the Contractor. Obtaining information from the Drawings for purposes of preparing a bid price (i.e. "take offs") shall be performed by inspection of the as-printed presentation of the Drawings information. Any inconsistencies in the layering information that causes the Contractor using such layering information to prepare a faulty bid shall be considered to be at the Contractor's risk.
- I. The Contractor's use of electronic copies of the Contract Documents shall constitute implicit acknowledgement and acceptance of the following conditions:
 - 1. The electronic data is transferred for a specific, limited purpose; any use of the data for other than its originally intended purpose is prohibited.
 - 2. The Architect / Engineer is the author of the data and retains full rights of authorship in the data and all other rights not specifically conveyed. The electronic data is transferred for the sole benefit of the client for whom the design services have been performed. The recipient may not transmit the information to other parties except for purposes of bidding this project. Use of this material for any other purpose is prohibited without the written permission of the Architect / Engineer.
 - 3. The recipient acknowledges that the data is being transmitted in electronic form for convenience only and that the signed and sealed hard copies are the only true Contract Documents of record.
 - 4. The recipient is solely responsible for verifying that the information contained in the electronic data file is identical in all material aspects to the Contract Documents of record.
 - 5. Use of the electronic data is at the sole risk of the recipient, who acknowledges that the electronic data is subject to undetectable alteration or electronic corruption or degradation.
 - 6. The recipient is solely responsible for confirming that the information is current and for updating the information to reflect any changes in the design subsequent to the date of receipt of the information.
 - 7. The recipient indemnifies and holds harmless the Architect for all claims and losses resulting from unauthorized or improper use of the data.
 - 8. Transfer of the information in electronic form does not convey to the recipient a license to use the software that was used to create the information, nor does it create an obligation on the author's part to provide the software to the recipient.
 - 9. The Architect / Engineer makes no representation or warranty and shall have no liability concerning the operation or performance of the templates or programs, or concerning the accuracy of the data as delivered, or in connection with hardware

or any software, any changes made to the electronic materials as delivered, any viruses contained in the materials as delivered, or any other defect or error or alleged defect or error in the materials as delivered.

- J. These documents may not explicitly disclose all final details required for a complete systems installation; however, Contractors shall possess the expertise to include the necessary appointments of complete operating systems in their bid price.
- K. The Contractor shall include in his bid price the cost of all work that is an obvious, logical, or reasonably foreseeable consequence of other work explicitly indicated in the documents.
- L. Damper Quantities: Damper quantities indicated on the Drawings are not explicit. In each location where a life safety damper (e.g. fire, smoke, or combination fire/smoke damper), backdraft damper, or motorized damper is indicated, the Contractor shall provide the quantity of dampers required to meet the indicated performance requirements and completely fill the associated duct, plenum, or opening size. Provide an actuator or operator for each damper, as applicable.
- M. Interpretation of Flow Diagrams and Piping Connection Details:
 - 1. Unless there are explicit notes to the contrary on piping system flow diagrams, piping system flow diagrams are generally not intended to establish the quantity, type, and orientation of pipe elbows, tees, and caps, as the diagrams are schematic in nature and are not drawn to scale. In the event of a conflict between the graphical depictions on piping floor plans and flow diagram(s) with respect to pipe elbows, tees, and caps, the piping floor plan(s) shall take precedence.
 - 2. Many of the required piping appurtenances, valves, small or minor piping, control devices, sensors, and similar items are omitted from floor plans and sections for clarity purposes only. Refer to piping system flow diagrams, control diagrams, details, and specifications for additional required work (appurtenances) not shown on the floor plans and/or sections. The Contractor shall include in his bid price all devices shown on any one (or more) portion of the documents, as if they were shown in all locations (e.g. section, diagram, and floor plan).
 - 3. The normal (e.g. spring return or fail) position of mixing and diverting valves shall be as described in the sequences of operation or as noted on the Drawings. The graphical representation on details and flow diagrams shall not be construed to indicate otherwise. Mixing and diverting valves shall be piped to produce the normal position described or indicated.
 - 4. The Contractor shall connect water inlets and outlets to the connection locations required or as labeled by the equipment manufacturer to affect proper performance and heat transfer of the equipment. The graphical representation on flow diagrams and piping connection details on the Drawings shall not be construed to indicate otherwise.
- N. Should a bidding Contractor find conflicts or discrepancies in, or omissions from, the Drawings or Specifications, or should he be in doubt as to their meaning, the bidding Contractor should at once notify the Architect, who will send written instructions to all bidders. If these are ignored by the bidding Contractor, the bidding Contractor will be responsible for furnishing the proper or workable equipment as deemed necessary by

the Architect / Engineer. The same shall apply to conflicts or discrepancies between different drawings or between different specification sections.

- O. Should some portion of the work appearing on the HVAC Drawings and/or the Division 23 Specifications also be addressed in part or whole on the Drawings of another trade, or in the specifications of another Division, the cost of the work indicated on the HVAC / Division 23 documents shall be included with the Division 23 Contractor's bid price, unless explicitly clarified otherwise during the bidding period by the Architect / Engineer. During the construction period, prior to submitting the relevant materials and equipment for review, coordinate with the other affected trades and obtain clarification from the Architect / Engineer.
- P. Details shown on the Drawings shall apply to all instances of such item or condition indicated elsewhere on the Drawings, with or without an explicit reference thereto.
- Q. The Drawings and Specifications primarily indicate the work that is required by the contract. In selected instances, an indication of work that is NOT acceptable may be made in the Contract Documents in order to provide additional emphasis or clarity. The omission of a similar statement elsewhere in the Documents shall not be construed by the Contractor to mean that unspecified or unindicated work will be accepted or is permitted under this contract.
- R. Where a code, standard, or other reference document is referenced, unless explicitly indicated otherwise, it shall be taken to refer to the most recent published version / edition at the time of bidding.
 - 1. Exception: For standards referenced by applicable building codes, comply with dates of standards as listed in building codes.
- S. In cases where equipment and materials are specified in the singular or plural number, it is intended that such reference shall apply to as many such items as are required to complete the installation.
- T. In these Specifications, the words "shall," "shall be," "shall include," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
- U. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.
- V. Compliance with requirements and performance of the work described in the Contract Documents are the responsibility of the Contractor unless specifically stated otherwise.

1.16 BASIS OF DESIGN PRODUCTS AND SUBSTITUTIONS

- A. Basis of Design: Throughout the project specifications and drawings, materials and equipment may be indicated as the "basis of design" material or equipment. If the bidding Division 23 Contractor desires to furnish equipment of a manufacturer other than that which is indicated to be the "basis of design", even if that alternative manufacturer

and/or product name are also listed, it is the full burden of the bidding Division 23 Contractor to verify, prior to submitting a bid price, that the proposed product meets all of the project requirements and specifications. The cost of any additional changes to the work, including changes to the work of other trades / Divisions, that are associated with the Division 23 Contractor's use of a product other than the "basis of design" product, shall be borne by the Division 23 Contractor at no additional cost to the Owner, and the proposed additional changes shall be subject to the approval of the Architect / Engineer.

- B. Listing of Product and Manufacturer Names: Where names of manufacturers of products are listed in the Specifications, the mere listing of a manufacturer's name, or of a specific product name does not relieve the Contractor of the obligation to meet all provisions of the Contract Documents. All proposed products, even of those of manufacturers listed in the Specifications, are subject to the requirements of the Contract, and therefore are only acceptable provided that they meet the requirements of the Contract, as interpreted by the design professionals (Architect and Engineer).
1. Where a manufacturer or product list is preceded by "subject to compliance with requirements, provide products by one of the following:", or similar language, the Contractor shall interpret this to mean that products or manufacturers not contained within the list are not acceptable and shall not be submitted for approval without conforming to Division 01 substitution requirements.
 2. Where a manufacturer or product list is preceded by "subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:", or similar language, the Contractor shall interpret this to mean that products or manufacturers other than those listed may be submitted for review and possible approval by the Architect / Engineer.
- C. Specification by Product Name: Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular supplier, without the listing of additional product or supplier name(s), the Contractor shall interpret the documents to mean that no other product or supplier may be used. However, where the phrase "or-equal" follows the product or supplier name, the name reference is intended to establish the type, function, appearance, and quality required. Other items of material or equipment or material or equipment of other suppliers may be submitted to Architect / Engineer for review under the circumstances described below.
1. "Or-Equal" Items: If, in the Architect / Engineer's sole discretion, an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related work will be required, it may be considered by Engineer as an "or-equal" item. For the purposes of this Paragraph, a proposed item of material or equipment will be considered functionally equal to an item so named if:
 - a. In the exercise of reasonable judgment the Architect / Engineer determines that:
 - 1) It is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;

- 2) It will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole; and
- 3) It has a proven record of performance and availability of responsive service.

b. Contractor certifies that, if approved and incorporated into the work:

- 1) There will be no increase in cost to the Owner or increase in contract times; and
- 2) It will conform substantially to the detailed requirements of the item named in the Contract Documents.

D. Product Availability:

1. Where a product name or model number is indicated on the drawings or specifications and that product model is no longer available, the bid price shall include the currently available product model with the equal or greater quality, capacity, features, and warranty as the unavailable model listed.
2. The Contractor is responsible for confirming that all specified products will be available in a timely manner to meet the contract schedule. Should the delivery time schedule of any specified product be an issue that could adversely affect the project schedule, the Contractor shall notify the Architect, in writing, within 14 days following the award of the contract. Documentation as to when specified products were ordered and anticipated delivery dates will be required to be submitted to the Architect at this time.

1.17 SUBMITTALS - GENERAL REQUIREMENTS

- A. Refer to Division 01 for basic requirements.
- B. The Contractor shall provide product data and shop drawings for all equipment, systems, products, and materials proposed for installation under this contract, and as directed in other Division 23 Sections and Division 01.
- C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect / Engineer on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet. Submittals lacking this information may be rejected solely on these grounds.
- D. Provide manufacturer's performance curves showing all available performance characteristics with submittals for all fans and pumps utilized on the project.

1.18 WARRANTIES

- A. Defective equipment, materials or workmanship, including damage to the work provided under other Divisions of this contract, shall be replaced or repaired at no additional cost to the Owner for the duration of the stipulated guarantee periods.
- B. Special Warranties: Special manufacturers' warranties that extend beyond the general warranty period are specified in other Division 23 Sections. Special warranties shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
 - 1. Where the duration of a manufacturer's standard warranty exceeds that specified for the special warranty, the manufacturer's warranty shall take precedence.
 - 2. Where the duration of a manufacturer's standard warranty is less than that specified, the manufacturer shall provide a special warranty extension as required, and shall provide a certificate attesting to that extension with the equipment submittal. Failure to include that certificate with the submittal shall be grounds for rejection of the submittal.
 - 3. Special warranties shall defined be interpreted to be non-pro-rated and shall begin on the date of Substantial Completion, unless noted otherwise.
 - a. The manufacturer's warranty time periods may coincide with the Contractor's time period of obligation, but where the manufacturer's warranty contains an expiration date based upon the equipment shipping date, startup date, or some other criteria, the Contractor shall not be relieved of responsibility for covering the full warranty time periods specified.
 - 4. Special warranties and their obligations to the Owner which have been violated by the Contractor's actions (e.g. method of handling, installation, storage, operation, etc.) shall become the responsibility of the Contractor for the original factory warranty duration and coverage. In such cases, the Contractor shall issue written documentation to the Owner attesting to the Contractor's acknowledgement of this responsibility.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Fire- and Smoke-Stopping Materials and Assemblies:
 - a. As indicated in Division 07.
 - 2. Fire-Stop Pipe Sleeves:
 - a. Hilti, Inc.

- b. Holdrite
- c. Pro-Set Systems Inc.

2.2 FIRE AND SMOKE -STOPPING MATERIALS

- A. General Requirements for Fire-and Smoke Stopping Materials: Provide --listed fire-stopping and smoke-stopping systems and assemblies for filling openings around duct, conduit, low-voltage cable, and piping penetrations of Division 23 work through walls, partitions, slabs, and floors as required by the International Building Code and any local amendments. Comply with the provisions of Division 07.

2.3 MATERIALS USED IN AIR PLENUMS

- A. All materials provided under Division 23 that are installed within, or otherwise exposed to, an air plenum shall meet the requirements of the International Mechanical Code and shall have maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested to UL 723 Test for Surface Burning Characteristics of Building Materials, or ASTM E84. Exceptions include:
 - 1. Wiring shall have a peak optical density not greater than 0.50, average optical density not greater than 0.15, and a flame spread distance not greater than 5 feet, when tested in accordance with NFPA 262.
 - 2. Pneumatic tubing shall have a peak optical density not greater than 0.50, average optical density not greater than 0.15, and a flame spread distance not greater than 5 feet, when tested in accordance with UL 1820.
 - 3. Electrical and control equipment with combustible enclosures, other discrete mechanical products, and firestopping shall be listed and labeled for plenum use in accordance with UL 2043.
 - 4. Non-metallic ducts and flexible ducts shall be Class 0 or Class 1 air ducts per UL 181.
 - 5. Pipe and duct insulation shall additionally not flame, glow, smolder, or smoke when tested in accordance with ASTM C4111.
- B. Where a specified material does not comply with the above, and is indicated to be installed in an air plenum, the material shall be concealed with 3M "Fire Barrier Plenum Wrap 5a+", Unifrax "FyreWrap 0.5 Plenum Insulation", or approved equal UL listed insulation that permits the wrapped item(s) to meet the requirements of the International Mechanical code for use in a plenum, per UL 723, UL 1887, NFPA 262, or ASTM E84 test procedures. Such insulation shall also be provided where indicated on the Drawings.
- C. Air plenums may include spaces such as above-ceiling and below-floor cavities, attics, crawlspaces, and mechanical equipment rooms and closets, where those spaces are used to convey supply, return, exhaust, ventilation, or relief airflow.

2.4 CEILING, WALL, AND SHAFT ACCESS PANELS

- A. The Division 23 Contractor shall provide factory-fabricated access panels for access to concealed dampers, valves and other equipment provided under Division 23 where no other means of access is available. Unless more restrictive requirements are referenced in Division 08, comply with the following:
 - 1. Access panels shall be of appropriate size but not less than 20x20 inches, flush type, hinged to drop down and out, screwdriver-operated, stainless steel in tile work and prime coated sheet steel in drywall, plaster or acoustical tile. Exact locations and sizes of panels shall be determined by the Contractor, but panels shall be located for a symmetrical appearance. Locations for access panels in finished areas must be approved by the Architect / Engineer. Access panels are not required at lift-out removable tile ceilings.
 - 2. At locations where access panels are installed in fire-rated construction, access panels shall contain the 1-1/2-hour fire-rated "B" label; and in addition, shall also be provided with layers of gypsum wall board in a thickness which will supply an additional one and two-hour fire rating equal to the fire rating of adjacent construction.
- B. Acceptable manufacturers / products are specified in Division 08.

2.5 PNEUMATIC CONTROL AND INSTRUMENTATION TUBING

- A. Polyethylene Tubing: Black, flame retardant, virgin polyethylene according to ASTM D 1248, Type 1, Class C and Grade 5. Tubing shall comply with stress crack test according to ASTM D 1693.
 - 1. Polyethylene Tubing Fittings: UL approved to MIL-F-18280 rod or forged brass rated to PSIG at 100 degrees Fahrenheit.
 - 2. Joints: Compression or barbed type.
- B. Copper Tubing: Seamless phosphor deoxidized copper, soft annealed or drawn tempered, with chemical and physical properties according to ASTM B 75. Performance, dimensions, weight and tolerance according to ASTM B 280.
 - 1. Copper Tubing Connectors and Fittings: Brass, compression or solder joint type.
- C. The existing air mains shall be purged of contaminants and extended where required.

PART 3 - EXECUTION

3.1 CONSTRUCTION DURING OCCUPANCY

- A. The Owner intends to occupy the building during this project. Existing building systems serving the occupied areas shall be maintained and remain functional during the renovation process. The Division 23 Contractor shall be responsible for maintaining the integrity of HVAC air and water distribution systems outside the area of work where such

HVAC air and water distribution systems may be compromised by demolition or renovation processes. Therefore, this Contractor shall be responsible to provide on a temporary or permanent basis whatever HVAC equipment, components, piping, ductwork, controls control wiring, accessories, etc., required to maintain the integrity of HVAC air and water distribution systems outside the renovation area, where such systems may be compromised by demolition, the renovation processes, or connections to existing systems.

- B. Refer to the Article titled "HVAC Demolition" below for additional requirements.

3.2 HVAC DEMOLITION

- A. Refer to Division 01 and Division 02 for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material. Existing work is not permitted to be abandoned in place unless explicitly indicated. Piping shall be tagged as "Abandoned in Place" with the date of abandonment at the points of disconnection as well as along its length at maximum 20-foot intervals, where accessible.
 - 3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - 4. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - 5. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
- C. If pipe, ductwork, insulation, wiring, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.
- D. The disposal of all demolished materials shall be in accordance with all applicable laws, and all costs shall be borne by the Contractor.
- E. Disconnect and remove existing systems and equipment no longer required.
- F. Demolished items shall be cut into sizes small enough to fit through existing building passageways and openings.
- G. Only where explicitly permitted by the Owner and Architect / Engineer, existing ductwork and piping no longer required and concealed in walls, below slabs on grade, or above fixed ceilings and not interfering with new construction or remodeled work may remain in place. Such work shall be capped, abandoned and rendered "dead". Provide labels or other form of identification on the work that identifies it as "abandoned in place", along with the month/year of abandonment.

- H. Where work is to be performed above existing ceilings, the Contractor will be responsible for removing ceiling tiles, storing tiles and reinstalling tiles after work is complete. The Contractor shall also be responsible for restoring the existing ceilings to their present condition where they are damaged or where the surfaces are dirtied or marred by the work included under this contract. New matching ceiling tiles and supports shall be furnished and installed under this contract where necessary. Existing ceiling tiles shall be kept as clean as possible.
- I. No demolition shall occur which leaves the building interior without weather protection. All demolition of exterior surfaces shall be followed immediately by protective construction, either permanent or temporary.
- J. Review the construction documents, to determine the affected areas of the existing structure. Remove systems in the affected areas not to be reused including equipment, piping, ductwork, controls, hangers, supports, etc.
- K. Schedule demolition work with the Owner.
- L. All existing piping shall be saw-cut, not broken, at point where piping connects to existing.
- M. Where the project requires demolition of existing piping, ductwork, mechanical equipment, and similar services, all such systems shall be terminated in an approved manner to allow affected systems to remain in operation. Provide temporary caps on piping and ductwork at all points of connection between new and existing until new/modified systems are completed in the renovation area. Duct caps shall not be removed until all dust and dirt generating construction activities are complete and the renovation area has been cleaned.
- N. The draining of existing piping systems, and subsequent filling, venting of air, and chemical treatment required to perform the demolition and/or new piping system connections to existing systems shall be provided under this contract.
- O. Repair ductwork and associated insulation and jacketing where control devices and other work installed on or in existing to remain ductwork was removed.
- P. The Contractor shall, at his own expense, repair, replace and maintain in service, any utilities, facilities or services (underground, over ground, interior or exterior) damaged, broken or otherwise rendered inoperative during the course of construction. The method used by the Contractor in repairing, replacing or maintaining the services shall be approved by the Architect and the Owner.
- Q. When demolishing existing equipment, all control wiring or pneumatic tubing serving that equipment shall be properly terminated in an approved manner to allow affected systems to remain in operation. Remove pneumatic tubing back to risers and plug.
- R. Where ductwork systems serve both areas under construction and areas not affected by the construction, all branch ducts in the construction area shall be capped, and fans shall be rebalanced for new air quantities.

3.3 CUTTING AND PATCHING

- A. The Division 23 Contractor shall include in his bid all cutting and patching work required for the installation of HVAC work performed under Division 23. Any damage incident to cutting or other causes in the performance of the contract work shall be made good by replacement or repairs in a manner satisfactory to the Architect/ Engineer.
- B. Where piping, ducts, or other equipment pass through fire or smoke rated construction, furnish and install sleeves and thoroughly seal openings around sleeves, pipes, ducts, etc. With fire and smoke resistant materials. Materials shall be provided to maintain the fire rating of the adjacent construction in accordance with the requirements of NFPA and other applicable codes.
- C. No structural members shall be cut without prior approval of the Architect.
- D. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of trades involved.
- E. Repair cut surfaces to match adjacent surfaces.

3.4 FIRESTOPPING AND SMOKESTOPPING INSTALLATION

- A. During bidding, the Division 23 Contractor shall thoroughly review the architectural documents to determine the location and hour rating of fire resistance rated construction (e.g. walls, shafts, floors, etc.), and shall include in his bid the costs of providing all fire and smoke stopping of Division 23 work required by the 2015 International Building Code and Mechanical Code.
- B. Comply with Division 07 provisions unless more restrictive or demanding requirements are indicated below.
- C. Pre-Installation Inspection: The Division 23 Contractor, with the assistance and technical support of a fire- and smoke-stopping product manufacturer, shall inspect all fire and smoke barriers (floors, walls, partitions, and slabs) for penetrations of Division 23 work, and shall mark or otherwise identify all penetrations indicating action required: 1) repair; 2) firestopping; and/or 3) smokestopping.
 - 1. Conduct inspection prior to covering up or enclosing walls or ceilings.
 - 2. Conduct inspection jointly with authorized representative of authority having jurisdiction.
 - 3. Submit a report detailing findings of inspection to the Architect/ Engineer.
- D. Modifications: If the configuration of a particular penetration does not conform to the configuration necessary for the required firestopping assembly, notify the installer of the penetration for modification of the configuration to suit the assembly; do not use the firestopping assembly in other configurations except as specifically stated in the test report or as approved by the authority having jurisdiction.

E. Permanent Identification of Penetrations:

1. Near fire and smoke barriers, mark each exposed penetration with label identifying it as a fire-stopped or smoke-stopped assembly.
2. Mark each fire and smoke barrier above lay-in ceilings with words identifying it as a fire or smoke barrier at intervals required by authorities having jurisdiction, but not less than 20 feet.

3.5 EQUIPMENT AND PRODUCT INSTALLATION - COMMON REQUIREMENTS

- A. Install manufactured equipment, products, and systems in full accordance with the manufacturer's requirements and recommendations. Note that the manufacturer's requirements and recommendations may be more restrictive or require work beyond that explicitly shown on the Contract Documents. If a manufacturer permits but does not explicitly require their product to be installed in a manner that is inconsistent or incompatible with the Contract Documents, the content of the Contract Documents shall take precedence.
- B. Install equipment to provide maximum possible headroom, if mounting heights are not indicated.
- C. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to Architect.
- D. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- E. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- F. Install equipment giving right of way to piping installed at required slope.
- G. Supporting equipment from roof and floor decking in steel framed buildings is prohibited. All equipment shall be supported from building steel structural system.

3.6 CONTROL WIRING

- A. Power wiring will be provided under Division 26. Unless otherwise indicated on the drawings, 120 volt control and interlock wiring for HVAC systems and equipment will also be provided under Division 26. Low voltage (24 volt) control wiring for HVAC systems and equipment shall be provided under Division 23. Coordinate all work between Divisions.
- B. Control wiring shall be in accordance with the National Electrical Code and Divisions 26 and 27 of these specifications, and shall not be in conflict with state and local codes. No control wiring shall be installed in the building lighting and power circuit system.

- C. All control wiring, including low voltage wiring, outside of control panels shall be run in rigid conduit or EMT, and installed in strict accordance with the requirements of NEC.
 - 1. Exception: Low voltage control wiring may be routed in plenum-rated cable, without raceway, above accessible ceilings only. Bundle and harness multi-conductor instrument cable in place of single cables where several cables follow a common path. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors. Run parallel with building lines and properly supported by "wedding ring" cable supports and tied neatly to prevent sagging of cable.
 - a. Plenum Rated Cables: Peak optical density not greater than 0.50, average optical density not greater than 0.15, and a flame spread distance not greater than 5 feet, when tested in accordance with NFPA 262, as required by the NEC and International Mechanical Code.
- D. Wiring for controls, except the low voltage conductors operating at 30VAC or less, shall be single conductor solid or stranded copper not less than No. 12 AWG, 90 degrees C., with 600-volt Type THHN/THWN insulation. Wiring in panel construction may be No. 16 or No. 18 AWG copper provided same is properly protected and/or is in accordance with the NEC.
- E. Low voltage two conductor and three conductor wire shall be twisted (six turns per foot) 16 AWG or 18 AWG wire, 90 degrees C., 600 volt THHN/THWN insulation. Cable shall have a characteristic impedance between 100 and 120 ohms. Distributed capacitance between conductors shall be less than 17 pF per foot. Shielded cable shall be provided for analog input signals, for communications between controllers, and for runs exceeding 500 feet. Both foil and braided type shields are acceptable. Ground at one end only; cap the other end. Capacitance between conductors and the shield shall be less than 60 pF per foot. Cable shall be as manufactured by Alpha Wire Company, Belden Wire Company, Standard Wire and Cable, or approved equal.
- F. All conduit, fittings, hangers and accessories for control wiring installed under Division 23 shall conform to the levels of quality specified under Divisions 26 and 27.

3.7 CLEANING AND PROTECTION

- A. Cleaning: General cleaning requirements are specified in Division 01. Upon completion of the work, clean the exterior surface of equipment, accessories, and trim installed.
- B. The Division 23 Contractor shall clean up areas as the work progresses and remove waste and debris produced by performance of the Division 23 work daily or when directed by the Owner or Architect / Engineer.
- C. Protection of Surfaces:
 - 1. Protect new and existing surfaces from damage during the construction period.
 - 2. Provide plywood or similar material under equipment or materials stored on floors or roofs. Provide protection in areas where construction may damage surfaces.

3. Surfaces damaged during the construction shall be repaired or replaced at the cost of the Contractor at fault. The method of repairing or replacing the surface shall be approved by the Owner and Architect/Engineer.

D. Protection of Equipment and Materials:

1. Equipment and materials shall be stored in a manner that shall maintain an orderly, clean appearance. If stored on-site in open or unprotected areas, equipment and material shall be kept off the ground and out of standing water by means of pallets or racks, and covered with tarpaulins.
2. Equipment and material, if left unprotected and damaged or soiled, shall be repainted, repaired, or otherwise refurbished at the discretion of the Architect and Owner. Equipment and material is subject to rejection by the Architect, if, in the opinion of the Architect or the manufacturer's engineering department, the equipment has deteriorated or been damaged to the extent that its utility, performance, or life expectancy has been reduced. Rejected materials shall be replaced.
3. During the construction period, protect ductwork, piping and equipment from damage and dirt. Properly cap ductwork and piping. Each system of piping shall be flushed to remove grit, dirt, sand, and other foreign matter for as long a time as required to thoroughly clean the systems.

3.8 PAINTING AND FINISHING

- A. Painting of HVAC systems, equipment, and components is specified in Division 09. In the event of a direct conflict between the provisions of Division 09, and this Section, Division 09 shall take precedence.
- B. Do not paint piping specialties and similar items with factory-applied finish. Do not paint bronze or copper materials. Do not paint fastener threads (except on pipe hangers and threaded rods), nameplates, identification devices and labels, flexible connectors, vibration control devices, meters and gauges, and any items for which the proper function and/or longevity will be compromised by the application of paint.
 1. Apply protection / masking to items that shall not receive paint prior to paint surface preparation and painting. Coordinate and schedule this work with the General Contractor who is performing finish painting. Any damage to Division 23 work due to a failure to mask items that should not have been painted shall be replaced and repaired at no additional cost to the Owner.
- C. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish. Marred finishes on items exposed to view in finished spaces shall be replaced with new items when the severity of the damage or quality of the finish repair is judged to be unacceptable by the Architect or Engineer.

- D. At locations where it is necessary to cut and patch existing construction to perform Division 23 work, painting at each location shall be performed by the Division 23 Contractor. New finishes shall match existing finishes. Comply with the provisions of Division 09.

END OF SECTION 230500

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 electrically commutated motors, and for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on AC power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.
- B. Related Sections include the following:
 - 1. Division 23 Sections for application of motors and reference to specific motor requirements for motor-driven equipment.

1.3 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Listing and Labeling: Provide motors specified in this Section that are listed and labeled.
 - 1. Terms "Listed and Labeled": As defined in the National Electrical Code, Article 100.
- C. Minimum Efficiency: Conform to requirements of NEMA MG 1, Table 12-12, as per the Federal Energy Independence and Security Act of 2007 (EISA), and DOE 10 CFR 431, as applicable, for minimum energy efficiency ratings of motors.
- D. Motors between 1/12 HP and 1HP shall have a minimum efficiency of 70%, when rated in accordance with DOE 10 CFR 431.
- E. Source Quality Control: Perform the following routine tests according to NEMA MG 1:
 - 1. Measurement of winding resistance.
 - 2. No-load readings of current and speed at rated voltage and frequency.
 - 3. Locked rotor current at rated frequency.
 - 4. High-potential test.
 - 5. Alignment.

1.4 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.
- B. 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.
- C. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.

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. Overload Protection:
 - 1. All motors shall be provided with thermal overload protection at the manual or magnetic motor starter or variable frequency controller, as per NFPA 70.
 - 2. All single phase motors, and all three phase motors used with variable frequency controllers shall have integral thermal protective devices.

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 AC INDUCTION MOTORS

- A. Description: NEMA MG 1, medium induction motor.
 - 1. Design Characteristics: NEMA MG 1, Design B, unless otherwise indicated.
 - 2. Minimum Energy-Efficient Design: Conform to EISA requirements.

3. Stator: Copper windings, unless otherwise indicated. Multispeed motors shall have separate winding for each speed.
4. Rotor: Random-wound, squirrel cage.
5. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
6. Temperature Rise: Match insulation rating, unless otherwise indicated.
7. Insulation: Class F, unless otherwise specified.
8. All squirrel cage, three phase, induction motors 15 HP and larger shall have a maximum locked rotor starting KVA/HP no greater than that specified for NEMA Code "G" (5.6 to 6.3).
9. Enclosure Material: Unless indicated otherwise in other Division 23 Sections, cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.
10. Full Load Current Ratings: Shall not exceed NEC Table 430.250 - "Full Load Current, Three-Phase Alternating-Current Motors". If 6 and 8 pole motors with full load currents exceeding the values of this table are provided, the Division 23 Contractor shall be responsible for any additional costs to the Division 26 Contractor such as larger VFDs and input wiring.

B. Subject to compliance with requirements, provide products by one of the following:

1. Lincoln Motors; Div. of Regal Rexnord
2. Marathon Motors; Div. of Regal Rexnord
3. General Electric Co.
4. Toshiba
5. Baldor / Reliance Electric Co.; Div. of ABB Motors and Mechanical Inc.
6. US Motors; Div. of Nidec Motor Corp.
7. WEG Electric Corp.
8. Siemens
9. TECO-Westinghouse Motor Co.
10. Leroy-Somer; Div. of Emerson Industrial Automation

2.4 ELECTRICALLY COMMUTATED MOTORS (ECMs)

A. Synchronous, constant torque, brushless DC type, specifically designed for HVAC applications, with a permanent magnet rotor and integral solid state inverter circuitry to accept single- or 3-phase AC power input and to control the power output and speed of rotation.

1. Integral controllability down to 20% of full, rated speed. No external speed controller shall be required.
 - a. Speed shall be adjustable by integral potentiometer dial (for balancing purposes) and/or by external 0-10 VDC control signal, as required by the application and control sequence of operation.
2. Minimum 85% efficiency over full speed range.
3. Permanently lubricated ball bearings which are not dependent on motor speed for lubrication.
4. Integrated power factor correction filter.

5. Integrated motor protection verified by UL to protect the motor against over- and under-voltage, overtemperature of motor and/or electronics, overcurrent, and locked rotor.
- B. Provide ECMs where explicitly indicated, either in other Division 23 Sections, or on the Drawings.
- C. Subject to compliance with requirements, provide products by one of the following:
 1. Baldor; a Div. of ABB Motors and Mechanical Inc.
 2. EBM-Papst
 3. Nidec Motor Corp.
 4. Regal Rexnord
 5. Rosenberg
 6. Telco Intercontinental Corp.
 7. WEG Electric Cor.
 8. Zeihl-ABEGG

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Coordinate with the Division 26 Contractor all locations of all conduit stub-ups with actual locations of motor terminal boxes for power and motor auxiliary device connections.
- B. Provide the required wiring and control relays for heaters in the motor frames and the required controls to de-energize the heaters when the motors operate.
- C. Align the motor shaft with driven equipment according to manufacturer's written instructions.
- D. Field Checks:
 1. Check power and accessory connections for all motors.
 2. Confirm correct rotation for all motors.
 3. Confirm that the motor and coupled load are properly aligned, rotate freely, and are not binding.
 4. Check all motors for correct clearances and proper installation of all safety guards and screens.
 5. Check all motors for correct lubrication and correct any identified deficiencies in accordance with the manufacturer's written instructions.
- E. Field damaged factory finish on motors shall be touched-up with paint that is equal in quality and color to the original factory finish.

END OF SECTION 230513

SECTION 230553 - IDENTIFICATION FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes HVAC identification materials and devices.

1.3 ACTION SUBMITTALS

- A. Product Data: For identification materials and devices.

1.4 QUALITY ASSURANCE

- A. ASME Compliance: Unless requested otherwise by the Owner, comply with ASME A13.1, "Scheme for the Identification of Piping Systems" for lettering size, length of color field, colors, and viewing angles of identification devices.
- B. Coordinate colors, abbreviations, and similar features with the Owner's existing marking and labeling systems and match existing installations.

1.5 SEQUENCING AND SCHEDULING

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Almetek Industries Inc.
 - 2. Bunting
 - 3. EMED Co.

4. Marking Services, Inc.
5. Rodgers Enterprises and Distributors Inc. (RED)
6. Seton Identification Products
7. W.H. Brady Corp.

2.2 IDENTIFYING DEVICES AND LABELS

- A. Plastic Duct Markers: Manufacturer's standard laminated plastic.
 1. Color Coding:
 - a. Blue: Air supply.
 - b. Green: Outside, return, and mixed air.
 - c. Yellow: Exhaust air.
 2. Terminology and Lettering: Include direction of airflow; duct service such as supply, return, or exhaust, size of duct, and name of connected air handling apparatus or fan. For ducts downstream of VAV terminal units (boxes) that are not within line of sight of the terminal unit, additionally indicate the VAV terminal unit identifier / name.
 - a. Letters shall be no smaller than 1-1/2-inches high.
- B. Plastic Tape: Manufacturer's standard color-coded, pressure-sensitive, self-adhesive, vinyl tape, at least 3 mils thick.
 1. Width: 1-1/2 inches on pipes with OD, including insulation, less than 6 inches; 2-1/2 inches for larger pipes.
 2. Color: Comply with ASME A13.1, unless otherwise indicated.
- C. Ductwork Stencils: With clean cut symbols and letters no smaller than 2-1/2" tall. Paint shall be semi- gloss enamel, with colors conforming to the color coding specified above for plastic duct markers, except black shall be used instead of yellow.
- D. Plastic Equipment Labels and Signs: Manufacturer's standard laminated plastic, in the following color codes:
 1. Green: Cooling equipment and components.
 2. Yellow: Heating equipment and components.
 3. Brown: Energy reclamation equipment and components.
 4. Blue: Equipment and components that do not meet criteria above.
 5. Hazardous Equipment: Use colors and designs recommended by ASME A13.1.
 6. Text Size: Letter height shall be no less than 1/4-inch.
- E. Plasticized Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with mat finish suitable for writing.
 1. Size: 3-1/4 by 5-5/8 inches.
 2. Fasteners: Brass grommets and wire.

3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.
 4. Color: Yellow background with black lettering.
- F. Ceiling Markers: Markers shall be round, adhesive backed or push-pin type, a minimum of 7/8 inch diameter, and shall include engraving to indicate service. Place push pin type in the ceiling tiles, use adhesive backed markers on the lay in grid and on drywall ceilings.
- G. Access Panel Markers: Manufacturer's standard laminated plastic, adhesive backed, with abbreviated terms and numbers corresponding to concealed item. Black lettering on a white background. Letter height shall be no less than 1/4-inch.

PART 3 - EXECUTION

3.1 GENERAL

- A. Walking / head clearance hazards in mechanical room such as horizontal runs of piping or ductwork less than 6'-8" above the finished floor shall be identified according to ANSI Z535 OSHA standards.
- B. Tripping hazards in mechanical rooms shall be identified according to ANSI Z535 and OSHA standards.
- C. Lettering and Graphics: Coordinate names, abbreviations, and other designations used in mechanical identification with corresponding designations indicated on the Drawings. Use numbers, letters, and terms indicated for proper identification, operation, and maintenance of mechanical systems and equipment.
 1. Multiple Systems: Identify individual system number and service if multiple systems of same name are indicated.
- D. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.
- E. Prepare surfaces in accordance with Division 09 provisions for stencil painting.
- F. Warning-Tag Installation: Write required message on, and attach warning tags to, equipment and other items where required by OSHA standards.

3.2 EQUIPMENT SIGNS AND LABELS

- A. Equipment Signs and Labels: Install and permanently fasten equipment nameplates on HVAC equipment. Locate nameplates where accessible and visible.
 1. Include signs and labels for all equipment and devices scheduled or tagged on the Drawings.

2. Terminology: Match schedules as closely as possible. Include the following:
 - a. Name and plan number.
 - b. Equipment service.
 - c. Design capacity.
 - d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.
 - e. Regularly required maintenance actions for equipment and systems, including the title or publication number for the operation and maintenance manual for that particular model and type of product, as required by the 2018 International Energy Conservation Code.
- B. Provide warning labels or tags in a conspicuous location on all electrically powered equipment that reads "DANGER - LOCK OUT ELECTRICITY BEFORE WORKING ON EQUIPMENT".

3.3 LABELING AND IDENTIFYING DUCTWORK SYSTEMS

- A. Identify all ducts with duct markers; or provide stenciled signs and arrows indicating service and direction of flow.
 1. Location: Locate signs near points where ducts enter into concealed spaces, at all access panels and doors, on both sides of floor and wall penetrations, below roof penetrations, at all major changes in direction, and at maximum intervals of 30 feet.
 2. Label duct access doors with laminated plastic, adhesive backed markers. Text shall indicate the purpose of the door (e.g. "Fire Damper", "Inspection and Cleaning Access", etc.).
 3. Ducts and duct access doors exposed in finished areas shall NOT be labeled.

3.4 SPACE CONTROL DEVICE LABELS

- A. Label space thermostats, relative humidity sensors, carbon dioxide sensors, start/stop switches, override switches, and similar space control devices with the name/designation/number of the associated HVAC equipment / air system. For devices controlling a VAV terminal, the name of the VAV terminal only shall be indicated.
- B. Labels shall use 1/4" high black text on a white background. Labels shall be water resistant flexible plastic with adhesive backing, such as those produced by common handheld label makers. Apply labels to the device or box cover plate. Do not apply to walls or other surfaces unless approved by the Architect/Engineer.

3.5 CEILING AND ACCESS PANEL LABELS AND MARKERS

- A. Ceiling Markers: Provide for concealed equipment, dampers, VAV boxes, air valves, duct reheat coils, piping valves, smoke dampers, fire dampers, and combination fire/smoke dampers, duct mounted sensors, and other similar equipment, devices, and duct system accessories.

1. Obtain approval from the Owner's maintenance personnel regarding the colors to be used for each type of device.
 2. Do not label drywall ceilings.
- B. Access Panel Labels: Provide labels on wall, shaft, and ceiling access panels, outside of finished spaces only.
- C. Provide labels on the ceiling grid to identify the correct tile to be removed for filter change out access.

3.6 ADJUSTING AND CLEANING

- A. Relocate mechanical identification materials and devices that have become visually blocked by work of this or other Divisions.

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.
- B. Testing and adjusting requirements unique to particular systems and equipment are included in the Sections that specify those systems and equipment.
- C. Field quality-control testing to verify that workmanship quality for system and equipment installation is specified in system and equipment Sections.

1.2 SUMMARY

- A. This Section includes testing, adjusting, and balancing HVAC systems, including the following:
 - 1. Air Systems:
 - a. Constant-volume air systems.
 - b. Single zone variable-air-volume systems.
 - 2. Testing, Adjusting, and Balancing of Equipment, including, but not limited to:
 - a. Fans, and fan-containing equipment.
 - b. Electric duct heaters.
 - 3. Existing systems TAB.
 - 4. Diffuser and grille supply pattern adjusting.
 - 5. Verifying that automatic control devices are functioning properly.
 - 6. Reporting results of activities and procedures specified in this Section.

1.3 DEFINITIONS

- A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- B. Airflow Control Terminal: Device installed in the duct system that automatically regulates the airflow rate passing through the device. (e.g. VAV boxes, air valves, etc.)
- C. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to design quantities.

- D. Deficiency: Any installation, measurement, or finding outside the tolerances allowed by the referenced testing and balancing procedural standards or project specifications.
- E. Diversity: In air or hydronic systems, diversity is the term used to describe the difference in air or water volume between the prime mover (fan or pump) and sum of the terminal elements.
- F. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.
- G. Memory Stop: An adjustable mechanical device that allows a valve to be closed (for service) and limits the valve to a predetermined position when re-opened.
- H. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- I. Report Forms: Test data sheets for recording test data in logical order.
- J. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- K. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
- L. TAB (Testing, Adjusting, and Balancing): A systematic process or service applied to HVAC systems, and other environmental systems, to achieve and document air and hydronic flow rates.
- M. TAB Agent: The contractor performing the work of this Section.
- N. Terminals: In the context of a hydronic system, a device such as a coil where heat is either removed or added to the working fluid, other than the system prime movers (chillers, cooling towers, boilers, etc.).
- O. Terminal Outlet or Inlet: A point where air, enters or leaves the ductwork distribution system. (e.g. diffuser, register, grille, etc.)
- P. Test: A procedure to determine quantitative performance of a system or equipment.
- Q. Testing, Adjusting, and Balancing Agent: The entity responsible for performing and reporting the testing, adjusting, and balancing procedures.
- R. AABC: Associated Air Balance Council.
- S. AMCA: Air Movement and Control Association.
- T. NEBB: National Environmental Balancing Bureau.
- U. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

1.4 ACTION SUBMITTALS

- A. Testing and Balancing Agent Qualifications: Verification of experience and capability of the testing and balancing agent. The purpose of this submittal is to establish, in a proactive manner, that the agent proposed by the Division 23 Contractor to perform the work of this Section is qualified. The Contractor's failure to obtain approval for this submittal prevents the Contractor from utilizing the proposed service provider. Within 30 days from the Contractor's Notice to Proceed, submit 2 copies of evidence that the testing, adjusting, and balancing Agent and this Project's testing, adjusting, and balancing team members meet the qualifications specified in the "Quality Assurance" Article below. Also submit the following:
1. Resumes of the technicians anticipated to work on this project.
 - a. Note: Do not submit 'generic' firm resumes or resumes of firm principals unless those individuals are proposed to do the actual testing and balancing work on site for this project.
 2. A list of projects completed for each technician within the last 12 months. Include no less than three (3) client references with contact information relevant to projects completed within the last 12 months for each technician. The same project may be used more than once if multiple technicians worked on the project.
 3. A list of any projects completed for this same Owner within the last 3 years, if any, along with the technicians who worked on those projects, and the Owner's contact information.

1.5 INFORMATIONAL SUBMITTALS

- A. Certified Testing, Adjusting, and Balancing Reports: Submit reports prepared, as specified in this Section, on approved forms certified by the testing, adjusting, and balancing Agent.
- B. Sample Report Forms: Submit sample testing, adjusting, and balancing report forms.

1.6 CLOSEOUT SUBMITTALS

- A. Warranty: Submit 2 copies of special warranty specified in the "Warranty" Article below.

1.7 QUALITY ASSURANCE

- A. Agent Qualifications: Engage a testing, adjusting, and balancing agent that is currently certified by either AABC or NEBB or TABB (Testing, Adjusting, and Balancing Bureau).
1. The company / agency as a whole shall be certified, and at least one individually certified supervisor or technician shall be supervising or participating in the work at the project site at all times when testing and balancing activities are taking place.
 2. The individually certified supervisor or technician shall be a AABC 'TBE' or NEBB or TABB Certified with a minimum of eight (8) years' experience in performing

- HVAC system testing, adjusting and balancing, with at least four (4) of those years in a supervisory position.
3. At least one of the on-site certified supervisors or technicians shall have performed work characteristic of this project on at least three (3) other similar projects within the last five (5) years.
- B. Sub-Contracting Arrangement: The Agent shall be an independent company that is not financially affiliated with the Division 23 Contractor.
1. Agent shall function as a subcontractor responsible to the Division 23 / HVAC Contractor.
- C. Certification of Testing, Adjusting, and Balancing Reports: Certify the testing, adjusting, and balancing field data reports. This certification includes the following:
1. Review field data reports to validate accuracy of data and to prepare certified testing, adjusting, and balancing reports.
 2. Certify that the testing, adjusting, and balancing team complied with the approved testing, adjusting, and balancing plan and the procedures specified and referenced in this Specification.
- D. Testing, Adjusting, and Balancing Reports: Use standard forms from AABC's "National Standards for Testing, Adjusting, and Balancing" or from NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" or TABB / SMACNA forms.
- E. Instrumentation Type, Quantity, and Accuracy: As described in AABC national standards or in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification" or in TABB Standards.
- F. Instrumentation Calibration: Calibrate instruments at least every 6 months or more frequently if required by the instrument manufacturer.
- 1.8 PROJECT CONDITIONS
- A. Partial Owner Occupancy: Owner will occupy areas of building outside of the immediate work area during the testing, adjusting, and balancing period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.
- 1.9 COORDINATION
- A. The Division 23 Contractor shall coordinate the efforts of factory-authorized service representatives for systems and equipment, ATC System Installer, and other mechanics to operate HVAC systems and equipment to support and assist testing, adjusting, and balancing activities.
- B. Notice: Provide 7 days' advance notice for each test. Include scheduled test dates and times.

- C. Perform testing, adjusting, and balancing after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.10 WARRANTY

- A. General Warranty: The project performance guarantee 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. Project Performance Guarantee: Provide a guarantee on AABC'S "National Standards" forms or on NEBB or TABB forms stating that AABC or NEBB or TABB will assist in completing the requirements of the Contract Documents if the testing, adjusting, and balancing Agent fails to comply with the Contract Documents. Guarantee includes the following provisions:
 - 1. The certified Agent has tested and balanced systems according to the Contract Documents.
 - 2. Systems are balanced to optimum performance capabilities within design and installation limits.
 - 3. The warranty shall meet the requirements of the following program(s):
 - a. AABC - National Project Performance Guarantee
 - b. NEBB - Conformance Certification
 - c. TABB - International Quality Assurance Program

PART 2 - PRODUCTS

2.1 DUCT TEST HOLES AND HOLE PLUGS

- A. Refer to Division 23 Section "Air Duct Accessories" for instrument test holes for ducts constructed to pressure classes exceeding 2" w.g. positive pressure, and for ducts of welded seam and joint construction.
 - 1. The TAB Agent shall review the Division 23 Contractor's ductwork shop drawings and shall prescribe the location, spacing, and quantity of all required instrument test holes.
- B. For ducts not utilizing welded seam and joint construction and for those constructed for 2" w.g. positive pressure class or less, the TAB Agent shall provide tapered, round LDPE plastic plugs with center pull-tabs to seal holes drilled in ductwork for measuring purposes. Provide Caplugs "CPT" series or approved equal. Holes drilled in ducts shall be no larger than 1/2" diameter.

2.2 INSULATION REPAIR MATERIAL

- A. Refer to Division 23 Sections "HVAC Duct Insulation" and "HVAC Piping Insulation" for insulation, jackets and tapes to repair insulation and insulation jackets removed or damaged during testing and balancing work.
- B. Except where ducts are exposed in finished spaces, label the location of test holes on insulated ducts at the location of the insulation jacket repair with a permanent marker stencil or stick-on vinyl label.

PART 3 - EXECUTION

3.1 TESTING, ADJUSTING, AND BALANCING SCOPE

- A. Post-Construction Airflow Balancing: Include in the airflow adjustment and balancing scope, no less than the following:
 - 1. All new systems and new equipment.

3.2 EXAMINATION

- A. Examine Contract Documents to become familiar with project requirements and to discover conditions in systems' designs that may preclude proper testing, adjusting, and balancing of systems and equipment.
 - 1. Verify that balancing devices, such as balancing valves and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
 - 2. Identify locations where instrument test holes are required and coordinate with the sheet metal shop drawings and coordination drawings so that the required test holes are installed prior to beginning testing and balancing operations.
- B. Examine approved submittal data of HVAC systems and equipment.
 - 1. Verify the balancing and/or flow verification requirements of the equipment provided with the manufacturers or manufacturer's representatives.
- C. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.
- D. Examine system and equipment test reports.
- E. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as balancing valves and manual volume dampers, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

- F. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- G. Examine air-handling equipment to ensure clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- H. Examine airflow control terminal units, such as variable air volume boxes, to verify that they are accessible and their controls are connected and functioning.
- I. Examine strainers for clean screens and proper perforations.
- J. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- K. Examine equipment for installation and for properly operating safety interlocks and controls.
- L. Examine automatic temperature system components to verify the following:
 - 1. Dampers, valves, and other controlled devices operate by the intended controller.
 - 2. Dampers and valves are in the position indicated by the controller.
 - 3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions.
 - 4. Automatic modulating control valves are properly connected.
 - 5. Thermostats are located to avoid adverse effects of sunlight, drafts, and cold walls.
 - 6. Sensors are located to sense only the intended conditions.
 - 7. Sequence of operation for control modes is according to the Contract Documents.
 - 8. Controller set points are set at design values. Observe and record system reactions to changes in conditions. Record default set points if different from design values.
 - 9. Interlocked systems are operating.
 - 10. Changeover from heating to cooling mode occurs according to design values.
- M. Report deficiencies discovered before and during performance of testing, adjusting, and balancing procedures.

3.3 PREPARATION

- A. Complete system readiness checks. Verify, at the minimum, the following:
 - 1. Permanent electrical power wiring is complete.
 - 2. Automatic temperature-control systems are operational.
 - 3. Equipment and duct access doors are securely closed.
 - 4. Balance dampers are open.
 - 5. Fire and smoke dampers are open.
 - 6. Balancing valves are open and control valves are operational.
 - 7. Ceilings are installed in areas where air-pattern adjustments are affected by the ceiling.

8. Air terminal inlets and outlets (grilles, diffusers, etc.) have been fitted with their specified accessories, such as dampers, neck baffles, and control grids, and have been adjusted to the required throw pattern.
9. Access to balancing devices is provided.
10. Windows and doors can be closed so design conditions for system operations can be met.
11. Fans are operating, free of vibration, and rotating in the correct direction.
12. Strainers are pulled and cleaned.
13. Shut-off and balancing valves are verified 100% open.
14. Control Valves shall be provided with a plastic tag with the design GPM and final balance GPM value written in permanent marker . The tag shall be secured to the valve.

3.4 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in the latest edition of AABC's "National Standards for Total System Balance" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" or TABB's "Quality Assurance Program for Environmental Systems Balance", and this Section.
 1. The content of this Section shall be considered supplemental to the referenced standards, however in the event of a direct conflict between the methods prescribed by this this Section and those contained in the referenced standards, the TAB Agent shall request a clarification from the Architect / Engineer. The higher cost method / procedure shall be carried in the bid price.
- B. Access and Repair: Cut insulation on ducts , and pipes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes as specified elsewhere in this Section and patch insulation and jacketing with new materials identical to those removed. Restore vapor barrier and finish according to the insulation Specifications for this Project.
 1. Do not cut or otherwise penetrate equipment cabinets or the top of exterior ducts unless specifically permitted to do so by the Architect / Engineer.
- C. Final Setting Marks: Mark equipment settings with paint or other suitable, permanent identification material, including damper-control positions , valve indicators and similar controls and devices, to show final settings.
- D. Provide all instruments, equipment, and materials needed for tests.

3.5 RE-TESTING

- A. If any deficiency in the installation of the work discovered during initial TAB operations prevents complete, accurate, and uncompromised testing, adjusting, and balancing of the systems, the TAB Agent shall report the deficiencies in writing. Any preliminary balancing work done with the deficiency still present shall will not be sufficient for

acceptance, and re-testing and balancing shall be required after the deficiency has been fully corrected by the Contractor.

3.6 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
 - 1. Do not use readouts from airflow measuring stations as report data. The Agent shall independently measure airflow rates.
- D. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- E. Check dampers for proper position to achieve desired airflow path.
- F. Check for airflow blockages.
- G. Check for proper sealing of air duct system.

3.7 PROCEDURES FOR MULTIPLE-ZONE VARIABLE-AIR-VOLUME SYSTEMS

- A. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
 - 1. Verify that the system is under static pressure control.
 - 2. Select the airflow control terminal unit (e.g. VAV box) 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.
 - 3. Calibrate and balance each airflow control 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 d cold-deck airstreams unless so designed.

3.8 PROCEDURES FOR SINGLE-ZONE VARIABLE-AIR-VOLUME SYSTEMS

- A. Calibrate system airflow measuring stations. If the airflow station manufacturer does not recommend field calibration, perform readings to verify that the stations are approximately accurate.
- B. Adjust and balance the system (fans, diffusers, grilles, etc.) as described above in the Article "Constant Volume Air Systems" at the system design peak airflow rate, for both supply and return portions of the air system.
 - 1. 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. 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 diffusers, grilles, etc. 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 each component that makes up the air-handling system.
 - d. Report any artificial loading of filters at the time static pressures are measured.
 - 3. 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.
 - 4. 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 / relief fans

3.9 PROCEDURES FOR HEAT-TRANSFER COILS

A. Electric-Heating Coils: Measure the following data for each coil:

- 1. Nameplate data.
- 2. Airflow.
- 3. Entering- and leaving-air temperature at full load.
- 4. Voltage and amperage input of each phase at full load and at each incremental stage.
- 5. Calculated kilowatt at full load.
- 6. Fuse or circuit-breaker rating for overload protection.

3.10 DIFFUSER AND GRILLE SUPPLY PATTERN ADJUSTING

A. Minimizing Drafts - Adjust all supply outlet diffusers, grilles, and registers to minimize drafts in all areas. Generally, this should consist of the following:

- 1. Adjust drum louvers, wall and duct mounted bar grilles and slot diffusers, and similar supply outlets as follows:
 - a. Adjust the horizontal spread provide full coverage across the occupied space, and to minimize the strength of the draft at the end of the jets.
 - b. For interior spaces or spaces with only roof exposure, adjust the vertical spread upwards to ensure that the supply jet does not fall into the occupied space before decaying to below 50 feet per minute. Perform measurements using a velocimeter, adjust, and retest until this criteria is met. Perform the above mentioned horizontal spread adjustments before adjusting the vertical pattern.
 - c. For exterior spaces, adjustment shall be made to provide the most nearly-horizontal pattern that still ensures the supply air jet reaches the occupied zone during conditions of peak or near-peak heating (i.e. during the warmest supply air condition).
- 2. Verify that ceiling supply diffusers indicated on the drawings for 1, 2, or 3-way patterns achieve the required throw directions. Re-arrange and adjust louvers and deflectors as required. For some styles of diffusers, this will require verifying that the diffusers have the required sectorizing baffles installed.
- 3. Ceiling diffusers with moving center cones or deflection tabs for horizontal-vertical pattern adjustment shall be set to provide the most horizontal pattern that still ensures the supply air reaches the occupied zone during conditions of peak or near-peak heating (i.e. during the warmest supply air condition).

4. Ceiling mounted slot diffusers shall be adjusted to produce a horizontal pattern along the ceiling, unless a vertical pattern is specifically indicated on the drawings. This adjustment shall be made prior to balancing the diffuser.
- B. Adjustments shall be made to prevent drafts on space temperature sensors controlling heating and cooling equipment.
- C. In laboratories, kitchens, and other spaces with exhaust hoods, verify that the supply airflow patterns are not negatively interfering with the containment or capture performance of the hood. Adjust outlets to eliminate or reduce the interference. Where no adjustment is possible, report the issue to the Architect / Engineer.

3.11 TEMPERATURE-CONTROL VERIFICATION

- A. In conjunction with system balancing, perform the following:
 1. Verify that controllers are calibrated and commissioned.
 2. Confirm that the sequences of operation are in compliance with Contract Documents.
 3. Check transmitter and controller locations and note conditions that would adversely affect control functions.
 4. Record controller settings and note variances between set points and actual measurements.
 5. Verify that controller set points are as indicated.
 6. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).
 7. Check free travel and proper operation of control devices such as damper and valve operators.
 8. Check the sequence of operation of control devices. Note device positions and correlate with airflow and water flow measurements. Note the speed of response to input changes.
 9. Check the interaction of electrically operated switch transducers.
 10. Check the interaction of interlock and lockout systems.
 11. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or non-grounded power supply.
 12. Note operation of electric/pneumatic actuators using spring return for proper fail-safe operations.
- B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

3.12 TOLERANCES

- A. Set HVAC system airflow and water flow rates within the following tolerances:
 1. Fans and Equipment with Fans: Zero to plus 10 percent, when tested with filter pressure drop simulated at dirty conditions.
 2. Air System Minimum Outdoor Air Intake: 100% to 110% of design.
 3. Air Outlets and Inlets (Diffusers and Grilles): Minus 10 percent to plus 10 percent.

4. Terminal Units (e.g. VAV boxes, air valves, etc.): Minus 5 percent to plus 5 percent.
5. Hydronic Flow Rate: Zero to minus 5 percent.
6. Pressurized Room Offset: 100% to 110% of design (and verified to be in the correct direction - positive or negative). Maintaining pressure relationships as designed shall have priority over the other airflow tolerances specified above.

3.13 FINAL REPORT

- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.
- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
 1. Include a list of instruments used for procedures, along with proof of calibration.
- C. Final Report Contents: In addition to report data specified in paragraphs below, include the following:
 1. Manufacturers' test data.
 2. Field test reports prepared by system and equipment installers.
 3. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.
 4. All required measurements and tests described in Articles above, but not listed in paragraphs below.
- D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
 1. Title page.
 2. Name and address of TAB firm.
 3. Project name.
 4. Project location.
 5. Architect's name and address.
 6. Engineer's name and address.
 7. Contractor's name and address.
 8. Report date.
 9. Signature of TAB firm who certifies the report.
 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 12. Nomenclature sheets for each item of equipment.
 13. Data for airflow control terminal units, including manufacturer, type size, and fittings.

14. Notes to explain why certain final data in the body of reports varies from indicated values.
- E. 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 supply, return, and exhaust airflows.
 2. flow rates.
 3. Duct, outlet, and inlet sizes.
 4. Pipe and valve sizes and locations.
 5. Airflow control terminal units.
 6. Airflow terminal inlets and outlets.
 7. Balancing stations.
 8. Position of balancing devices.
- F. Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
1. Report Data:
 - a. System, fan 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.
- G. Air-Terminal-Device Reports (Grilles, Diffusers, etc.):
1. Unit Data:
 - a. System and air-handling unit identification.
 - b. Location and zone.
 - c. Test apparatus used.
 - d. Area served.
 - e. Air-terminal-device make.
 - f. Air-terminal-device number from system diagram.
 - g. Air-terminal-device type and model number.
 - h. Air-terminal-device size.
 - i. Air-terminal-device effective area in sq. ft..
 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.

H. Airflow Control Terminal (e.g. VAV box) Reports:

1. Unit Data:

- a. Make and Model Number
- b. System and air-handling unit identification.
- c. Location and Room(s) served.
- d. Inlet duct size and number of re-heat coil rows.
- e. Supply outlet numbers connected from system diagram.

2. Test Data (Indicated and Actual Values):

- a. Heating minimum airflow rate in cfm
- b. Cooling minimum airflow rate in cfm
- c. Maximum (cooling) airflow rate in cfm
- d. Induced air cfm (if fan powered) during fan operation at each of the above primary air states in cfm.
- e. Static pressure drop through terminal (including coil, if present) at maximum airflow.
- f. Minimum and maximum flow calibration factors determined for the unit inlet velocity sensor.

I. Duct-System Hydronic- Coil Reports: For duct-mounted reheat coils and water re-heat coils of airflow control terminal units (e.g. VAV boxes), include the following:

1. Unit Data:

- a. Associated system and air-handling unit identification.
- b. Location and zone.
- c. Room or riser served.
- d. Coil make and size.
- e. Flow measurement method.

2. Test Data (Indicated and Actual Values):

- a. Airflow rate in cfm.
- b. Entering-water temperature in deg F.
- c. Leaving-water temperature in deg F.
- d. Water pressure drop in feet of head or psig.
- e. Entering-air temperature in deg F.
- f. Leaving-air temperature in deg F.

3.14 ADDITIONAL TESTS

- A. After acceptance of the final balancing report, and within one year of substantial completion, provide up to 8 hours of on-site time for additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions. "Additional testing and balancing" meaning work not otherwise required by the Contract Documents.
- 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.

END OF SECTION 230593

SECTION 230713 - HVAC 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.
- B. Related Sections include the following:
 - 1. Division 23 Section "Ductwork" for duct liner.
 - 2. Division 23 Section "Common Work Results for HVAC" for definitions of some terms used in this Section.
 - a. Definition of the term 'Mixed Air': An airstream containing, in some or all system operating modes, a fraction of outdoor air mixed with return air.

1.2 SUMMARY

- A. This Section includes duct and plenum insulation; accessories and attachments; and sealing compounds.

1.3 ACTION SUBMITTALS

- A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

- A. Samples: For each type of insulation. Identify each Sample, describing product and intended use. Submit 8x11-inch or 12-inch-square sections of each sample material.
- B. Installer Certificates: Signed by the Contractor certifying that installers comply with requirements.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed a craft training program offered by the Contractor, insulation material manufacturer, or trade association relating to the installation of duct insulation for commercial, industrial and institutional applications. Installers shall also have no less than one (1) year of relevant experience.

- B. Installation Standards: The application of insulation shall conform to the Midwest Insulation Contractors Association's (MICA) "*National Commercial and Industrial Insulation Standards*", 8th Edition, except where the content of this Section conflicts.
- C. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer material containers with appropriate markings of applicable testing and inspecting agency.
 - 1. Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less, for all insulation and jacketing materials used indoors.
- D. Minimum Insulation Thicknesses and R-Values: Conform to requirements of ASHRAE Standard 90.1- 2013 and 2015, or the requirements of this Section, whichever is most demanding.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.
- B. Protect materials from dirt and water. If insulation materials are dirtied or wetted, they shall not be installed, or shall be removed from the ductwork if wetted or soiled after installation.

1.7 COORDINATION

- A. Coordinate clearance requirements for insulation application during the preparation of ductwork shop drawings and coordination drawings, and during ductwork system installation.

1.8 SCHEDULING

- A. Schedule insulation application after successful leakage and pressure testing duct systems, and acceptance by the Architect / Engineer. Insulation application may begin only on segments of ducts that have satisfactory test results.
- B. Schedule the application of insulation on cold duct systems to occur during the winter months, or with the cooling system de-energized. Substrates shall be completely dry at the time of application. Do not restore cooling service until the insulation installation is complete.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Glass Mineral-Fiber Insulation:
 - a. CertainTeed Corp.
 - b. Johns Manville, Inc.
 - c. Knauf Insulation.
 - d. Manson Insulation Inc.
 - e. Owens-Corning Fiberglas Corp.

2.2 INSULATION MATERIALS

- A. General Requirements: All insulation materials shall comply with the following:
1. Products shall not contain asbestos, lead, mercury, or mercury compounds.
 2. 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.
 3. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
 4. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- B. Glass Mineral-Fiber Board Thermal Insulation for Interior Use: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IB, 3.0 PCF density, with a factory applied white, paintable, all-service jacket (ASJ) manufactured from kraft paper, fiberglass reinforcing scrim, and aluminum foil backing, complying with ASTM C 1136, Type I.
1. 3.0 PCF materials shall have a maximum thermal conductivity of 0.23 Btu-in./h-ft²-°F.
 2. Conductivity ratings shall be at a 75°F mean temperature when tested in accordance with ASTM C 177 or ASTM C 518, latest revisions.
- C. Glass Mineral-Fiber Blanket Thermal Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type III, 3/4 PCF density, without facing and with aluminum, foil-scrim-kraft (FSK) jacket manufactured from kraft paper backing, reinforcing fiberglass scrim, and aluminum foil; complying with ASTM C 1136, Type II.
1. 3/4 PCF materials shall have a maximum thermal conductivity of 0.29 Btu-in./h-ft²-°F.
 2. Conductivity ratings shall be at a 75°F mean temperature when tested in accordance with ASTM C 177 or ASTM C 518, latest revisions.

2.3 JACKET TAPES

- A. For use on factory jackets.
- B. FSK Jacket 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. All-Service Jacket (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.

2.4 ACCESSORIES AND ATTACHMENTS

- A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, pre-sized a minimum of 8 oz./sq. yd.
 - 1. Tape Width: 4 inches.
- B. Bands: 3/4-inch-wide, in one of the following materials compatible with jacket:
 - 1. Stainless Steel: ASTM A 666, Type 304; 0.020 inch thick.
 - 2. Galvanized Steel: 0.005 inch thick.
 - 3. Aluminum: 0.007 inch thick.
- C. Wire: 0.080-inch, nickel-copper alloy; 0.062-inch, soft-annealed, stainless steel; or 0.062-inch, soft-annealed, galvanized steel.
- D. Weld-Attached Anchor Pins and Washers: Copper-coated steel pin for capacitor-discharge welding and galvanized speed washer. Pin length sufficient for insulation thickness indicated.
 - 1. Welded Pin Holding Capacity: 100 lb. for direct pull perpendicular to the attached surface.
- E. Adhesive-Attached Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct and plenum with adhesive. Pin length sufficient for insulation thickness indicated.

1. Adhesive: Single component moisture curing adhesive recommended by the anchor pin manufacturer as appropriate for surface temperatures of ducts, plenums, and breechings; and to achieve a holding capacity of 100 lb. for direct pull perpendicular to the adhered surface.
2. Peel and stick (self-adhesive) type pins are not acceptable.

2.5 CORNER ANGLES

- A. Aluminum Corner Angles: 0.040-inch thick, minimum 2 by 2 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

2.6 VAPOR RETARDERS

- A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
- 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. Ensure that insulation is clean and dry, and in good mechanical condition with all factory applied vapor or weather barriers intact and undamaged.
- B. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics and insulation cements during and after installation for a minimum period of 24 hours.
- C. On cold surfaces where a vapor barrier is required (e.g. supply ductwork), insulation shall be applied with a continuous, unbroken moisture and vapor seal. All hangers, supports, anchors, or other projections that are secured to cold surfaces shall be insulated and vapor sealed to prevent condensation.

- D. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; and free of voids throughout the length of ducts and fittings.
- E. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each duct system.
- F. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- G. Apply multiple layers of insulation with longitudinal and end seams staggered.
- H. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- I. Keep insulation materials dry during application and finishing.
- J. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- K. Apply insulation with the least number of joints practical.
- L. Apply insulation over fittings and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
- M. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic. Apply insulation continuously through hangers and around anchor attachments.
- N. Insulation Terminations and Penetrations: For insulation application where vapor retarders are indicated, seal ends and cut penetrations with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
- O. Install corner angles on external corners of insulation on ductwork in exposed mechanical or finished spaces and outside the building before covering with jacketing.
- P. Apply insulation with integral jackets as follows:
 - 1. Pull jacket tight and smooth.
 - 2. Joints and Seams: Cover with tape and vapor retarder as recommended by insulation material manufacturer to maintain vapor seal.
 - 3. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- Q. Cut insulation according to manufacturer's written instructions to prevent compressing insulation to less than 75 percent of its nominal thickness.

- R. Install vapor-retarder mastic on ducts and plenums scheduled to receive vapor retarders.
 - 1. Ducts with Vapor Retarders: Overlap insulation facing at seams and seal with vapor-retarder mastic and pressure-sensitive tape having same facing as insulation. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-retarder seal.
 - 2. Ducts without Vapor Retarders: Overlap insulation facing at seams and secure with outward clinching staples and pressure-sensitive tape having same facing as insulation.
- S. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.
 - 1. Seal penetrations with vapor-retarder mastic.
 - 2. Apply insulation for exterior applications tightly joined to interior insulation ends.
 - 3. Seal insulation to roof flashing with vapor-retarder mastic.
- T. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and partitions, except fire-rated walls and partitions.
- U. Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire/smoke damper sleeves for fire-rated wall and partition penetrations.
- V. Floor Penetrations: Terminate insulation at underside of floor assembly and at floor support at top of floor.
 - 1. For insulation indicated to have vapor retarders, taper termination and seal insulation ends with vapor-retarder mastic.

3.4 GLASS MINERAL-FIBER INSULATION INSTALLATION

- A. Blanket Applications for Ducts and Plenums: Secure blanket insulation with adhesive and anchor pins and speed washers.
 - 1. Apply adhesives to duct, plenum, fittings and transitions surfaces according to manufacturer's recommended coverage rates.
 - 2. Install anchor pins and speed washers on the two sides and bottom of horizontal ducts and all four sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, along longitudinal centerline of duct. Space 3-inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches. Space 16 inches o.c. each way, and 3-inches maximum from insulation joints. Apply additional pins and clips to hold insulation tightly against surface at cross bracing.
 - c. Anchor pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not over-compress insulation during installation.
 - 3. Impale insulation over anchors and attach speed washers.

4. 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.
 5. 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 segment with 1/2-inch staples, 1 inch o.c., and cover with pressure-sensitive tape having same facing as insulation.
 6. Overlap un-faced blankets a minimum of 2 inches on longitudinal seams and end joints. Secure with steel band at end joints and spaced a maximum of 18 inches o.c.
 7. Apply insulation on rectangular duct elbows and transitions with a full insulation segment for each surface. Apply insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 8. Insulate duct stiffeners, hangers, and flanges that protrude beyond the insulation surface with 6-inch-wide strips of the same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 inches o.c.
 9. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.
- B. Board Applications for Ducts and Plenums: Secure board insulation with adhesive and anchor pins and speed washers on all sides of ducts and plenums.
1. Apply adhesives to duct, plenum, fittings and transitions surfaces according to manufacturer's recommended coverage rates.
 2. Space anchor pins as follows:
 - a. On duct sides with dimensions 18 inches and smaller, along longitudinal centerline of duct. Space 3-inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches. Space 16 inches o.c. each way, and 3-inches maximum from insulation joints. Apply additional pins and clips to hold insulation tightly against surface at cross bracing.
 - c. Anchor pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not over-compress insulation during installation.
 3. 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. 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 segment with 1/2-inch staples, 1 inch o.c., and cover with pressure-sensitive tape having same facing as insulation.
 5. Apply insulation on rectangular duct elbows and transitions with a full insulation segment for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Apply insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 6. Insulation on round and flat oval duct shall be back-scored to conform to duct profile.

7. Insulate duct stiffeners, hangers, and flanges that protrude beyond the insulation surface with 6-inch-wide strips of the same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 inches o.c.
8. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.

3.5 DUCT SYSTEM APPLICATIONS - GENERAL REQUIREMENTS

- A. Insulation materials and thicknesses are specified in schedules at the end of this Section.
- B. Field-insulate the following plenums and duct systems listed below, and those listed in the application schedule articles located elsewhere in this Section:
 1. Indoor concealed supply- mixed air-, and outside-air ductwork.
 2. Indoor exposed supply-, mixed air-, and outside-air ductwork.
 3. All ductwork located outdoors and exposed to weather.
 4. Ducts scheduled to receive insulation in the schedules at the end of this Section.
- C. Insulate, as specified for the connecting ductwork, the outside of damper frames, silencers, duct coil casings, and similar duct accessories and equipment that form an air conveying portion of the duct wall, except for access doors and smoke, fire, and combination smoke-fire damper sleeves.
- D. Items Not Field-Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:
 1. Indoor ducts in conditioned or indirectly conditioned locations indicated or specified to receive duct liner. Refer to Division 23 Section "Ductwork" for those ducts specified to receive liner. Also refer to the Drawings for other ductwork required to receive liner.
 2. Factory-insulated flexible ducts.
 3. Factory-insulated plenums, casings, air terminal units (i.e. VAV boxes), and filter boxes and sections.
 4. Flexible connectors.
 5. Vibration-control devices.
 6. Testing agency labels and stamps.
 7. Nameplates and data plates.
 8. Factory insulated access panels and doors in air-distribution systems.
 9. Motorized damper shafts and manual volume damper quadrants.
 10. Life Safety Damper sleeves unless required by the damper's UL listing or installation instructions.
 11. Factory pre-insulated double-wall ducts. Refer to Division 23 Section "Ductwork" and the Drawings for those ducts required to be double wall.

3.6 INDOOR DUCT AND PLENUM APPLICATION SCHEDULE

- A. Refer to Division 23 Section "Common Work Results for HVAC" for definitions of 'conditioned' and 'unconditioned' spaces, as well as 'exposed' and 'concealed' installations.
- B. Minimum R-Values scheduled below are in units of h-ft²- °F./ Btu, at 75°F mean temperature when tested in accordance with ASTM C 177 or ASTM C 518. For blanket insulation, they shall be 'as-installed' R-values and thicknesses with 25% compression.
 - 1. Provide additional insulation thickness than the minimum thicknesses scheduled below if required to meet the minimum R-value indicated.
- C. Service: Supply-air, and outside-air ducts concealed in indirectly conditioned spaces (e.g. ceiling plenums, shafts, etc.).
 - 1. Material: 3/4 PCF glass mineral-fiber blanket with aluminum foil-scrim-kraft (FSK) jacket.
 - 2. Minimum Thickness: 1-1/2 inches.
 - 3. Number of Layers: One.
 - 4. Vapor Retarder Required: Yes.
 - 5. Minimum R-Value: 4.2
- D. Service: Portions of exhaust duct and plenum systems between an isolation motorized or backdraft damper and the duct system termination at a louver, gravity ventilator, gooseneck, or similar discharge opening to the exterior.
 - 1. Insulate as specified above for outdoor air ductwork.

END OF SECTION 230713

SECTION 230800 - COMMISSIONING FOR HVAC AND PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Commissioning requirements unique to particular systems and equipment are included in the specification Sections that specify those systems and equipment.
 - 2. Field quality-control testing to verify that workmanship quality for system and equipment installation is specified in system and equipment Sections.

1.2 SUMMARY

- A. This Section includes:
 - 1. General requirements for coordinating and scheduling commissioning.
 - 2. Commissioning meetings.
 - 3. Commissioning reports.
 - 4. Use of test equipment, instrumentation, and tools for commissioning.
 - 5. Construction checklists, including, but not limited to, installation checks, startup, performance tests, and performance test demonstration.
 - 6. Commissioning tests and commissioning test demonstration.
 - 7. Adjusting, verifying, and documenting identified systems and assemblies.

1.3 EMPLOYMENT OF THE COMMISSIONING AGENT

- A. The cost to employ an independent Commissioning Agent (CxA) to provide commissioning services for this Project shall be included in the Division 23 Contractor's bid price.
 - 1. The CxA shall function as a subcontractor responsible to the Division 23 / HVAC sub-contractor. The CxA may not be a direct employee of any Prime or sub-contractor performing installation work under this Contract.

1.4 CONTRACTOR'S RESPONSIBILITIES

- A. The Division 23 Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities as specified in this Section, and including, but not limited to, the following:

1. Furnish approved submittals and operations and maintenance information for all equipment and systems to the CxA.
2. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
3. Attend commissioning team meetings held on a monthly basis beginning after the commencement of mechanical/electrical construction work.
4. Integrate and coordinate commissioning process activities with construction schedule.
5. Review and accept construction checklists provided by the CxA.
6. Complete construction checklists as Work is completed and provide to the CxA on a weekly basis.
7. Create the start-up plan, perform startup of equipment and systems, and complete startup checkout reports.
8. Review and accept commissioning process test procedures (both pre-functional and functional) provided by the CxA.
9. Complete and participate in all commissioning process test procedures (both pre-functional and functional).
10. Resolve issues identified in the Issues Log. Perform re-tests as required after corrections have been made.
11. Require equipment suppliers to perform the work assigned to them in this Section.
12. Require the ATC sub-contractor to perform the work assigned to them in this Section.
13. Provide staff assigned to participate in commissioning, meeting the following:
 - a. HVAC and Electrical Testing Technician Qualifications: Technicians shall perform HVAC construction checklist verification tests, commissioning tests, and commissioning test demonstrations shall have the following minimum qualifications:
 - 1) Journey-level or equivalent skill level. Vocational School four-year program graduate or an Associate's degree in mechanical systems, air conditioning, or similar field. Degree may be offset by three years' experience in servicing mechanical systems in the HVAC industry. Generally, required knowledge includes HVAC&R systems, electrical concepts, building operations, and application and use of tools and instrumentation to measure performance of HVAC&R equipment, assemblies, and systems.
 - 2) Minimum three years' experience installing, servicing, and operating systems manufactured by approved manufacturer.

1.5 DIVISION 23 EQUIPMENT SUPPLIER'S RESPONSIBILITIES

- A. As indicated in individual equipment Specification Sections, and including, but not limited to, the following:
 1. Provide all requested submittal data, including detailed start-up procedures and specific responsibilities of the Owner to keep warranties in force.
 2. Assist in equipment start-ups as indicated in Division 23 equipment specification Sections per agreements with the Division 23 Contractor.

3. Participate in the process of functionally testing factory packaged controls with the assistance of the Division 23 Contractor and at the direction of the ATC sub-contractor as indicated in Division 23 equipment specification Sections prior to functional testing by the CxA.
4. Include all special tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment according to the Contract Documents in the base bid price to the Division 23 Contractor.
5. Provide information requested by CxA regarding equipment sequence of operation and testing procedures unique to the equipment supplied.
6. Review test procedures for equipment.
7. Attend commissioning meetings upon the request of the CxA or Division 23 Contractor.

1.6 COMMISSIONING AGENT'S RESPONSIBILITIES

- A. Review the Division 23 Contractor submittals and equipment operations and maintenance information for all systems and equipment to be commissioned.
- B. Review the Contract Documents to obtain familiarity with the Project and the project requirements.
- C. Request clarifications of the Design Professionals as required to determine the project's commissioning requirements.
- D. Organize and conduct commissioning team meetings held on a monthly basis.
- E. Inform the General Contractor of scheduling requirements, sequencing and milestones required to accomplish commissioning and balancing so that those can be incorporated into the master schedule prepared by the General Contractor.
- F. Prepare a Commissioning Plan. The Cx Plan will include no less than the following:
 1. A narrative description of the activities that will be accomplished in each phase of the commissioning, including the personnel intended to accomplish each of the activities.
 2. A listing of the specific equipment, appliances, or systems to be tested, and a description of the tests to be performed.
 3. Functions to be tested including, but not limited to, calibrations and economizer controls.
 4. Conditions under which each test will be performed. Testing shall affirm winter and summer design conditions and full outside air conditions.
 5. Measurable criteria for performance.
- G. Prepare and provide project-specific pre-functional construction checklists and functional test procedures.
- H. Prepare and update the Issues Log as contractors notify the Division 23 Contractor of corrections or updates.

- I. Commission systems identified within this Section. The commissioning scope is identified in Part 3 of this Section.
- J. Observe the installation of the systems. Identify any items of non-compliance with the requirements of the Contract Documents.
- K. Perform functional tests in all operating modes with the cooperation of the Division 23 Contractor, representatives of the ATC system sub-contractor, and equipment manufacturer representatives.
- L. Verify that automatic control devices are functioning properly and that all of the control sequences of operation are met.
- M. Compile test data, inspection reports, and certificates; include them in the systems manual and commissioning reports.

1.7 ACTION SUBMITTAL

- A. Commissioning Agent Qualifications: Verification of experience and capability of the CxA. The purpose of this submittal is to establish, in a proactive manner, that the CxA proposed by the Division 23 Contractor to perform the work of this Section is qualified. The Contractor's failure to obtain approval for this submittal prevents the Contractor from utilizing the proposed service provider. Within 60 days from the Contractor's Notice to Proceed, submit 2 copies of evidence that the CxA and this Project's commissioning team members meet the qualifications specified in the "Quality Assurance" Article below. Also submit the following:
 - 1. Resumes of the Cx technicians anticipated to work on this project.
 - a. Note: Do not submit 'generic' firm resumes or resumes of firm principals unless those individuals are proposed to do the actual Cx work on site for this project.
 - 2. A list of projects completed for each technician within the last 12 months. Include no less than three (3) client references with contact information relevant to projects completed within the last 12 months for each technician. The same project may be used more than once if multiple technicians worked on the project.
 - 3. A list of any projects completed for this same Owner within the last 3 years, if any, along with the technicians who worked on those projects, and the Owner's contact information.

1.8 INFORMATIONAL SUBMITTALS

- A. Test Reports:
 - 1. Pre-Functional Test Reports: Prior to startup of equipment or a system, submit signed, completed construction checklists completed by the Division 23 Contractor.

2. 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.
 3. Weekly Progress Report: Weekly, at the end of each week in which tests are conducted, submit a progress report.
 4. Functional Test Reports for each system and equipment commissioned.
- B. Manufacturers Startup and Checkout Procedures: Submitted by the Division 23 Contractor for all equipment specified in this Section to be commissioned.
- C. Preliminary Commissioning Report.
- D. Final Commissioning Report.

1.9 QUALITY ASSURANCE

- A. CxA Qualifications: Engage a Commissioning Agent (CxA) who is currently licensed Professional Engineer (PE) in the Commonwealth of Pennsylvania. In addition, the CxA shall be a currently an ASHRAE certified 'BCxP' - Building Commissioning Professional, or is a current Building Commissioning Association 'CCP' - Certified Commissioning Professional.
1. The CxA shall have a minimum of two (2) years full time equivalent experience performing work of a similar nature.
 2. The CxA shall furnish evidence of licensure or certification upon request of the Architect / Engineer or the Owner, along with a resume detailing two (2) years' worth of relevant experience, and no less than five (5) Building Owner references relevant to commissioning projects no older than five (5) years.
 3. The Owner reserves the right to reject the CxA on the basis of insufficient qualifications. The Division 23 Contractor may obtain pre-approval of their proposed CxA sub-contractor by submitting qualifications no less than ten (10) days prior to the bid-due date.
 4. The CxA may utilize direct employees or staff who are employed by the same company as the CxA to assist in performing the commissioning work, however the CxA shall be present at the site when any commissioning activities are taking place.
 5. The CxA, as referred to above, shall be taken to mean the particular individual meeting the qualification requirements, not other employees of the same firm or company.
- B. Commissioning Standards: Except as modified by this Section or the provisions of other Sections, all commissioning work by the CxA, including the scope and level of detail of pre-functional and functional checklists and test procedures, shall comply with one of the following:
1. ANSI / ASHRAE / IES Std. 202-2018, "Commissioning Process for Buildings and Systems" and ASHRAE Guideline 1.1-2007, "HVAC&R Technical Requirements for the Commissioning Process"
 2. ANSI / SMACNA "HVAC Systems Commissioning Manual", 2nd edition (2013).

3. The Building Commissioning Association's (BCxA's) "The Building Commissioning Handbook", 3rd edition (2017)
- C. The commissioning process shall be in full compliance with the requirements of the 2018 International Energy Conservation Code.

1.10 PROJECT CONDITIONS

- A. Partial Owner Occupancy: Owner will occupy areas of building outside of the immediate work area during the commissioning period. Cooperate with Owner during Cx operations to minimize conflicts with Owner's operations.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. All standard testing equipment required to perform startup and initial checkout and required functional performance testing shall be provided by the Division 23 Contractor for the equipment being tested. The Division 23 Contractor is responsible for all standard testing equipment for the HVAC system and controls system.
- B. Two-way radios for the cooperative use of all parties involved in the commissioning process shall be provided by the Division 23 Contractor.
- C. Special equipment, tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment, according to these Contract Documents shall be included in the base bid price to the Division 23 Contractor and left on site.
- D. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances indicated in the Specifications. If not otherwise noted, the following minimum requirements apply:
 1. Temperature sensors and digital thermometers shall have a certified calibration within the past year to an accuracy of 0.5°F and a resolution of + or - 0.1°F.
 2. Pressure sensors shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year.
 3. All equipment shall be calibrated according to the manufacturer's recommended intervals and when dropped or damaged. Calibration tags shall be affixed or certificates readily available.

PART 3 - EXECUTION

3.1 SYSTEMS TO BE COMMISSIONED

- A. Unless otherwise indicated, demonstrate tests for 100 percent of work to which the test applies (i.e. sampling approaches are not acceptable).

- B. Plumbing Systems: Service water heating systems, including the heaters, mixing valves, recirculation pumps, heater-mounted pumps, and all associated controls.
 - 1. Functional testing of service water heating systems shall not occur until the domestic water testing and balancing work has been completed.
- C. HVAC Systems:
 - 1. DDC System / Building Automation and Controls
 - 2. Fans
 - 3. Rooftop Air Conditioning Units
 - 4. Air Terminal Units
 - 5. Terminal Heating Equipment (e.g. Radiant Panels, Fin Tube Radiators, Cabinet Heaters, Unit Heaters)

3.2 EXAMINATION AND VERIFICATION BY THE COMMISSIONING AGENT - GENERAL REQUIREMENTS

- A. Examine Contract Documents to become familiar with project requirements and to discover conditions in systems' designs that may preclude proper commissioning of systems and equipment.
- B. Examine approved submittal data of HVAC systems and equipment.
- C. Examine equipment performance data, including fan and pump curves. Relate performance data to project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- D. Examine system and equipment installations to verify that they are complete and that Manufacturer's start-up and Division 23 Contractor testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.
- E. Examine system and equipment test reports produced by the Division 23 Contractor as specified in individual Specification Sections.
- F. Verify that systems have been air and water tested and balanced prior to beginning functional testing.
- G. Examine systems for functional deficiencies that cannot be corrected by commissioning or by adjusting and balancing.
- H. Examine automatic temperature system components to verify the following:
 - 1. Dampers, valves, and other controlled devices operate by the intended controller.
 - 2. Dampers and valves are in the position indicated by the controller.
 - 3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions.
 - 4. Automatic modulating control valves are properly connected.
 - 5. Thermostats are located to avoid adverse effects of sunlight, drafts, and cold walls.

6. Sensors are located to sense only the intended conditions.
 7. Sequence of operation for control modes is according to the Contract Documents.
 8. Controller set points are set at design values. Observe and record system reactions to changes in conditions. Record default set points if different from design values.
 9. Interlocked systems are operating.
 10. Changeover from heating to cooling mode occurs according to design values.
- I. Report deficiencies discovered in the Issues Log.

3.3 EXECUTION OF PREFUNCTIONAL CHECKLISTS AND STARTUP

- A. The CxA shall develop the Prefunctional Testing Forms for each system that is to be commissioned.
1. Prefunctional checklists cannot modify or conflict with the Contract Documents.
 2. Prefunctional checklists are important to ensure that the equipment and systems are fully installed and operational. It ensures that functional performance testing (in-depth system checkout) may proceed without unnecessary delays. Each piece of equipment receives full prefunctional checkout. No sampling strategies are permitted. The prefunctional testing for a given system must be successfully completed prior to formal functional performance testing of equipment or subsystems of the given system.
 3. These checklists and tests shall be provided by the CxA to the trade responsible for executing and documenting each of the line item tasks and notes that trade on the form. Each form will have more than one trade responsible for its execution.
- B. Start-Up Plan: The Division 23 Contractor shall develop the full start-up plan by combining (or adding to) the CxA checklists with the manufacturer's detailed start-up and checkout procedures from the O&M manual and the normally used field checkout sheets. The plan shall include checklists and procedures with specific boxes or lines for recording and documenting the checking and inspections of each procedure and a summary statement with a signature block at the end of the plan.
1. The full start-up plan consists of:
 - a. The CxA pre-functional checklists.
 - b. The manufacturer's standard written start-up procedures copied from the installation manuals with check boxes by each procedure and a signature block added by hand at the end.
 - c. The manufacturer's normally used field checkout sheets.
 2. The Division 23 Contractor shall submit the full startup plan to the CxA for review and approval. The CxA reviews the procedures and the format for documenting them, noting any procedures that need to be added.
- C. Prior to equipment or system startup, the Division 23 Contractor and associated vendors shall schedule startup and checkout with the CxA. The completion of the prefunctional checklists and startup and checkout shall be directed and executed by the Division 23 Contractor and/or equipment manufacturer's representative. When checking off

prefunctional checklists, signatures may be required of other prime contractors or sub-contractors for verification of completion of their portion of the work.

- D. The Division 23 Contractor and vendors shall execute startup and provide the CxA with a signed and dated copy of the completed start-up and prefunctional tests and checklists.
- E. Only individuals that have direct knowledge and witnessed that a line item task on the prefunctional checklist was actually performed shall initial or check that item off. It is not acceptable for witnessing supervisors to fill out these forms.

3.4 DEFICIENCIES AND NON-CONFORMANCE DISCOVERED DURING PRE-FUNCTIONAL CHECKS AND STARTUP.

- A. The Division 23 Contractor shall clearly list any outstanding items of the initial start-up and prefunctional procedures that were not completed successfully, at the bottom of the procedures form or on an attached sheet. The procedures form and any outstanding deficiencies are provided to the Division 23 Contractor within two days of test completion.
- B. The installing Division 23 Contractor or equipment suppliers / vendors shall correct all areas that are deficient or incomplete in the checklists and tests in a timely manner, shall notify the CxA as soon as outstanding items have been corrected, and shall resubmit an updated start-up report and a Statement of Correction on the original non-compliance report.
- C. Items left incomplete, which later cause deficiencies or delays during functional testing may result in back charges to the responsible party.

3.5 FUNCTIONAL PERFORMANCE TESTING - GENERAL REQUIREMENTS

- A. Functional testing shall be conducted after prefunctional testing and startup has been satisfactorily completed. The control system shall be sufficiently tested and approved by the CxA before it is used for testing, adjusting, and balancing or to verify performance of other components or systems. The air balancing and water balancing shall be completed and debugged before functional testing of air-related or water-related equipment or systems. Testing proceeds from components to subsystems to systems. When the proper performance of all interacting individual systems has been achieved, the interface or coordinated responses between systems shall be checked.
- B. Objectives and Scope: The objective of functional performance testing is to demonstrate that each system is operating according to the documented design intent, sequence of operations, and Contract Documents. Functional testing facilitates bringing the systems from a state of substantial completion to full dynamic operation. Additionally, during the testing process, areas of deficient performance are identified and corrected, improving the operation and functioning of the systems.
 - 1. Each system shall be operated through all modes of operation (seasonal, occupied, unoccupied, warm-up, cool-down, part- and full-load) where there is a specified system response. Verifying each sequence in the sequences of operation is required. Proper responses to such modes and conditions as power

failure, freeze condition, low oil pressure, no flow, equipment failure, etc. shall also be tested.

2. Tests shall also include the following:

- a. Redundant or automatic back-up mode
- b. Alarm reporting performance
- c. Mode of operation upon a loss of normal power and restoration of normal power
- d. Air economizer functions

C. Development of Test Procedures: The CxA will develop specific test procedures and forms to verify and document proper operation of each piece of equipment and system. The Division 23 Contractor or equipment vendor who is responsible to execute a given test, shall provide assistance to the CxA in developing the procedures review (answering questions about equipment, operation, sequences, etc.). The purpose of any given specific test is to verify and document compliance with the stated criteria of acceptance given on the test form.

D. The Division 23 Contractor shall review the proposed tests for feasibility, safety, and equipment and warranty protection.

E. The CxA shall direct and document the tests.

F. The Division 23 Contractor shall provide technicians, instrumentation, and tools to conduct the functional tests as directed by the CxA. The Division 23 Contractor shall operate the equipment and systems during tests. Other installing contractors may be required to assist in tests of equipment and systems with which their work interfaces.

3.6 FUNCTIONAL TEST METHODS

A. Functional performance testing and verification may be achieved by manual testing (i.e. persons manipulate the equipment and observe performance) or by monitoring the performance and analyzing the results using the control system's trend log capabilities or by stand-alone data loggers. The CxA shall determine which method is most appropriate for tests that do not have a method specified.

1. Simulated Conditions. Simulating conditions (not by an overwritten value) shall be allowed, though timing the testing to experience actual conditions is encouraged wherever practical.
2. Overwritten Values. Overwriting sensor values to simulate a condition, such as overwriting the outside air temperature reading in a control system to be something other than it really is, shall be allowed, but shall be used with caution and avoided when possible. Such testing methods often can only test a part of a system, as the interactions and responses of other systems will be erroneous or not applicable. Simulating a condition is preferable. (e.g. For the above case, by heating the outside air sensor with a hair blower rather than overwriting the value or by altering the appropriate setpoint to see the desired response.) Before simulating conditions or overwriting values, sensors, and transducers, devices shall have been calibrated.
3. Simulated Signals. Using a signal generator which creates a simulated signal to test and calibrate transducers and DDC constants is generally recommended over

using the sensor to act as the signal generator via simulated conditions or overwritten values.

4. Altering Setpoints. Rather than overwriting sensor values, and when simulating conditions is difficult, altering setpoints to test a sequence is acceptable. For example, to see the AC compressor lockout work at an outside air temperature below 55F, when the outside air temperature is above 55F, temporarily change the lockout setpoint to be 2F above the current outside air temperature.
5. Indirect Indicators. Relying on indirect indicators for responses or performance shall be allowed only after visually and directly verifying and documenting, over the range of the tested parameters, that the indirect readings through the control system represent actual conditions and responses. Much of this verification is completed during prefunctional testing.

- B. Setup: Each function and test shall be performed under conditions that simulate actual conditions as close as is practically possible. The Division 23 Contractor shall provide all necessary materials, system modifications, etc. to produce the necessary flows, pressures, temperatures, etc. necessary to execute the test according to the specified conditions. At completion of the test, the Division 23 Contractor shall return all affected building equipment and systems, due to these temporary modifications, to their pre-test condition.
- C. Coordination and Scheduling: The Division 23 Contractor shall provide sufficient notice to the CxA regarding their completion schedule for the prefunctional checklists and startup of all equipment and systems. The CxA will schedule functional tests through the Construction Manager, General Contractor, and Division 23 Contractor. The CxA shall perform, witness, and document the functional testing of all equipment and systems. The Division 23 Contractor shall be available when the tests are executed.

3.7 DEFICIENCIES AND NON-CONFORMANCE DISCOVERED DURING FUNCTIONAL TESTING

- A. If any deficiency in the installation of the work discovered during initial functional testing operations prevents complete, accurate, and uncompromised testing of the systems, the CxA shall report the deficiencies in writing. Any preliminary functional testing work done with the deficiency still present shall not be sufficient for acceptance, and re-testing shall be required after the deficiency has been fully corrected by the Division 23 Contractor.
- B. The CxA shall track and report commissioning compliance issues until resolution and retesting are successfully completed.
- C. If a test demonstration to the Architect / Engineer or Owner must be repeated due to failure caused by a Contractor's work or materials, that Contractor shall reimburse the Owner for billed costs for the participation in the repeated demonstration.

3.8 PROGRESS REPORTING

- A. Status Reports: As commissioning progresses, prepare bi-weekly (i.e. twice a month) reports to describe completed procedures, procedures in progress, and scheduled

procedures. Include a list of deficiencies and problems found in systems being commissioned. Prepare a separate report for each system and piece of equipment.

- B. Preliminary Commissioning Report: The report shall be provided no later than 7 days prior to Substantial Completion. The preliminary report shall include the range of information specified below for the Final Cx Report, and the following additional items:
1. Itemization of deficiencies found during testing that have not been corrected at the time of report preparation.
 2. Deferred tests that cannot be performed at the time of report preparation because of climatic conditions.
 3. Climatic conditions required for performance of the deferred tests.

3.9 FINAL COMMISSIONING REPORT

- A. Format: Paper copies, in three-ring binder, tabulated and divided into sections by commissioned systems and equipment.
- B. The Final Commissioning Report shall be issued no later than 90 days after the Owner's receipt of their Certificate of Occupancy.
- C. Contents: The report shall include the following:
1. A certification sheet in front of binder signed and sealed by the certified CxA.
 2. General Report Data:
 - a. Title page.
 - b. Name and address of CxA firm.
 - c. Project name.
 - d. Project location.
 - e. Architect's name and address.
 - f. Engineer's name and address.
 - g. Division 23 Contractor's name and address.
 - h. Report date.
 - i. Signature of CxA who certifies the report.
 - j. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 3. Functional test procedures used during the commissioning process, including measurable criteria for test acceptance, provided herein for repeatability.
 4. Final functional test reports
 5. Pre-function test checklists
 6. Final Issues Log
 7. Disposition of deficiencies found during testing, including details of corrective measures used or proposed

3.10 OPPOSITE SEASON FUNCTIONAL PERFORMANCE TESTING

- A. Functional performance testing shall be performed for those systems and portions of the sequences of operation that could not be adequately tested during the primary phase of commissioning due to the climatic conditions. Test results and updated issues logs shall be issued by the CxA as addendums to the Final Cx Report. All functional testing shall be complete within one (1) year of Substantial Completion.
- B. The Division 23 Contractor and ATC sub-contractor shall be present upon request of the CxA.

3.11 ADDITIONAL COMMISSIONING INVESTIGATIONS AND TESTS

- A. After acceptance of the final commissioning report, and within one (1) year of Substantial Completion, provide up to 12 hours of on-site time to verify that the proper operation of systems are being maintained throughout, and to investigate and correct unusual conditions. This allowance may be required over as many as three (3) separate site visits. The additional on-site time shall be provided at the request of the Owner or Engineer.

END OF SECTION 230800

SECTION 233113 - DUCTWORK

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 Division 23 Sections include the following:
 - 1. "HVAC Duct Insulation" for duct insulation other than duct liner.
 - 2. "Air Duct Accessories" for dampers, sound-control devices, duct-mounted access doors and panels, turning vanes, flexible ducts, and other duct mounted specialties.
 - 3. "Diffusers, Registers, and Grilles" for air inlets and outlets.
 - 4. "Testing, Adjusting, and Balancing for HVAC" for air balancing and final adjusting of manual-volume dampers.

1.2 SUMMARY

- A. This Section includes rectangular and round metal ducts and plenums for heating, ventilating, and air-conditioning systems in pressure classes from minus 10- to plus 10-inch w.g. Products specified herein include the following:
 - 1. Single-wall, rectangular ducts and fittings.
 - 2. Single-wall round spiral-seam ducts and formed fittings.
 - 3. Sealants and gaskets.
 - 4. Duct liner.

1.3 INTERPRETATION OF THE DRAWINGS

- A. Duct system design, as indicated, has been used to select and size air-moving and -distribution equipment and other components of air system. Ductwork indicated on the Drawings is schematic; therefore, changes in ductwork sizes and/or location shall be made when necessary to conform to project conditions. Offsets, rises, drops, and duct profile changes shall be made at no additional cost to the Owner. The Architect / Engineer shall be consulted for approval of duct size changes which cannot maintain the same equivalent flow area and friction rate, require a duct aspect ratio exceeding 4 to 1, or represent a fundamental change to the configuration of duct system. Proposed changes must be specifically approved in writing by Architect / Engineer prior to being implemented. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

- B. Duct dimensions indicated on Drawings are the required clear, inside dimensions. Note that, typically, the first dimension listed on the Drawings is that of the side visible in the particular 2D view (plan, section, etc.).
- C. The Drawings schematically indicate fitting types. All proposed changes in fitting types shown on the Drawing or specified in this Section shall be approved in writing by the Architect / Engineer prior to being implemented.
- D. Turning vanes not shown on the Drawings for mitered rectangular elbows have been omitted for clarity purposes only. The Contractor shall provide turning vanes as required by this Section regardless of drawing depiction.
 - 1. At the Contractor's option, radius type elbows with 1.5 or 1.0 centerline radius to duct width ratio may be provided in lieu of mitered elbows shown on the Drawings where the duct width in the plane of change in direction is less than 14", provided that the elbow fits in the space available.
 - 2. Mitered elbows shall not be substituted for a radius type elbows shown on the Drawings unless specifically approved by the Architect / Engineer.

1.4 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 this Section, and elsewhere in the Contract Documents.
 - 1. Where the requirements of this specification section exceed SMACNA requirements or where a prohibition of specific type of work contained in the SMACNA standard is made, the requirements of this specification section shall take precedence.
- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity and wind loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.5 ACTION SUBMITTALS

- A. Product Data: For prefabricated ductwork, duct components, duct liner, sealant and gasket materials.
- B. Shop Drawings: Show details of the following:
 - 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 pressure classes.
4. Elevations of top and bottom 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. Penetrations through the roof and exterior walls.
11. Equipment installation based on equipment being used on Project.
12. Duct accessories, including dampers and access doors.
13. Hangers and supports, including methods for duct and building attachment, vibration isolation.
14. Control dampers, airflow measuring stations, temperature and pressure sensors, and all other control devices required. Coordinate with the work of the ATC Sub-contractor as described in Division 23 Section "Instrumentation and Control for HVAC".

1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items. Refer to Division 23 Section "Common Work Results for HVAC" for additional coordination drawing requirements. Show the following:
 1. Ceiling suspension assembly members.
 2. Other systems installed in same space as ducts.
 3. Ceiling- and wall-mounted access doors and panels required to provide access to dampers and other operating devices.
 4. Coordination with ceiling-mounted items, including lighting fixtures, diffusers, grilles, speakers, sprinkler heads, access panels, and special moldings.
 5. Other items required to be included as per the provisions of Division 23 Section "Common Work Results for HVAC".
- B. Field Test Reports: Indicate and interpret test results for compliance with performance requirements for the following:
 1. Pressure and leakage tests.

1.7 CLOSEOUT SUBMITTALS

- A. Record Drawings: Indicate actual routing, fitting details, reinforcement, support, and installed accessories and devices.

1.8 QUALITY ASSURANCE

- A. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA): Generally, ductwork and ductwork supports shall meet the requirements of SMACNA's Publication "HVAC Duct Construction Standards--Metal and Flexible", 3rd Edition (2005), and various other SMACNA Publications referenced in this specification section.

However, where the requirements of this specification section exceed SMACNA requirements or where a prohibition of specific type of work contained within or permitted by the SMACNA standard is made, the requirements of this specification section shall take precedence.

- B. Comply with NFPA 96 for kitchen grease and vapor hood ducts, unless otherwise indicated.
- C. Minimum Seal Class Requirements: Conform to requirements of 2015 the referenced SMACNA standards and ASHRAE Standard 90.1- 2013 except where these specifications exceed those requirements.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver sealant and firestopping materials to site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle sealant and firestopping materials according to manufacturer's written recommendations.
- C. Protect shop fabricated and factory fabricated ductwork, accessories and purchased products from damage during shipping, storage and handling. Prevent end damage and prevent dirt and moisture from entering ducts and fittings with a polyethylene film with a high-tack adhesive to attach to the ductwork and accessories. Where possible, store ductwork inside and protect from weather. Where necessary to store outside, store above grade and enclose with polyethylene waterproof wrapping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Fibrous-Glass Duct Liner:
 - a. CertainTeed Corp.; Insulation Group.
 - b. Johns Manville International, Inc.
 - c. Knauf Fiber Glass GmbH.
 - d. Owens Corning.
 - 2. Single Wall Round Prefabricated Ducts and Fittings:
 - a. Hranec Sheet Metal Inc.
 - b. Linx Industries Inc.
 - c. McGill AirFlow LLC
 - d. MKT Metal Manufacturing

- e. SEMCO LLC
 - f. Sheet Metal Connectors, Inc.
 - g. Spiral Manufacturing Co., Inc.
 - 3. Round Prefabricated Connectors:
 - a. Ductmate Industries, Inc.
 - b. Hranec Sheet Metal Inc.
 - c. Linx Industries Inc.
 - d. McGill AirFlow LLC
 - e. MKT Metal Manufacturing
 - f. SEMCO LLC
 - g. Sheet Metal Connectors, Inc.
 - h. Spiral Manufacturing Co., Inc.
 - 4. Sealant and Gaskets:
 - a. Ductmate Industries
 - b. Carlisle Hardcast
 - c. Childers; a Div. of HB Fuller Construction Products Inc.
 - d. McGill Airflow LLC
 - e. Foster; a Div. of HB Fuller Construction Products Inc.
 - 5. Flanged Duct Connector Systems for Rectangular Duct:
 - a. Ductmate '35' and '45' systems.
 - b. CL Ward "J" and "H" flange and corner systems.
 - c. Hardcast / Nexus "J" and "G" flange and corner systems.
 - d. Ward Industries / Hart and Cooley "FLGJ" and "FLGH" systems
 - e. Note: SMACNA joint types T-25a and T-25b (TDC and TDF type connectors, respectively) using corner pieces provided by the above listed manufacturers are also acceptable on ducts where the pressure class does not exceed 2" w.g., positive or negative.
 - 6. Flanged Duct Connector Systems for Round Duct:
 - a. Ductmate 'Spiralmate'.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 1. Steel Cable Hanger Systems:
 - a. Ductmate 'Clutcher'
 - b. DuroDyne 'Dyna-Tite' Series
 - c. Gripple Inc. 'Standard Hanger' Series

2.2 SHEET METAL MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, except as otherwise indicated or modified by this Section. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized, Sheet Steel: Lock-forming quality; ASTM A 653 or ASTM A 924, G60 or G90 coating designation. Minimum thickness permitted shall be 24 gauge.

2.3 FIBROUS GLASS DUCT LINER

- A. General: Comply with NFPA 90A and NAIMA's "Fibrous Glass Duct Liner Standard."
- B. Where Required:
 - 1. Transfer air ducts.
 - 2. Supply air ducts downstream of air terminal units (VAV boxes).
- C. Materials: ASTM C 1071, Type II (rigid sheet), with the surface exposed to airstream coated with an approved surface covering to prevent erosion of glass fibers in duct systems operating with velocities as high as 6000 feet per minute. Coatings shall meet the requirements of NFPA 90A and shall be impregnated with an EPA-Registered biocide to inhibit mold and bacteria growth. Insulation shall be treated with a biocide to inhibit biological growth.
 - 1. Minimum Thickness: 1 inch.
 - 2. Thermal Conductivity (k-Value): No more than 0.27 at 75 deg F mean temperature.
 - 3. Fire-Hazard Classification: Maximum flame-spread rating of 25 and smoke-developed rating of 50, when tested according to ASTM E84 or UL 723.
 - 4. Liner Adhesive: Comply with NFPA 90A and ASTM C 916.
 - 5. For Round Ducts: Provide a liner specifically manufactured for this purpose (e.g. Johns Manville 'Spiracoustic Plus', 'CertainTeed "Ultra-Round"', or Owens Corning "QuietZone", etc.). Do not use liner intended for rectangular ducts in round ductwork.
 - a. All round ductwork on portions of the ductwork systems indicated to receive liner shall be provided with liner, including, but not limited to, round branch duct connections to diffusers. The only exception is round ducts with clear inside diameters of less than 6".
- D. Insulation Pins and Washers for Liner in Rectangular Ducts: Fasteners shall not damage liner when applied as recommended by manufacturer or cause leakage in duct.
 - 1. Cupped-Head, 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 with integral 1-1/2-inch galvanized carbon-steel washer. Pin lengths as required for liner thickness, without compressing the liner more than 10% or the pin protruding into the duct more than 1/8".

2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

2.4 SEALANT AND GASKETS

- A. Tapes: One-step (peel and stick) pressure-sensitive duct sealing tapes, two-part tape systems, and similar sealing tapes are not permitted for sealing metal duct joints and penetrations.
- B. 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. Sealants shall be UL-181B-M listed.
- C. Indoor Duct Water-Based Joint and Seam Sealant:
 1. Application Method: Brush-on or trowel-on to minimum 1/16" thickness to joints and seams. Application temperature range: 40 to 100 deg F.
 2. Solids Content: Minimum 68 percent.
 3. Shore A Hardness: Minimum 72.
 4. Shall be permanently flexible and water, mold, and mildew resistant after curing.
 5. Adhesion Strength per ASTM C794 to Bright Annealed Stainless Steel: 6.25 PLI
 6. VOC Content: Maximum 30 g/L (less water).
 7. UL 181B-M listed; UL 723 Classified.
 8. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 9. Service Application: Indoor duct installations, except for unconditioned outdoor air ducts.
 10. Acceptable Products: Ductmate 'PROseal', Foster '32-19 Duct-Fas', or Childers 'Chil-Flex CP-146'.
- 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.
- E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
 1. Comply with UL 723 and meet Mil-C 18969B and TTS-S-001657. This material, in addition to the above, shall not contain vegetable oils, fish oils, or any other type vehicle that will support fungal and/or bacterial growth.
 2. The use of gaskets with adhesive properties on fitting and duct connections shall not substitute for fastening hardware.

F. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.5 HANGERS AND SUPPORTS

- A. Supports shall comply with Chapter 5 of the SMACNA Publication "HVAC Duct Construction Standards--Metal and Flexible, 3rd Edition, 2005, except as modified by this section.
- B. Building Attachments: Concrete inserts, power-actuated fasteners or mechanical-expansion fasteners , or structural-steel fasteners appropriate for building materials.
1. Use power-actuated concrete fasteners for standard-weight aggregate concretes or for slabs 4 inches thick and thicker.
 - a. NOTE: Do not use power-actuated concrete fasteners for lightweight-aggregate concrete or for slabs less than 4 inches thick.
 2. Do not use strap type attachments, , or friction type beam clips / clamps (e.g. hammer-on / slide-on flange clips and similar devices).
 - a. C-type beam clamps that incorporate a bolt for fastening, consistent with MSS Types 19 and 23, are acceptable.
- C. Hanger Materials: Galvanized, sheet steel straps, wire rope locking cable hanger system or round, threaded steel rod. Strap galvanizing shall be G90, or matching that of the supported duct, whichever is greater.
1. Exceptions to the Above:
 - a. Hangers and supports for aluminum duct shall be constructed of 6061- T6 aluminum or galvanized steel and isolated from the aluminum with an epoxy paint finish. Reinforcements shall be made of 6061-T6 aluminum.
 - b. Hangers, supports, and fasteners for exterior ducts shall be hot dipped galvanized or stainless steel.
 - c. Hangers and supports in corrosive atmospheres and spaces.
 2. Straps and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for sheet steel width and thickness and for steel rod diameters.
 3. Do not use wire hangers unless explicitly specified elsewhere in this Section.
- D. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

1. Fasteners for interior galvanized ducts shall be zinc or cadmium coated.
 2. Blind rivets using pull-through mandrels are not permitted if they leave holes for air leakage. Fasteners shall not project into duct interiors more than 1/2".
- E. Trapeze and Riser Supports: Steel shapes shall comply with ASTM A 36.
1. Supports for Galvanized-Steel Ducts: Galvanized steel shapes and plates.
- F. Steel Cable Hanger Systems: Factory-fabricated system of steel wire cables, locking cable anchors, and related accessories for the support of horizontal ducts which do not exhibit, or have been restrained from, lateral movement during system operation. All products shall be from a single manufacturer, and shall have been tested by SMACNA Testing and Research Institute and found to conform to the requirements of the "HVAC Duct Construction Standards, Metal and Flexible" for upper and lower attachments. Hangers shall be factory engineered for a 5 to 1 safety factor.
1. Steel Cables: Galvanized steel complying with ASTM A 603 or Stainless steel complying with ASTM A 492.
 2. Steel Cable Locks / End Connections: Cadmium or zinc-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
 3. Stress Distribution Corner Guards: Used with uninsulated rectangular duct to prevent cable stress or deformation of the ductwork. Corner brackets are an acceptable alternative so long as the ductwork is not material handling or of fully welded construction.
 4. Acceptable Upper Attachments Are Limited to the Following:
 - a. Eyebolts, drilled concrete eyelets, ring anchors, studded cable ends in concrete structure buildings.
 - b. Cable loops around building structural steel and supplemental steel where the minimum required cable bending radius is ensured, and channel support system attachments in steel structure buildings.

2.6 RECTANGULAR DUCT FABRICATION – GENERAL REQUIREMENTS

- A. General: Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" (3rd Edition; 2005), except as modified by this Section. Comply with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.
1. Transverse joint types are limited to the following:
 - a. T-1 through T-14 as shown in Figure 2-1, "Rectangular Duct/Transverse Joints" in the above referenced SMACNA standard, for ductwork in the 1/2" or 1" w.g. (positive or negative) pressure classes.
 - b. Flanged duct connector systems as elsewhere specified in this Section.
 - c. Joint types explicitly specified elsewhere in this Section.

2. Longitudinal joint types are limited to joint types shown in Figure 2-2, "Rectangular Duct/Longitudinal Seams" in the above referenced SMACNA standard, except for L-2 (button punch snap lock) and L-3 (grooved seam), which are not permitted. Joint types explicitly specified elsewhere in this Section are also permitted.
- B. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification.
- C. Materials: Free from visual imperfections such as pitting, seam marks, roller marks, stains, and discolorations.
- D. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359-inch-thick or less, with more than 10 sq. ft. of unbraced panel area, unless ducts are lined.

2.7 FLANGED DUCT CONNECTOR SYSTEMS

- A. A pre-fabricated flanged duct connector system is acceptable for forming transverse joints on rectangular and round ductwork where the specified pressure class can be met, and subject to other restrictions herein indicated.
- B. The system shall consist of factory-fabricated add-on flange connectors, gaskets, and related components and fasteners. Materials shall be galvanized steel, aluminum, or stainless steel to match the connecting ductwork. The system shall be suitable for ductwork having pressure ratings from +2 inches w.g. to +10 inches w.g. and from -2 inches w.g. to -10 inches w.g. The system flanges and corner pieces shall form a flange frame around the full perimeter of the duct, and shall be designed to produce a sealed fit onto a plain duct end using an integrated sealant pocket.
 1. 'Formed-on' style flanges, such as SMACNA joint types T-25a and T-25b (TDC and TDF type flanges, respectively) and similar joining methods using a flange that is formed directly from the duct end and secured in place with corner connectors, are acceptable where the pressure class does not exceed 2" w.g., positive or negative.
 2. Corners shall be jointed using corner clips or a bolted connection.
- C. The duct connector system shall be applied in full conformance with the system manufacturer's installation instructions and with all required screws, sealants, gasket tape, corner clips, bolts, nuts, washers, and spring clip / cleats. Systems that do not use spring clips are not acceptable.
 1. Substitution of zip screws for the recommended galvanized steel spring clips (cleats) is not permitted. Spring clips shall be of the length, gauge, and quantity recommended by the system manufacturer.
- D. Flange Gaskets: Permanently flexible butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

1. Comply with UL 723 and meet Mil-C 18969B and TTS-S-001657. This material, in addition to the above, shall not contain vegetable oils, fish oils, or any other type vehicle that will support fungal and/or bacterial growth.

2.8 SHOP APPLICATION OF LINER

- A. General: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," 2005, Figure 7-11, "Flexible Duct Liner Installation."
 1. For round ducts, where the referenced SMACNA standard does not address the unique requirements of lining round and oval ductwork, the liner manufacturer's recommendations shall be followed.
- B. Adhere a single layer of indicated thickness of duct liner with 100 percent coverage of adhesive at liner contact surface area. Insulation shall be adhered directly to clean, oil-free surfaces. Multiple layers of insulation to achieve indicated thickness are prohibited.
- C. Apply adhesive to liner facing in direction of airflow not receiving metal nosing.
- D. Butt transverse joints without gaps and coat joint with adhesive.
- E. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
- F. Do not apply liners in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and standard liner product dimensions make longitudinal joints necessary.
- G. Secure liner to rectangular ducts with mechanical fasteners (weld pins and washers) 4 inches from corners and at intervals not exceeding 12 inches transversely around perimeter; 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" profile or are integrally formed from duct wall. Fabricate edge facings at the following locations:
 1. Fan discharge.
 2. Intervals of lined duct preceding unlined duct.
 3. Upstream edges of transverse joints in ducts.
- 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.

2.9 ROUND DUCT FABRICATION

- A. Round Ducts: Fabricate ducts with standard spiral lock seams according to Figure 3-2 of SMACNA's "HVAC Duct Construction Standards--Metal and Flexible", 2005 (3rd Edition).
 - 1. Snap-lock, lapped and riveted, butt weld, and grooved type longitudinal seam construction is not acceptable.
- B. Transverse Joints Between Duct Sections and to Fittings: Fabricate according to Figure 3-1 of the above referenced SMACNA standard.
 - 1. Ducts up to 20 Inches in Diameter: Factory fabricated slip-on gasketed flange system or type 'RT-1' beaded sleeve joint consisting of an interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.
 - 2. Ducts 21 to 72 Inches in Diameter: Factory fabricated slip-on gasketed flange system or a type 'RT-2' Van Stone joint consisting of a gasketed, flanged joint with two internal flanges formed on the duct end, two exterior flanges, and flange hardware.
 - 3. Ducts Larger than 72 Inches in Diameter: Type 'RT-2A' companion angle flanged joints.
 - 4. Gasketed Push-On Joints (all sizes): Refer elsewhere in this Section for requirements for round duct joint O-ring seals:
 - a. Round Ducts: Factory-fabricated connection system consisting of double-lipped, EPDM rubber gasket. Manufacture ducts according to connection system manufacturer's tolerances.
 - 5. Draw-band, crimp joint sleeve, swedge bell, and outside sleeve joints are not acceptable.

2.10 ROUND FITTING FABRICATION

- A. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," 2005, with metal thicknesses specified for spiral lock seam straight duct.
- B. Diverging-Flow Fittings: Fabricate with a reduced entrance to branch taps with no excess material projecting from body onto branch tap entrance.
- C. Elbows: Fabricate in die-formed (stamped), gored (segmented), or pleated construction. Single-mitered and adjustable type elbows are not permitted on round ductwork. Fabricate with a centerline bend radius of at one and one-half times elbow diameter. Fabricate elbows as follows:
 - 1. Round Elbows, 12 Inches and Smaller: 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 configuration or nonstandard diameter elbows with gored construction.

2. Round Elbows, Larger than 12 Inches: Fabricate gored (segmented) elbows. Maximum 22.5 degree change in direction per segment (e.g. this requires a 5-segment elbow for a 90 degree change in direction, and elbows with less than 90-degree change of direction shall have proportionately fewer segments.).
3. Die-Formed Elbows for Sizes through 8 Inches and All Pressures: 0.040-inch-thick with two-piece welded construction.
4. Round Gored (Segmented)-Elbow Metal Thickness: Same as non-elbow fittings specified above.
5. Pleated Elbows for Sizes through 12 Inches and Pressures through 10-Inch w.g: 0.028 inch.

PART 3 - EXECUTION

3.1 DUCT APPLICATIONS

- A. Refer to Division 23 Section "Common Work Results for HVAC" for definitions of 'conditioned' and 'unconditioned' spaces.
- B. Unless more restrictive requirements are scheduled on the Drawings, select and construct and seal duct systems components (ducts, fittings, and accessories) in accordance with the following SMACNA Static-Pressure and Seal Classes. The pressure ratings indicated are minimum values:
 1. Ducts Located in Interior Conditioned and Indirectly Conditioned Spaces: Unless otherwise indicated, construct ducts to the following:
 - a. Multiple Zone VAV Supply Ducts Upstream of Air Terminal Boxes: + 4-inch w.g., Seal Class "A".
 - b. Multiple Zone VAV Supply Ducts Downstream of Air Terminal Boxes: +] 2-inch w.g., Seal Class "A".
 - 1) Exception: Where exposed in the space served, Seal Class "B" may be followed.
 - c. Constant Volume and Single Zone VAV Supply Ducts: +2-inch .wg., Seal Class "A".
 - 1) Exception: Where exposed in the space served, Seal Class "B" may be followed.
 - d. Return and Relief Air Ducts: -1-inch w.g., Seal Class "C".
 - e. Unconditioned Outside Air Ducts: - 2-inch w.g., Seal Class "A".
 - f. Transfer Air Ducts: +1/2-inch w.g., Seal Class "C"
 - g. Exhaust Air Ducts: -2-inch w.g., Seal Class "B".
 - h. All supply and relief air ducts not explicitly addressed by the above sub-paragraphs shall be +2" w.g., Seal Class "A".
 - i. All return, outdoor air, and exhaust, ducts not explicitly addressed by the above sub-paragraphs shall be -2" w.g., Seal Class "A".

2. Ducts Located in Interior Unconditioned Spaces: Unless otherwise indicated, construct ducts to the following:
 - a. As specified above for ducts located Interior Conditioned Spaces, except that all ducts listed above to receive Seal Class "C" shall be provided with Seal Class "B" instead, and all ducts listed above to receive Seal Class "B" shall be provided with Seal Class "A" instead.
- C. Material Application: All ducts shall be galvanized steel.
- D. All ducts shall be single wall.

3.2 DUCT FITTING APPLICATIONS

- A. Elbow Configuration: Unless explicitly noted otherwise on the Drawings, use the following elbow types:
 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows", as modified below. NOTE: All radii listed below are to the centerline of the duct, in the plane of change of direction.
 - a. Supply ducts downstream of terminal units, exhaust and return ducts upstream of terminal units, and constant volume ducts, and duct systems lacking in terminal units and air valves:
 - 1) Radius Type RE 1 with minimum 1.5 centerline radius-to-duct width (r-to-dw) ratio.
 - 2) Radius Type RE 1 with minimum 1.0 r-to-dw ratio.
 - a) These are only permitted where a 1.5 r-to-dw elbow is demonstrated to not possibly fit in the available space by way of the ductwork shop drawing and coordination drawing review and approval process.
 - 3) Mitered Type RE 2 with small single-wall vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, 2005" Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
 - b. Supply ducts upstream of terminal units, return and exhaust ducts downstream of terminal units and air valves:
 - 1) Radius Type RE 1 with minimum 1.5 centerline radius-to-duct width (r-to-dw) ratio.
 - 2) Radius Type RE 3 with minimum 1.0 r-to-dw ratio and splitter vane(s) complying with Chart 4-1 and Figure 4-9 of SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, 3rd Edition (2005)".
 - a) Ducts less than 12" wide: Provide 1 splitter vane.

- b) Ducts from 12" to 36" wide: Provide two (2) splitter vanes.
 - c) Ducts wider than 36": Provide three (3) splitter vanes.
 - 3) Mitered Type RE 2 with small single-wall vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, 3rd Edition (2005)" Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
 - c. All other elbow types (e.g. RE 4 un-vaned square/mitered ells, RE 5, 6, 7, 8, 9, or 10 ells, and square throat / radius heel, etc.) are not permitted, except where explicitly shown on the Drawings.
 - 1) Exception: Type RE 4 (un-vaned and mitered) ells are permitted in transfer-air ducts, and in ducts where the peak / design velocity is less than 800 feet per minute.
2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, 2005" Figure 3-4, "Round Duct Elbows."
- a. Minimum Radius-to-Diameter Ratio:
 - 1) 1.0 centerline radius-to-diameter ratio for 90-degree elbow. These are only permitted where a 1.5 centerline radius-to-diameter elbow is demonstrated to not possibly fit in the available space by way of the ductwork shop drawing and coordination drawing review and approval process.
 - 2) 1.5 centerline radius-to-diameter ratio for 90-degree elbow.
 - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, 14 Inches and Larger in Diameter: Segmented (gored) with standing seams or welded joints. Maximum 22.5 degree change in direction per segment (e.g. this requires a 5-segment elbow for a 90 degree change in direction, and elbows with less than 90-degree change of direction shall have proportionately fewer segments.)
- B. Branch Configuration: Unless explicitly noted otherwise on the Drawings, use the following branch-to-main connection types:
- 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connections."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry, except as indicated on the Drawings.
 - b. Rectangular Main to Round Branch: Flanged or spin-in bellmouth or conical tap.
 - 1) Where the height of the duct main is insufficient to permit a bellmouth or conical tap, provide a round-to-rectangular transition on the branch duct so that a rectangular 45 degree entry connection to the main duct can be made. The transition shall be to a height equal to the main duct

- height, and to a width as required to maintain equal or greater total flow area as the connecting round branch duct.
- 2) Plain, straight (e.g. constant diameter round) taps are not acceptable.
2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90-Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are only permitted for new branches on existing ducts.
 - a. Conical tap, 90-degree tee with oval-to-round tap, or 45-degree lateral tap. Plain taps are not permitted.
 - C. Rectangular Duct Divided Flow Branches: Type 1 or 2 of the referenced SMACNA Standard.
 - D. Vertical and Horizontal Offsets: Full duct dimensions shall be maintained. Use a pair of elbows complying with the above provisions. Elbows with the smallest number of degrees of change in direction that will possibly fit in the available space shall be used. Offset types shown the referenced SMACNA Standard are not acceptable.
 - E. Transitions: Changes in duct sizes shall be made with uniformly sloping transitions.
 1. Transitions from a larger to a smaller duct in the direction of flow in either duct depth or height shall have not more than a 45 degree angle parallel to the airflow for a one sided transition, or 22.5 degree angle for a two sided transition (i.e. 22.5 degrees on each side, for 45 degrees total).
 2. Transitions from a smaller duct to a larger duct in the direction of flow in either duct depth or height shall have not more than a 30 degree angle parallel to the airflow for a one sided transition, or 15 degree angle for a two sided transition (i.e. 15 degrees on each side, for 45 degrees total).

3.3 DUCT INSTALLATION, GENERAL

- 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. Construct and install each duct system for the specific duct pressure classification specified.
- C. Install round ducts in lengths not less than 12 feet, unless interrupted by fittings.
- D. All ductwork shall be constructed to be free from vibration, chatter, objectionable pulsations and leakage under specified operating conditions. Provide additional external reinforcement to prevent visible or audible vibration of the duct walls.
- E. Install ducts with fewest possible joints.

- F. Install fabricated fittings for changes in directions, changes in size and shape, and connections.
- G. Provide SMACNA small type, single-wall turning vanes in all mitered duct elbows, except for transfer ducts and other clean air ducts with design velocities less than 750 feet per minute. Note that vanes may not be explicitly shown on the Drawings for clarity purposes only.
- H. Install couplings tight to duct wall surface with a minimum of projections into duct.
- I. Install ducts, unless otherwise indicated, vertically and horizontally, parallel and perpendicular to building lines; avoid diagonal runs.
- J. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- K. Successfully pressure and leak test ductwork before applying external insulation.
- L. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- M. Where ductwork is to be lined with insulation, sizes indicated on the Drawings shall be interpreted as indicating clear dimensions inside the insulation. Adjust actual sheet metal dimensions accordingly. Shape and location of ducts may be changed to suit building conditions but cross-sectional area shall be maintained.
- N. Conceal ducts from view in finished spaces with ceilings. Do not encase horizontal runs in solid partitions, unless specifically indicated.
- O. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.
- P. Electrical Equipment Spaces: Route ductwork to avoid passing through electrical equipment spaces and enclosures. Ductwork not serving transformer vaults is prohibited in such spaces.
- Q. Non-Fire- or Smoke-Rated Partition Penetrations: Where ducts pass through interior partitions, conceal space between construction opening and duct or duct insulation with minimum 22 gauge galvanized steel sheet flanges/frames. Overlap opening on four sides by at least 1-1/2 inches and seal to wall with silicone caulk. Seal sheet metal frame to duct with duct sealant. Tightly pack the width and depth of the annular space between wall opening and duct with ASTM C 665 rock wool batt insulation, min 2.0 lbs./cu. ft. density.
- R. Fire-Rated Wall Penetrations: Where ducts pass through interior partitions and exterior walls, install an appropriately rated fire damper. Fire and smoke dampers are specified in Division 23 Section "Air Duct Accessories."
- S. Fire-Rated Shaft Penetrations: Where ducts pass through a fire-rated shaft enclosure, install an appropriately rated combination fire and smoke damper. Fire and smoke dampers are specified in Division 23 Section "Air Duct Accessories."

3.4 INDOOR AIR QUALITY MANAGEMENT DURING CONSTRUCTION

- A. Containment of Contaminants: The Contractor shall meet or exceed the control measures recommended by SMACNA "IAQ Guidelines for Occupied Buildings Under Construction", 2nd edition (2007) - ANSI/SMACNA 008-2008, in Chapters 3 and 4, to prevent construction dust and other contaminants from escaping the work area or contaminating new **[and existing]** HVAC systems and equipment.
- B. Protect stored on-site and installed absorptive materials from moisture damage.
- C. The Contractor shall protect new and existing duct and air system equipment (e.g. fans, AHUs, etc.) interiors from moisture, construction debris and dust, and other foreign materials. During ductwork system installation, keep open ends of ductwork and terminations at registers, grilles, VAV terminal units, and diffusers sealed off and closed with a polyethylene film to prevent entrance of dirt and debris. The film shall be Ductmate 'ProGuard', or approved equal. In addition, the Contractor shall take great care to thoroughly clean and wipe-down all HVAC system components and ductwork above prior and during installation.
 - 1. Comply with SMACNA "Duct Cleanliness for New Construction", 1st edition (2000), published as Appendix G of the SMACNA "IAQ Guidelines for Occupied Buildings Under Construction", 2nd edition (2007).
 - a. Comply with the requirements of "Advanced Level" cleanliness.
 - 2. Where new duct systems have not been wiped down before and during installation or where visual contaminants are found from a duct wipe-down observation by the Owner or Architect/ Engineer, after installation, the Contractor shall clean the entire ductwork system with a vacuum cleaning method in compliance with the requirements and recommendations found within NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems", 2013.
- D. HVAC System Start-Up: Delay the start-up of permanent ductwork systems until construction activities that generate large amounts of indoor or exterior airborne particulates have been completed. System startup shall be considered to be a process that involves operating the equipment and systems only as long as it necessary to verify proper operation and installation of the equipment, verification of connections, making adjustments and settings, testing controls, and conducting similar field quality control and commissioning efforts. Successful start-up does not grant the Contractor license to use the permanent systems for construction phase heating and cooling.
 - 1. Start-up of the permanent HVAC systems shall not occur prior to all of the following being met:
 - a. The duct systems being pressure tested and fully insulated and sealed.
 - b. All filters installed, including temporary supplemental filters described below.
 - c. Completion of all drywall sanding and similar dust-generating construction activities performed inside the building, and subsequent clean-up.
 - d. Completed and functioning condensate drainage traps and piping installations.

- e. Such time that the environmental conditions of the building under construction meet the factory warranty requirements /conditions of all installed HVAC equipment. Factory warranties and their obligations to the Owner which have been violated by the Contractor's use of equipment during construction shall become the responsibility of the Contractor for the original factory warranty duration and coverage.
- 2. Temporary Supplemental Filters: Operation of the permanent systems for any purpose prior to completion of final cleaning of the building by the General Contractor shall only occur with minimum ASHRAE 52.2 - MERV 10 filter media secured and sealed to each return or exhaust air grille, register, and open ended duct inlet. Filters shall be changed weekly, or more often as needed.
 - a. Outdoor air intakes require an equivalent treatment if outdoor construction activities involve site work generating airborne dust and dirt.
- E. Temporary / Construction-Phase HVAC Services: Do NOT utilize the permanent HVAC systems, or any portion thereof, to provide construction-phase heating, cooling, ventilation, exhaust, or dehumidification required by the construction process until the permanent systems are permitted to operate continuously, and outside of the start-up process, as defined below. Temporary systems shall be provided to meet all HVAC needs prior to that time. Temporary / construction-phase HVAC shall be provided by the General Contractor, unless Division 01 indicates otherwise.
 - 1. Changeover from temporary systems to the use of permanent HVAC system shall not occur prior to system start-up has been completed, subject to the conditions and restrictions placed on system start-up, as described above. The permanent system may not be capable of accommodating special conditions or loads created by ongoing construction processes (e.g. high latent loads created by painting), so supplemental temporary HVAC equipment shall be provided to meet those special needs and conditions.

3.5 SEAM AND JOINT SEALING

- A. General: Seal duct seams and joints according to the duct pressure classes and seal classes specified and as described in SMACNA's "HVAC Duct Construction Standards-Metal and Flexible", unless more restrictive requirements are indicated in this Section or in the Duct Construction Schedule on the Drawings.
- B. Seal and successfully pressure test externally insulated ducts before insulation installation.
- C. Seal duct seams and joints according to the Duct Construction Schedule on the Drawings, the referenced SMACNA standard, or this Section, whichever is most restrictive / demanding:
 - 1. For ducts where Seal Class A is indicated, seal transverse joints, longitudinal seams and wall penetrations (except for damper rod penetrations).
 - 2. For ducts where Seal Class B is indicated, seal transverse joints and longitudinal seams.

3. For ducts where Seal Class C is indicated, seal transverse joints only.
4. Regardless of the Seal Class specified, any joint, seam, or wall penetration through which air leakage makes an audible noise at a distance of 4 feet shall be sealed till the leakage is no longer audible.

3.6 HANGING AND SUPPORTING

- A. Unless otherwise indicated or specified, install rigid round and rectangular metal duct with support systems indicated in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
 1. Supporting ductwork and associated equipment from metal roof and floor decking is prohibited. All ductwork and associated equipment shall be supported from the building structural system.
 2. Ductwork shall be supported directly from the building's steel beams or from miscellaneous structural steel provided by the Division 23 Contractor bearing on steel beams.
 3. Loads supported by steel bar joists exceeding 100 lbs. shall be located at the joist panel points, and shall not impose an eccentric load (twisting moment). Provide supplemental steel and align direct hanger connections to the joists with the joist centerline. Connect to the upper chord of the joist wherever it is possible to do so.
 4. Do not drill or cut building structural steel.
- B. 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.
- C. Hanging ductwork from roof and floor decking in steel framed buildings is prohibited. All equipment shall be hung from building steel structural system (e.g. steel beams and joists).
 1. Ductwork shall be supported directly from the building's steel beams or from miscellaneous structural steel provided by the Division 23 Contractor bearing on steel beams.
 2. Loads supported by steel bar joists exceeding 100 lbs. shall be located at the joist panel points, and shall not impose an eccentric load (twisting moment). Provide supplemental steel and align direct hanger connections to the joists with the joist centerline. Connect to the upper chord of the joist wherever it is possible to do so.
 3. Supplemental steel deflections shall be limited to length/180 of the span.
- D. Fastener System Installation in Concrete Slab Construction:
 1. Install power-actuated fasteners for use in lightweight concrete or concrete slabs at least 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by power-actuated tool manufacturer. Install fasteners according to power-actuated tool manufacturer's operating manual.

2. Install drilled-in mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
 3. Anchor capacity used in design shall be based on the technical data published by the manufacturer or such other method as approved by the Architect and Structural Engineer of Record.
 4. Anchor capacity is dependent upon spacing between adjacent anchors and proximity of anchors to edge of concrete. Install anchors in accordance with the manufacturer's recommended spacing and edge clearances.
 5. Reinforcing bars in the concrete structure may conflict with specific anchor locations. Exercise care to avoid damaging existing reinforcing or embedded items. The Contractor shall review the structural drawings and shall undertake to locate the position of the reinforcing bars near the locations of the concrete anchors, by Hilti 'Ferroskan, GPR', X-rays, or other non-invasive means approved by the Architect and Structural Engineer of Record. Notify the Architect and Structural Engineer of Record if reinforcing steel or other embedded items are encountered during drilling.
- E. Steel Cable Hanger Systems Applications and Installation: Comply with all recommendations of the cable system manufacturer. Comply with all restrictions on the use of the system imposed by the SMACNA Testing and Research Institute to ensure full conformance with SMACNA standards and recommendations. System installers shall be site-trained in the use of the materials and tools by a manufacturer's representative prior to installing materials.
1. Use only on ducts with bare metal as the exterior, finished surface (e.g. uninsulated ducts, double wall ducts, and lined ducts).
 - a. Exception: Cable hanger systems may be used on ducts with exterior insulation when used as hangers for a channel trapeze support.
 2. Select cables and end connectors so that actual loads do not exceed 1/4 of the hanger system failure load. For cables hung at angles other than vertical, apply the required de-rating factor. Space hangers no more than 12 feet apart. Confirm engagement of cable locks prior to apply the load.
 3. Apply stress distribution corner guards on rectangular duct to prevent excessive cable stress and kinking or deformation of the ductwork.
 4. Material Applications:
 - a. Use galvanized steel cables on galvanized steel ducts.
 - b. Use stainless steel cables on aluminum and stainless steel ducts.
 5. Do not kink or deform cables or expose to sharp edges. Do not subject cables to a bending radius smaller than 1/4". Keep cables free of dirt, grease, and other lubricants.
 6. Do not use where the ducts are subject to dynamic loading either due to the presence of vibration or thrust force inducing equipment or asymmetrical outlet arrangements. Only use on static ducts. Restrain ducts from lateral movements using rigid hangers or by using multiple cables installed in opposing angles at a given support location (i.e. horseshoe or spread horseshoe hanger configuration). Do not use single point support methods.

7. Do not paint cable hangers. Any hangers that have been painted shall be replaced.

3.7 CONNECTIONS

- A. Connect equipment with flexible connectors according to Division 23 Section "Air Duct Accessories."
- B. For branch, outlet and inlet, and terminal unit connections, comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible", 2005, unless detailed otherwise on the Drawings.
- C. Make ductwork connections to curb-mounted rooftop equipment by extending ductwork to the top of the roof curb. Provide a duct transition as required to terminate the duct at the top of the curb with a size matching that of the mating duct connection opening on the curb and on the equipment. Provide neoprene gasket on the mating surfaces between the duct end or curb and the equipment.

3.8 PRESSURE AND LEAKAGE TESTS

- A. Disassemble, reassemble, and seal segments of systems as required to accommodate pressure and leakage testing and as required for compliance with test requirements.
- B. Conduct tests, in presence of the Architect / Engineer, at static pressures equal to maximum design pressure of system or section being tested. Do not pressurize systems above maximum design operating pressure. Give a minimum of seven (7) days' advance notice for testing. Test for leaks before applying external insulation. Where less than 100% of duct systems are specified below to be pressure tested, the Architect / Engineer reserves the right to select the particular portions of the duct systems to be tested. Pressure-test the following:

1. Indoor Ducts:

- a. No less than 25% of the total duct wall area of indoor ductwork with a pressure rating +2" w.g. or higher shall be pressure tested. This percentage requirement applies individually to each separate duct system associated with a given air handling unit, fan, etc.
- b. No less than 25% of the total duct wall area of indoor ductwork with a pressure rating of -2" w.g. or lower (i.e. more negative; e.g. -4" w.g.) shall be pressure tested. This percentage requirement applies individually to each individual duct system associated with a given air handling unit, fan, etc.
- c. Indoor ductwork with a pressure rating between -1" w.g. and +1" w.g. does not require pressure testing.

- 1) Exception: 100% of all ductwork located in shafts, chases, tunnels, crawlspaces, or attics shall be pressure tested.

- C. Determine leakage from entire system or section of system by relating leakage to surface area of test section.

- D. Inspect the pressurized ductwork for distortion or other physical damage that resulted from pressurizing the ductwork to the test level, and for audible leakage points. Repair and reinforce areas where physical damage occurred and seal all audible leaks, then perform a retest.
- E. Maximum Allowable Leakage:
 - 1. Round Ducts: Comply with requirements for Leakage Classification 4 for indoor ducts in pressure classification of 2-inch w.g. and lower, and Leakage Classification 2 for all outdoor ducts, and indoor ducts in pressure classification 3-inch w.g. and higher.
 - 2. Rectangular Ducts: Comply with Leakage Classification 8 for indoor ducts in pressure classification of 2-inch w.g. and lower, and Leakage Classification 4 for all outdoor ducts and indoor ducts in pressure classifications from 3-inch w.g. and higher.
 - 3. If a given duct test section fails, the Contractor shall:
 - a. Remake leaking joints and retest until leakage is less than maximum allowable for that test section.
 - b. Pressure-test an additional, previously untested section of ductwork that is of equal or greater surface area as the section that failed the initial pressure test. The Architect / Engineer shall select the additional duct test section(s).
- F. Leakage Test Method: Perform tests and report results according to Chapters 4 through 7 of the 2nd Edition (2012) of SMACNA's "HVAC Air Duct Leakage Test Manual" except where these specifications exceed or modify SMACNA requirements.

3.9 ADJUSTING

- A. Adjust volume-control dampers in ducts, outlets, and inlets to achieve design airflow.
- B. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for detailed procedures.

3.10 DUCT CLEANING

- A. Scope: Clean new and existing to remain duct systems within the project boundary before testing, adjusting, and balancing, and before operating any new air handling equipment.
 - 1. Clean the existing ducts to remain before new ductwork connections.
 - 2. Great care shall be taken so as not to damage the existing liner. The lowest amount of mechanical agitation that is effective shall be used.
- B. Duct Cleaning Contractor Qualifications: The duct cleaning shall be conducted by an HVAC system cleaning sub-contractor responsible to the Division 23 Contractor.
 - 1. Membership: The HVAC system cleaning sub-contractor shall be a member in good standing of the National Air Duct Cleaners Association (NADCA), or shall

- maintain membership in a nationally recognized non-profit industry organization dedicated to the cleaning of HVAC systems.
2. Certification: The HVAC system cleaning sub-contractor shall have a minimum of one (1) Air System Cleaning Specialist (ASCS) certified by NADCA on a full time basis, or shall have staff certified by a nationally recognized certification program and organization dedicated to the cleaning of HVAC systems.
 3. Supervisor Qualifications: A person certified as an ASCS by NADCA, or maintaining an equivalent certification by a nationally recognized program and organization, shall be responsible for the total work herein specified.
 4. Experience: The HVAC system cleaning sub-contractor shall submit records of experience in the field of HVAC system cleaning as requested by the Architect / Engineer or Owner.
- C. Standards: The cleaning work shall be performed in accordance with the requirements and recommendations of NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems", 2013. Level 1 containment controls shall be utilized.
1. Additionally, lined ductwork shall be cleaned in accordance with North American Insulation Manufacturers Association (NAIMA): "Cleaning Fibrous Glass Insulated Air Duct Systems," 2007.
- D. Use service openings for entry and inspection.
1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Division 23 Section "Air Duct Accessories" for access panels and doors.
 2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
 3. Remove and reinstall ceiling to gain access during the cleaning process.
- E. 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.
- F. 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, condensate drain pans, humidifiers, filters and filter sections, and condensate 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.

G. 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. 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.

H. Duct System Cleanliness Tests:

1. After cleaning, 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: The net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.
3. Duct system will be considered defective if it does not pass tests and inspections.
4. Prepare test and inspection reports.

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.
- B. Related Sections:
 - 1. Division 23 Section "Ductwork" for duct liner.
 - 2. Division 23 Section "Diffusers, Registers, and Grilles" for manual volume dampers that are integral to diffusers, registers, and grilles.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Backdraft dampers
 - 2. Manual-balancing volume control dampers
 - 3. Single wall turning vanes and vane rails
 - 4. General duty duct-mounted access doors
 - 5. Pressure relief doors
 - 6. Instrument test holes
 - 7. Flexible ducts
 - 8. Flexible connectors
 - 9. Duct accessory hardware
 - 10. Remote damper operators
 - 11. Flexible duct elbow braces

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loadings, required clearances, method of field assembly, components, location, and size of each field connection. Detail the following:
 - 1. Special fittings and manual-volume-damper installations.
 - 2. Fire-, smoke-, combination fire/smoke, and ceiling radiation damper installations, including sleeves and duct-mounted access doors and panels.

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. Also include locations of remote damper operators and instrument test holes for use by the Testing and Balancing Agent.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. NFPA Compliance: Comply with the following NFPA standards:
- B. Combustion Ratings. All duct accessory materials shall be equal to or less than the combustion ratings noted below when tested in accordance with ASTM E84, UL723 and NFPA 255.
 - 1. Flame Spread Classification: < 25
 - 2. Smoke Development Rating: < 50
- C. All duct accessories shall meet or exceed the SMACNA pressure class standards for the ductwork system in which they are installed, or the specified ratings, whichever are higher.
- D. Damper pressure drop and air leakage ratings shall be based on tests and procedures performed in accordance with AMCA 500-D.

1.7 COORDINATION

- A. Coordinate with the General Contractor the selection and installation of life safety dampers with the architectural assemblies in which they are installed, so that the damper maintains the fire and smoke resistance of the assembly per the UL listing, and the damper can be installed in full accordance with its own UL listing.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.

PART 2 - PRODUCTS

2.1 DAMPERS

A. General: The following general provisions apply to all dampers, unless noted otherwise:

1. Dampers shall be rated for no less than 2,000 feet per minute (fpm).
2. Dampers shall be pressure rated for no less than the system pressure to which they are connected, or the specified rating herein, whichever is higher.
3. Nominal damper dimensions shall match the connecting ductwork size indicated.
4. Contractor shop-fabricated dampers are not acceptable. Dampers shall be factory fabricated by one of the manufacturers listed herein.
5. Dampers shall have flanged or slip end connections. 'In-duct' type installations are not acceptable.

B. Backdraft Dampers:

1. Standard-Construction Backdraft / Barometric Relief Dampers: Factory made of minimum .050" extruded 6063-T5 aluminum blades supported on aluminum, stainless steel, or zinc plated steel rods (axles), in nylon or Celcon® bearings, set in minimum .060" 6065-T5 extruded aluminum frame. Blades shall be fitted with mechanically fastened extruded silicone or vinyl seals on contact edges to prevent noise. Aluminum and zinc-plated steel linkage hardware shall installed in the side of the frame. Damper assembly shall be provided with an adjustable counter-balance device adjusted to assist closing or opening as indicated or required by the application. Counterweight shall permit the start of opening with as little as 0.01" w.g. differential pressure.
 - a. Fans and gravity ventilators equipped with backdraft dampers shall be furnished with dampers conforming to the requirements of this specification, and shall be furnished with dampers no smaller than the full size of the connecting collar.
 - b. Dampers shall be suitable for up to 3" w.g. system pressure and 1,500 fpm velocity. Provide multiple dampers mulled together to form backdraft dampers with blade widths accommodating these pressure and velocity rating requirements.
 - c. Static pressure drop at 1,500 fpm face velocity shall not exceed 0.25" w.g. when tested in accordance with AMCA 500D in the 24"x24" size.
 - d. Dampers shall not have a leakage rate exceeding 10 cfm/sq.ft. at 1.0" w.g. differential pressure when tested in accordance with AMCA 500D in the 24"x24" size.
 - e. Damper shall be TAMCO Series '7000CW / 7000WT', or approved equal.

C. Standard-Construction Rectangular (Manual Balancing) Volume Control Dampers:

1. Volume control dampers shall be of the factory fabricated opposed blade, multi-blade type, controlled from a single point using linkages and a manual, locking quadrant.. On insulated ducts, the quadrant shall have a minimum 2" standoff bracket (or as otherwise required to accommodate the specified insulation thickness and permit damper operation without insulation damage). Dampers

shall be mounted in minimum 16 gauge roll formed galvanized steel channel frames with corner reinforcements. Blades shall be minimum 18 gauge galvanized roll-formed steel with a triple-V profile. Damper axles shall be 1/2" diameter plated steel, square or hex type, and the bearings shall be bronze or stainless steel oilite. Adjusting devices shall have locking mechanisms and shall be accessible. Damper shall be suitable for up to 2,000 fpm and 3.0" w.g. system pressure. Quadrants shall be oriented so that when the handle is parallel to the direction of airflow, the damper shall be fully open.

- a. At the Contractor's option, for rectangular dampers no taller than 12" on systems specified with a pressure rating of 2" w.g. or less, and exposed to velocity no greater than 2,000 fpm, a single blade type damper complying with all other provisions indicated above may be provided, however the bearings (including the end bearing) are permitted to be synthetic, and the frame and blades may be as thin as 18 and 20 gauge, respectively.

D. Standard-Construction Round (Manual Balancing) Volume Control Dampers:

1. Factory fabricated, single blade, center pivoted, constructed of galvanized sheet steel, minimum 22 gauge blade and frame for diameters up to 12", and minimum 20 gauge blade and frame for diameters larger than 12". Damper shall be controlled from a single point with a manual locking quadrant, and the opposite end shall be fitted with an end bearing support (i.e. no cantilevered dampers). On insulated ducts, the quadrant shall have a minimum 2" standoff bracket (or as otherwise required to accommodate the specified insulation thickness and permit damper operation without insulation damage). Axle shall be 1/4" square or hex shaped, plated steel, and the bearings shall be synthetic or brass. Damper shall be suitable for up to 2,000 fpm and 2.0" w.g. system pressure. Quadrants shall be oriented so that when the handle is parallel to the direction of airflow, the damper shall be fully open.
 - a. For systems with a specified pressure class above 2" w.g. and up to 3" w.g., the Contractor shall provide one of the following:
 - 1) Provide a square, multi-blade damper as specified above with a pair of square to round transitions. The height and width of the square damper shall match the round duct diameter indicated.
 - 2) Provide a round damper with a pressure rating meeting or exceeding the specified pressure class of the connected duct system.

E. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Backdraft Dampers:
 - a. Air Balance Inc.
 - b. American Warming & Ventilating (AWV)
 - c. Arrow United Industries, Inc.
 - d. Greenheck Fan Corp.
 - e. Ruskin Company
 - f. Pottorff

- g. Cesco Products, Div. of Mestek Inc.
- h. TAMCO, T.A. Morrison and Co. Inc.

2. Manual Balancing Volume Control Dampers:

- a. Air Balance Inc.
- b. American Warming & Ventilating (AWV)
- c. Louvers and Dampers, Inc.
- d. NCA Manufacturing.
- e. United McGill Corp.
- f. Ruskin Company
- g. Pottorff
- h. Cesco Products, Div. of Mestek Inc.
- i. TAMCO, T.A. Morrison and Co. Inc.

2.2 FLEXIBLE DUCTS

- A. General: Use of flexible air ducts shall be permitted for connecting air diffusers to metal ducts. Flexible duct individual lengths shall not exceed 6 feet, or as indicated on the Drawings, whichever is less. Ducts shall be suspended with band hangers to prevent sagging and kinking, and as required by the Air Diffusion Council (ADC) Publication "Flexible Duct Performance And Installation Standards", 5th Edition. Flexible ducts shall be listed by Underwriters' Laboratories under UL 181 as a Class I flexible air duct material and shall comply with NFPA Standard 90A.
- B. Construction: Flexible ducts shall be a factory fabricated assembly consisting of a polymeric or two-ply polyester liner duct (core) bonded permanently to a coated spring steel wire helix supporting a fiberglass insulating blanket and covered with a fiberglass scrim-reinforced metalized film vapor barrier laminate. The outer vapor barrier shall have a permeance rating no greater than 0.05 perms per ASTM E96, Method A. Insulation value shall be no less than R-6. Ducts shall be suitable for no less than 140 deg. F. continuous operating temperature, 5,000 FPM air velocity, and +6" w.g. static pressure in all sizes up to 16" flow area diameter. All materials shall be fire and smoke rated for installation within a return air plenum.
- C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Thermaflex (Type 'M-KE' or 'M-KC').
 - 2. Flexmaster USA, Inc. (Type '6M').
 - 3. JP Lamborn Co. (JPL) (Type 'MHP-50')
 - 4. Atco Rubber Products Inc. (Types '036' or '039')

2.3 SINGLE WALL TURNING VANES AND VANE RAILS

- A. Turning vanes shall be installed at each mitered elbow of all square or rectangular ductwork, and shall be of sizes to suit ductwork. Vanes shall be set in factory-fabricated vane rails. Turning vanes and vane rails shall be aluminum, stainless steel, or galvanized steel, and shall match the ductwork material in which they are installed.

- B. Turning vanes shall be of the single wall (single-thickness) type, with hemmed ends on the upstream side, and lacking extended trailing ends. Turning vanes shall be factory- or shop- fabricated in accordance with Figure 4-3 and Figure 4-4 of the SMACNA "HVAC Duct Construction Standards, Metal and Flexible", 3rd edition (2005). Vane material shall be no less than 0.029-inch thick (22 gauge), and shall be suitable for no less than 2,500 feet per minute air velocity. Use SMACNA "Small" vanes (2" radius at 1.5" spacing) for all duct widths. For vanes longer than 36", install in multiple sections with the runners fastened together, or provide a tie rod secured to the vanes at mid-span.
- C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. Duro Dyne Inc.
 - 3. C.L. Ward LLC
 - 4. Sheet Metal Connectors Inc.

2.4 DUCT ACCESS DOORS

- A. General Duty Duct Access Doors: Furnish and install access doors and frames to permit inspection, operation and maintenance of devices concealed behind the sheet metal work. Provide duct access doors of insulated double wall construction, not less than 24 gauge, galvanized steel. Provide doors and frames constructed of aluminum or stainless steel, in lieu of galvanized steel, where required to match the ductwork. Insulation shall be 1-1/2 PCF fiberglass, no less than 1" thick. Where ducts are uninsulated, insulation in access doors may be omitted.
 - 1. Light Duty Doors: Systems specified for 2" w.g. and SMACNA Seal Class B or C, or lower, shall utilize a double-cam or piano hinge-and-cam, square-framed access door. Doors may be either factory-fabricated or shop-fabricated. Doors shall be fitted with foam rubber gaskets around their entire perimeter, at both the door to frame junction, and where the frame meets the duct wall. Frames shall be secured to the duct using bend-back tabs and sheet metal screws.
 - a. Construct doors in accordance with Figure 7-2 of the SMACNA "HVAC Duct Construction Standards, Metal & Flexible" Third Edition (2005).
 - b. Sizing: Provide duct access doors no smaller than 18" x 18". Provide ducts smaller than 20" in height with access doors two (2) inches less in height than the height of the duct. In such cases, the length of the door shall be 18".
 - c. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Arrow United Industries
 - 2) Ductmate Industries
 - 3) Duro Dyne Inc.
 - 4) Flexmaster USA
 - 5) Pottorff
 - 6) Ruskin
 - 7) Ward Industries; a Div. of Hart and Cooley Inc.

- B. Duct Pressure-Relief Doors: Frames shall be Z-shaped, minimum 12 gauge galvanized steel with piano hinge on one side. The door panel shall be constructed of minimum 12 gauge galvanized steel. The door shall have a polyurethane foam or neoprene seal on all four sides and shall be provided with 1" thick insulation.
1. Automatic Opening: The door shall be automatically closed upon relief of pressure by stainless steel springs. The release mechanism and closure springs shall be out of the airstream. Relief opening action shall be under positive or negative pressure as required for the application. Doors shall open outward for positive-pressure ducts and inward for negative-pressure ducts.
 2. Factory Pressure Relief Settings: Relief doors shall be factory set and tested to open at **+2" w.g.**
 3. Airflow and Leakage Performance: A door sized at 18"x18" shall relieve 8,000 cfm at a differential pressure of 3" w.g. Leakage of this same size door shall not exceed 40 cfm at a differential pressure of 6" w.g.
 4. Pressure relief doors shall be Ruskin PRD / NRD series or approved equal by Greenheck or Pottorff.

2.5 ACCESSORY HARDWARE

- A. Fasteners and other hardware used to fasten duct accessories that penetrate duct walls shall utilize gasket-backed sealing washers.
- B. Instrument Test Holes: Cast iron, cast zinc alloy, cast bronze, or cast aluminum to suit duct material, including cap, base flange with screw holes and adhesive-backed gasket. Size (diameter) to allow insertion of pitot tube and other testing instruments, and length to suit duct insulation thickness. The cap shall screw-on, or shall use an expansion mechanism. Coordinate quantities and locations with the Testing, Adjusting and Balancing Agent.
1. Screw fasteners shall be galvanized on galvanized steel ducts.
- C. Indoor Duct End Screens: Provide screens on all duct end openings located indoors that are not fitted with a grille. Also provide safety screens meeting OSHA requirements for protection of maintenance personnel on all fan inlets and fan outlets to which no ductwork is connected.
1. Screens shall be No. 16 gage, one half inch (1/2") mesh in removable steel frame. Frame and mesh shall be galvanized steel on galvanized ducts, and Type 304 stainless steel on stainless steel, aluminum, plastic, or plastic-coated ducts.

2.6 REMOTE DAMPER OPERATORS

- A. Description: 'Bowden'-type cable system designed for remote manual (i.e. non-motorized, non-automatic) balancing damper adjustment. The actuator mechanism and guide tubing (e.g. casing or sheath) shall be constructed of stainless steel, galvanized steel, brass, or aluminum, and the cable shall be stainless steel. The controller shall consist of a self-locking work gear assembly. The regulator connected to the damper shaft shall consist of a shaft connector hub, wire stop, angle bracket,

and casing coupling. The tubing and cable shall be up to 40 feet long, if required. The cable and housing shall be routed entirely outside of the airstream and compatible with manual balancing dampers specified elsewhere in this Section. Radial-type dampers furnished with the remote operator and the routing of actuator housing and cables inside the duct airstream are not acceptable.

1. Unless indicated otherwise on the Drawings, locate the operator above the nearest accessible lay-in tile ceiling. Provide a mounting bracket and secure to the building structure, or to a wall or wall stud. Provide labeling that indicates which specific diffuser, grille, etc. is associated with the operator. Labeling shall reflect the final room numbers being used by the Owner.
 2. Where no accessible ceiling is located within 40 feet of the damper, provide a recessed, round wall or ceiling mounting cup for the operator. The cup shall be steel or aluminum and shall have a round stainless steel cover plate no larger than 3" in diameter. Coordinate the locations with the Architect and show on the ductwork shop drawings and coordination drawings. In this installation, the regulator connected to the damper shaft shall consist of a self-locking work gear assembly.
 3. Furnish one (1) cable adjustment tool to the Owner, if the tool is proprietary.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Metropolitan Air Technology (MAT)
 2. Pottorff
 3. United Enertech
 4. Young Regulator Company

2.7 FLEXIBLE DUCT ELBOW SUPPORT BRACES

- A. Universal-mount, 1-piece, fully adjustable, radius-forming brace to support 4-inch through 16-inch diameter flexible air ducts.
1. Classified: UL 2043.
 2. Material: 100 percent recycled copolymer polypropylene.
 3. Support Frame Radius: 8 inches.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Titus
 2. Build Right Products LLC
 3. Flexmaster USA
 4. Thermoflowtech

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details shown in SMACNA's "HVAC Duct Construction Standards, Metal and Flexible", 3rd Edition (2005), except as elsewhere modified by the project Specifications or Drawings.
- B. Install duct accessories of materials suited to duct materials. Unless otherwise noted, use galvanized-steel or aluminum accessories in galvanized-steel ducts.
- C. 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.]
- D. Dampers shall be selected so their static pressure ratings are no less than that specified for the connecting ductwork, and the damper velocity rating is no less than the design velocity of the duct section in which each damper is installed.
- E. Install remote cable damper operators to provide for remote manual volume damper adjustment where the dampers are not easily accessible through a lay-in tile ceiling.
- F. Instrument Test Holes: Provide test holes at fan inlets and outlets, in locations as required to measure pressure drops across each item in the system (e.g. outside air louvers, filters, fans, coils, intermediate points in duct runs, etc.), and elsewhere on ductwork as indicated or required for airflow testing, measuring, and balancing. Coordinate with the Testing and Balancing Agent performing the work of Division 23 Section "Testing Adjusting and Balancing for HVAC", and provide the quantity and size of test holes where directed by the Agent.
- G. Set dampers to fully open position before testing, adjusting, and balancing.
- H. Turning Vanes: Provide single wall turning vanes in all mitered duct elbows, except for transfer ducts and other clean air ducts with design velocities less than 750 feet per minute. Turning vanes and vane rails shall be aluminum, stainless steel, or galvanized steel, and shall match the ductwork material in which they are installed.
- I. General Duty Duct Access Door Installation: Install duct access doors on sides or bottom of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment.
 - 1. Where rectangular access doors are installed on round ducts constructed for 2" w.g. pressure class and less, provide a rectangular tap fitting to receive the rectangular door.
 - 2. Install doors at the following locations:
 - a. Both upstream and downstream of duct coils.
 - b. Downstream of VAV terminal unit coils.
 - c. Upstream from duct filters.
 - d. At outdoor-air intake plenums. Only side mounting is permitted.
 - e. At duct drain pans for duct humidifiers. Only side mounting is permitted.
 - f. Downstream from control dampers and backdraft dampers

- g. On discharge ductwork connected to equipment (in-line and cabinet fans, fan coil units, ducted cabinet heaters, blower coil units, water source heat pumps, ducted unit ventilators, make up air units, air handling units, etc.)
 - 1) All fans and fan-containing equipment shall have a minimum of one access door on the associated ductwork.
 - h. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links.
 - i. At each change in direction and at maximum 50-foot spacing.
 - j. Upstream from turning vanes.
 - k. Upstream of airflow measuring stations.
 - l. Upstream or downstream of other control devices requiring inspection.
 - m. Elsewhere as indicated or shown.
- J. Label access doors according to Division 23 Section "Identification for HVAC."
 - 1. Duct or plenum access doors for inspection and maintenance of fire, smoke, and combination fire/smoke dampers shall be labeled with letters not less than 1/2-inch in height that reads "FIRE/SMOKE DAMPER", "FIRE DAMPER", or "SMOKE DAMPER", as appropriate in accordance with the International Mechanical Code.
- K. Flexible Duct Installation:
 - 1. Install in accordance with Air Diffusion Council (ADC) Publication "Flexible Duct Performance And Installation Standards", 5th Edition.
 - 2. Install flexible duct with a maximum of one 90-degree bend, with a minimum of 1 duct diameter inner bend radius using a flexible duct support brace. Use the minimum length of flexible duct to make connections. Excess length of flexible duct shall not be installed to allow for possible future relocations of diffusers. Install ducts extended to their fullest length without compression.
 - 3. Seal insulation at both ends to maintain insulation and vapor barrier continuity.
 - 4. Do not kink flexible ducts. Supports ducts with galvanized hangers to avoid sagging.
 - a. Hanger or saddle material in contact with flexible ducts shall be of sufficient width to prevent any restriction of the internal diameter of the duct when the weight of the supported section rests on the hanger or saddle material. In no case shall the material contacting the duct be less than 1-1/2" wide.
 - b. Maximum support spacing shall be 4 feet.
 - 5. Flexible ducts shall not be used on return and exhaust systems. All exhaust and return system connections to grilles and registers shall be made with hard duct connections.
 - 6. Exposed supply ductwork spaces shall have hard duct connections to diffusers and registers.
 - 7. Flexible duct connections to diffusers are only permitted above acoustical ceilings. Do not locate flexible duct above inaccessible (drywall) ceilings. For grilles and diffusers located in drywall ceilings, provide rigid sheet metal duct connections.

8. Connect flexible ducts to metal ducts and diffuser necks as follows:
 - a. Apply mastic approximately 2" wide uniformly around the collar of the metal fitting / duct end / diffuser neck. Mastic shall comply with UL Standard 181B and shall be marked "181B-M" on the container.
 - b. Slide at least 2" of the flex duct core over the fitting or sleeve ends and past the bead (if present).
 - c. Secure core to collar with a galvanized or stainless steel worm gear clamp applied past the bead.
 - d. Pull jacket and insulation back over core ends. Tape jacket(s) with at least 2 wraps of tape. Tape shall comply with UL Standard 181B and shall be marked "181B-FX".
- L. Flexible Duct Elbow Support Brace Installation: All 90 degree elbows in flex ducts shall be made using flexible duct elbow support braces. Install in accordance with the manufacturer's recommendations and secure each end of the support brace to the flex duct using nylon cable ties. Do not overtighten, as to crush the flexible duct. Cut off and discard the excess from the cable tie ends. Hang the support brace from the structure above. Nylon ties shall be listed and labeled to standard UL 181B, and the fastener package shall be marked UL 181 B-C.

3.2 ADJUSTING

- A. Adjust duct accessories for proper settings.
- B. Adjust backdraft damper counter-balance devices to assist closing or opening as indicated or required.
- C. Adjust fire dampers for proper action.
- D. Final positioning of manual-volume dampers is specified in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.3 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, and verify that vanes do not move or rattle.
 5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 233300

SECTION 233400 - HVAC FANS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Division 23 Sections include the following:
 - 1. "Common Motor Requirements for HVAC Equipment" for general motor requirements.
 - 2. "Air Duct Accessories" for dampers and flexible duct connectors.

1.2 SUMMARY

- A. This Section includes the following types of fans that are not part of other equipment packages:
 - 1. Centrifugal ceiling exhaust cabinet fans
 - 2. Downblast centrifugal power roof ventilators

1.3 ACTION SUBMITTALS

- A. Product Data: Including specialties, accessories, and the following:
 - 1. Certified full range fan performance curves with system operating conditions indicated.
 - a. Fans shall be selected for the project's actual elevation above sea level unless noted otherwise on the Drawings.
 - b. Fans shall be selected for 70 degrees F. air, unless noted otherwise on the Drawings.
 - 2. Certified fan sound power ratings by octave band.
 - 3. Motor ratings and electrical characteristics plus motor and fan accessories.
 - 4. Materials thicknesses and finishes.
 - 5. Dampers, including housings, linkages, and operators.
 - 6. Roof curbs.
 - 7. Fan speed controllers.
- B. Shop Drawings: From manufacturer detailing equipment assemblies and indicating dimensions, weights, required clearances, components, and location and size of field connections.

- C. Wiring diagrams that detail power, signal, and control wiring. Differentiate between manufacturer-installed wiring and field- installed wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: For roof penetration requirements drawn accurately to scale for roof mounted fans. Show the following:
 - 1. Roof framing and support members relative to duct penetrations.
- B. Field quality control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For fans, for inclusion in Operating and Maintenance Manuals.
 - 1. Data shall include detailed instructions for bearing maintenance, including lubrication intervals, lubricant type, and procedures.

1.6 QUALITY ASSURANCE

- A. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal. All fans shall be AMCA rated for both sound and performance.
 - 1. Certify sound-power level ratings according to AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Comply with AMCA 311 and label fans with the AMCA-Certified Ratings Seal.
 - 2. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Comply with AMCA 211 and label fans with the AMCA-Certified Ratings Seal.
 - 3. Fans, except for power roof and wall ventilators, wall mounted propeller fans, and fans with motors smaller than 5 HP, shall have a fan efficiency grade (FEG) of no less than 67, when tested in accordance with AMCA 205 "Energy Efficiency Classification for Fans", and shall have a design point efficiency within 15 percentage points of the maximum total efficiency, in compliance with the 2018 International Energy Conservation Code.
- B. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.
- C. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code".
- D. Bearing fatigue life / ratings and the term "air handling quality" shall be as defined by the American Bearing Manufacturers Association (AMBA).

- E. UL Standards: All fans shall be listed to UL 705.
- F. NRCA Compliance: Roof curbs for roof-mounted fans shall be constructed according to recommendations of NRCA.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Lift and support units with the manufacturer's designated lifting or supporting points.
- B. Deliver fan units as a factory-assembled unit to the extent allowable by shipping limitations, with protective crating and covering.
- C. While in storage and after installation but before system startup, when recommended by the fan manufacturer, inspect and maintain fans once per month. Keep a record of inspection and maintenance performed. At each inspection, rotate the fan wheels by hand to re-distribute lubricant and alter the static bearing load.

1.8 SEQUENCING, SCHEDULING, AND COORDINATION

- A. Coordinate the installation of roof curbs, equipment supports, and roof penetrations.
- B. Coordinate fan motor size, starter type, local disconnecting means, voltage, and phase with the Division 26 Contractor.

1.9 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL IN-LINE CABINET FANS

- A. General: Provide ceiling exhaust fans at locations shown. Provide accessories specified herein and indicated or scheduled on the Drawings.
- B. Housing: Acoustically insulated, galvanized steel, with duct collars for horizontal the inlet and outlet duct connections.
- C. Integral Backdraft Damper: Aluminum.
- D. Fan: Centrifugal double inlet / double width fan wheel, constructed of galvanized steel, polypropylene, or aluminum, with the fan inlets perpendicular to and remote from inlet grille, with direct drive EC-type motor.

1.

2. Direct drive units shall have electrically commutated (EC) type motors with:
 - a. Integral speed adjustment dial for use by the TAB Agent during balancing.
 - b. Remote speed adjustment dial, remote wall mounted in a single gang junction box, for use by the space occupants.
 - c. Automatic on/off and speed control from a remote 0-10 VDC control signal.
 - d. control signal from BAS.
- E. Efficacy: Fans with motors smaller than 1/12 HP shall a minimum efficacy of 3.8 cfm/watt, when tested in accordance with HVI 916 at 0.2" w.g. static pressure.
- F. Electrical: Terminal box on housing with disconnect switch.
- G. Accessories:
 1. Exterior Wall Discharge Hood: Aluminum wall cap with birdscreen and integral backdraft damper.
- H. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Cook (Loren) Co. (Series Gemini - GN)
 2. Greenheck Fan Corp. (Series CSP)
 3. Twin City Fan & Blower (Series T/TL)

2.2 CENTRIFUGAL POWER ROOF VENTILATORS

- A. General: Provide power roof ventilators and prefabricated curbs of types, sizes and capacities scheduled on the Drawings. Provide accessories specified herein and indicated or scheduled on the Drawings.
- B. Wind Resistance: The fan, base, and curb assembly shall be factory-engineered and tested to resist wind loads in accordance with the 2018 International Building Code and ASCE Standard 7 (2016), as per the project location, Exposure Category B, and a Building Risk Category of II, without the use of supplemental straps or hold downs.
 1. Fans shall resist the greater of the following:
 - a. 3-Second Gust Design Wind Speed per ASCE Std. 7.
 - b. 16 lb./sq. ft. multiplied by maximum area of equipment projected on vertical plane normal to wind direction, and 45 degrees either side of normal.
 2. Fans that have been approved for use in Miami-Dade County, with a current NOA number, having successfully passed TAS 202 (Uniform Static Air Pressure Test), are also acceptable for meeting the wind resistance provisions above.
- C. Factory-built Roof Curbs: Constructed of aluminum or galvanized steel with rigid fiberglass insulation, wood nailer and counter-flashing. Minimum height of curb shall be 16" unless noted otherwise. Constructed to conform with roof slope and arranged so

that the roof ventilator is installed level. Refer to the Article "Roof Curbs" in this Section for additional requirements.

- D. Motors: Heavy duty permanently lubricated, sealed ball bearings, suitable for continuous service, electrical characteristics shown on the drawings. Motors shall be selected to be non-overloading on any point on the fan curve.
1. Each unit shall be provided with a factory mounted and wired disconnect switch. The switch shall be external to the fan housing in a NEMA 3R enclosure or shall be NEMA 1 and mounted in a weatherproof housing.
 2. Direct drive units shall have electrically commutated (EC) type motors with:
 - a. Integral speed adjustment dial for use by the TAB Agent during balancing.
 - b. Remote speed adjustment dial, remote wall mounted in a single gang junction box, for use by the space occupants.
 - c. Automatic on/off and speed control from a remote 0-10 VDC control signal.
- E. Fan, Motor, and Drive Assembly: The entire drive assembly, motor, and fan wheel shall be removable through the support structure without dismantling the fan housing. The wheel shaft shall be mounted in heavy duty ball bearings. Bearings shall be selected for a minimum (L10) life in excess of 100,000 hours at maximum cataloged operating speeds. The entire assembly shall be mounted on rubber vibration isolators.
- F. Dampers: Provide motorized or backdraft dampers as indicated on the Drawings. Backdraft dampers shall be as specified in Division 23 Section, "Air Duct Accessories". Motorized dampers are specified in Section 230900. Set dampers in the curb damper tray with fasteners of a material matching the damper.
- G. Type "RE" Downblast Power Roof Ventilators: Fabricated from heavy gauge spun aluminum with hood (shroud) removable for service access; direct-driven as scheduled on the Drawings; spun aluminum dome top with outlet baffle; centrifugal fan; square one-piece hinged aluminum base with restraining cables (for cleaning and damper access) with venturi inlet cone and birdscreen. The hood shall have tie down brackets for attachment of wind restraints. Ventilators shall be completely weatherproof and securely sealed and fastened to the roof curb.
1. Fan supporting framework shall be constructed of galvanized steel or aluminum members.
 2. Fan wheels shall be nonoverloading, quiet-operating, statically and dynamically balanced. Fan shall be mounted on vibration eliminators.
 3. Fan shafts shall be provided with an anti-corrosion coating.
 4. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Aerovent (Series ACXD)
 - b. Cook (Loren) Co. (Series ACED).
 - c. Greenheck Fan Corp. (Series G).
 - d. Twin City Fan & Blower (Series DCRD).

2.3 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "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.

2.4 ROOF CURBS

- A. Materials: Unless specified otherwise elsewhere in this Section, provide a minimum 16-gauge galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with National Roofing Contractors Association (NRCA) standards. Gasketing shall be provided for field mounting between the unit base and the roof curb. Curbs shall be assembled on the roof prior to unit shipment. The roof curbs shall be perimeter type with complete perimeter support of the unit. Curbs shall be constructed to accommodate the unit ductwork connections and recognize the roof slope and render the top of the curb flat and plumb in each direction. Curbs shall be laterally stable with internal bracing, and shall be constructed to resist the wind forces exerted on the curb by the supported equipment in a design wind as per the project conditions described in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment". Curbs shall be provided with a bottom flange suitable for securing the curb to the roof deck / building structural system in order to resist the design wind loads.
1. Curb Insulation and Adhesive: Comply with NFPA 90A.
 - a. Materials: Fibrous glass duct lining type insulation complying with ASTM C 1071, Type I or II.
 - b. Thickness: 2 inches.
 - c. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.
 - 1) Liner Adhesive: Comply with ASTM C 916, Type I.
 - 2) 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 cabinet.
 - 3) Liner materials applied in this location shall have air-stream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service air velocity.
 - 4) Liner Adhesive: Comply with ASTM C 916, Type I.
 2. Curb Height: Minimum 24 inches, unless a greater height is specified elsewhere.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for installation tolerances, housekeeping pads, and other conditions affecting performance of fans.
- B. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Install fans level and plumb, in accordance with manufacturer's written instructions.
- B. Install unit to permit access for maintenance.
- C. Install parts and accessories shipped loose.
- D. Roof Curb: Install on roof structure, level and secure, according to NRCA's "Low-Slope Membrane Roofing Construction Details Manual," Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts." Install units on curbs and coordinate roof penetrations and flashing with roof construction specified in applicable Division 07 Sections. Secure units to the curb, and secure the curb base flange to roof framing with anchor bolts and supplemental steel members. The installation shall provide the wind resistance required by the International Building Code and Division 23 Section "Hangers and Supports for HVAC".
 - 1. Install roof curbs in such manner as maintain roof bond.
 - 2. Provide roof opening, flashing, counter-flashing, sealant, roof insulation and structural framing members.
 - 3. Secure units to roof curbs with stainless steel hardware.
 - 4. Provide soft neoprene gasketing between the unit base and the top of the curb.
 - 5. If building roof insulation has been omitted on the roof deck inside the area surrounded by the curb, provide nominal 6" thick (R-19) fiberglass batt insulation with a vapor retarding foil-scrim-kraft (FSK) facing on the roof deck inside the curb. The FSK facing shall be in contact with the deck and shall be stapled and taped to the inside wall of the curb and sealed / taped to all penetrating items (ducts, piping, conduit, etc.).
- E. Arrange installation of units to provide access space around fans for service and maintenance.
- F. Label units according to requirements specified in Section 230553 "Identification for HVAC."

3.3 CONNECTIONS

- A. Duct installations and connections are specified in Division 23 Section "Ductwork".

- B. Provide flexible duct connectors on duct connections to fans as specified in Division 23 Section "Air Duct Accessories", except where specifically prohibited.
- C. Install ducts adjacent to power ventilators to allow service and maintenance.
- D. Connect wiring and ground equipment according to applicable Division 26 provisions.

3.4 ADJUSTING AND CLEANING

- A. Adjust damper linkages for proper damper operation.
- B. For direct drive fans, set VFD operating speed or adjust the ECM motor dial or speed controller as required to achieve design airflow.
- C. Lubricate bearings.
- D. Clean unit interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheel and cabinet.
- E. For coated, or paint finished fans, inspect the coating or paint finish for chips, scratches, and abrasions of the finish. Repair damaged finish as recommended by the fan manufacturer using a coating equal in performance to, with an equal or greater dry film thickness as, the factory-applied finish.

3.5 FIELD QUALITY CONTROL

- A. Final Checks Before Start-Up: Perform the following operations and checks before start-up:
 - 1. Remove shipping blocking and bracing.
 - 2. Verify unit is secure on mountings and supporting devices and that connections for piping, ductwork, and electrical are complete. Verify proper thermal overload protection is installed in motors, starters, and disconnects.
 - 3. Perform cleaning and adjusting specified in this Section.
 - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearings operations.
 - 5. Lubricate bearings and other moving parts with factory-recommended lubricants.
 - 6. Disable automatic temperature control operators.
- B. Starting procedures for fans:
 - 1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated RPM.
 - 2. Measure and record motor electrical values for voltage and amperage.
- C. Shut unit down and reconnect automatic temperature control operators.
- D. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for procedures for fan testing, adjusting, and balancing.

3.6 DEMONSTRATION

A. Demonstration Services: Train Owner's maintenance personnel on the following:

1. Procedures and schedules related to start-up and shutdown, troubleshooting, servicing, preventative maintenance, and how to obtain replacement parts.
2. Familiarization with contents of Operating and Maintenance Manuals.

B. Schedule training with at least 7 days' advance notice.

END OF SECTION 233400

SECTION 233600 - AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Single duct shutoff air terminals for supply air service

1.3 ACTION SUBMITTALS

- A. Product Data: Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories for each model indicated. Include a schedule showing drawing designation, room location, number furnished, model number, size, and accessories furnished.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.
 - a. Clearly indicate the load, voltage, phase, and number of wires (e.g. a requirement for a 3-wire vs. 4-wire vs. 5 connection, with or without a neutral wire).
 - 2. Hangers and supports, including methods for duct and building attachment and vibration isolation.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating air outlets with other items installed in ceilings.
- B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: List of parts for each type of air terminal and troubleshooting maintenance guide to include in the maintenance manuals. Include instructions for resetting minimum and maximum air volumes and instructions for adjusting software set points.

1.6 QUALITY ASSURANCE

- A. Listing and Labeling: Provide electrically operated air terminals specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.
- B. NFPA Compliance: Install air terminals according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."
- C. Comply with NFPA 70 for electrical components and installation.
- D. UL: Electric heaters shall be listed in accordance with UL 1996.
- E. Testing Requirements: Test and rate air terminals according to AHRI 880, "Performance Rating of Air Terminals."
 - 1. Acoustical performance shall be adjusted for reverb test room end reflection.
 - 2. Identification: Label each air terminal with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and AHRI certification seal.

1.7 COORDINATION

- A. Controls Enclosure: Verify that the controls enclosure provided with the terminal units is of sufficient size to house controllers and damper actuator being provided under Division 23 Section "Instrumentation and Control for HVAC".
- B. Arrange the work to provide no less than 42" of service clearance in front of electric re-heat coil power and control panels, for the full width of the panel, or 30", whichever is larger, as per the requirements of the National Electric Code. Provide 48" of clearance between two panels facing each other.
- C. Coordinate with the Electrical Contractor the electrical connection requirements, including the load, voltage, phase, and number of wires (e.g. a requirement for a 3-wire vs. 4-wire vs. 5 connection, with or without a neutral wire) prior to releasing the equipment for production.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS

2.1 SINGLE DUCT SHUTOFF AIR TERMINAL UNITS FOR SUPPLY AIR SERVICE

- A. General: Provide single duct, pressure independent air terminal units of the sizes and capacities shown on the Drawings.
- B. Casing and Insulation: The unit casing shall be 22 gauge galvanized steel, rated for +6 inches w.g. positive pressure, and internally lined with 1" thick 1-1/2 PCF density fiberglass insulation which complies with UL 181 and NFPA 90A. Exposed insulation edges shall be coated with NFPA 90A approved sealant or sheet metal to prevent erosion. Insulation shall have flame spread and smoke development ratings not greater than 25 and 50 respectively (UL 723 and ASTM E84). Provide a sheet metal controls enclosure to house temperature controls and damper actuator, and hanger brackets for receiving threaded rod hangers.
- C. Access Panels / Doors: Unit casing shall have an access panel to facilitate access and servicing of internal mechanical components. Panels shall be of sufficient size for removal of the damper as a unit, and to access the upstream side of the heating coil for inspection and cleaning. The panel shall be fully removable by latches that do not require the use of tools.
- D. Damper: Heavy gauge metal, with shaft rotating in Delrin self-lubricating bearings. Shaft shall be marked on the end to indicate the damper blade position. The damper shall have a built-in stop to prevent overstroking and shall seal against a closed-cell foam gasket. The unit shall be capable of full shutoff and leakage through the damper at full shut off shall be less than 1% of the maximum rated airflow at 3" w.g. inlet static pressure. The damper shall be suitable for up to 6 inches. w.g. differential pressure without damage.
- E. Factory-Furnished Direct Digital Controls (DDC): A complete controls package including a programmable digital controller, space thermostat, damper actuators, discharge air sensor, and control wiring shall be furnished and installed at each terminal unit. Controllers and piloting space thermostat shall provide for pressure independent airflow control of the terminal, and analog control of an SCR controlled electric heating coil. Terminal units shall be factory furnished complete with a controls enclosure and multi-point center-averaging sensor with flow measurement and balancing taps to amplify velocity pressure signals and provide accurate flow sensing regardless of air inlet duct configuration. The sensor shall have not less than four (4) monitoring ports, and monitoring ports shall not be in series. Provide a control transformer at each terminal.
 - 1. The controller shall be a BACnet controller, BTL listed and certified as a VAV terminal unit application specific controller (i.e. B-ASC certification).

2. The control parameters, including minimum and maximum airflow setpoints (for both heating and cooling modes) and space temperature setpoints (for both occupied and unoccupied modes), shall be configurable and established using the space thermostat with the use of resident programming, and without the use of proprietary software or service tools.
 3. Furnish a copy to the Owner of the programming software tools, passwords, programming guides, and all other information and software required to permit possible future re-programming of the unit controllers and integration into a building-wide DDC system over an BACnet MS/TP network. Software and other electronic data shall be furnished on a DVD or USB flash memory drive
 4. Space Thermostats: Thermistor or RTD type with +/- 0.5 deg. F. accuracy, user space setpoint adjustment and LCD readout with keypad or touchscreen, temperature indication, and password protection.
 5. Damper Actuators: Electric, direct mount. NEMA 1 enclosure. 24VAC tri-state type. Damper actuators may be integral to the controller.
 - a. Stroke Time: Maximum 5 minutes end to end full stroke.
 - b. Control Input: 0-10 VDC
 6. Sequence of Operation with Modulating Reheat and Dual Minimum Airflow: On a fall in room temperature below the cooling setpoint, the VAV box damper shall modulate the airflow rate from the maximum down to the minimum cooling/deadband mode value. Once at this minimum airflow, on a further drop in space temperature below the heating setpoint, the heating output of the electric heating coil shall be modulated as required to maintain the desired space temperature while the unit operates at the heating mode airflow rate, which shall be 50% of peak cooling supply airflow rate, unless indicated otherwise on the Drawings. On a rise in space temperature, the reverse shall occur.
 7. Basis of Design: Titus 'Alpha' Controls
- F. Electric Resistance Heating Coils: Where indicated on the Drawings, provide electric heating coils on air terminals. Electric coils shall be supplied and installed by the terminal unit manufacturer. Coils shall be listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use. The plenum connecting the heater to the terminal unit shall be lined with insulation matching that of the terminal unit itself.
1. Heating Elements: Coiled resistance wire of 80 percent nickel and 20 percent chromium; supported by ceramic isolators and staggered for maximum heat transfer and element life.
 2. Wiring Connection: Single point electrical connection at the control panel. 3-phase units shall be delta-connected, with an appropriate control transformer and no requirement for a neutral wire for the operation of the heater or the controls.
 3. Control Panel: Unit mounted with a disconnecting means and both line and control terminal blocks and magnetic contactor. Disconnect switch shall be of the door-interlock type. Panel shall include contactor(s) and safety and operating controls required by the NEC and UL. Also include the following additional controls:
 - a. Solid-state stepless SCR/SSR controller receiving 0-10 VDC pilot signals from the factory furnished DDC controller.

- b. Airflow proving switch, wired to control panel, to cut off power to the heater upon a loss of airflow.
 - c. Pilot light.
 - d. Over-temperature Protection: Disk-type, automatically reset, thermal-cutout, safety device; serviceable through terminal box without removing heater from duct or unit.
 - e. Secondary Protection: Load-carrying, manually resettable thermal cutouts; factory wired. Fuses and cutouts that cannot be reset are not acceptable.
- G. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Titus ('ESV' Series)
 - 2. Kreuger HVAC
 - 3. Price Industries ('SDV' Series)
 - 4. Johnson Controls Inc.
 - 5. Trane
 - 6. Enviro-Tec
 - 7. Tuttle and Bailey
 - 8. Greenheck
 - 9. Daikin Applied

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install air terminals level and plumb, according to manufacturer's written instructions, rough-in drawings, original design, and referenced standards; and maintain sufficient clearance for normal service and maintenance. Support terminals separately from the connecting ductwork from overhead building structural steel. Do not support from ceiling grid or from the connecting ductwork. Comply with Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- B. Hang terminal units that do not contain fans using four (4) threaded rods and factory-installed terminal unit hanger brackets or minimum 22 gauge galvanized sheet metal strap hangers, secured to the unit casing with two (2) sheet metal screws each, one on the side and one on the bottom of the casing.
- C. Duct installations and connections are specified in Division 23 Section "Ductwork"
- D. Provide the manufacturer's recommended straight length of inlet ductwork on the primary air connection.
- E. Provide an access door on both sides of reheat coils for inspection and cleaning access. The access panel / door on the terminal unit casing may suffice for one of the two (2) required doors.

F. Identify units according to Division 23 Section "Identification for HVAC."

1. Identification: Label each air terminal with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type and rated capacity, and AHRI certification seal.
2. Mark the ceiling grids identifying the location of terminal units. In the case of fan powered terminals, also mark which ceiling tile should be removed for filter change-out.

3.2 CONNECTIONS

- A. Electrical: Comply with applicable requirements in Division 26 Electrical.
- B. 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.
- C. Set field-adjustable switches and circuit-breaker trip ranges.

3.3 CLEANING

- A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes.

3.4 FIELD QUALITY CONTROL

- A. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Verify that installation of each air terminal is according to the Contract Documents.
- C. Check that inlet duct connections are as recommended by air terminal manufacturer to achieve proper performance.
- D. Check that controls and control enclosure are accessible.
- E. Verify that control connections are complete.
- F. Check that nameplate and identification tag are visible.
- G. Verify that controls respond to inputs as specified.
- H. Calibrate the airflow controller and flow sensor at both design minimum and maximum airflow rates during air testing and balancing.

3.5 DEMONSTRATION

A. Train Owner's maintenance personnel as specified below:

1. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
2. Review data in the maintenance manuals.
3. Schedule training with Owner, through Architect, with at least 7 days' advance notice.

END OF SECTION 233600

SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 23 Section "Air Duct Accessories" for:
 - a. Manual balancing dampers that are not integral to diffusers, registers, and grilles.
 - 2. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for balancing diffusers, registers, and grilles. That Section also includes requirements for airflow pattern adjustments.

1.2 SUMMARY

- A. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles.

1.3 ACTION SUBMITTALS

- A. Diffuser Register and Grille Product Data: For each model indicated, include the following:
 - 1. Data Sheet: For each type of air outlet and inlet, and accessory furnished; indicate construction, finish, and mounting details.
 - 2. Performance Data: Include throw and drop, static-pressure drop, and noise ratings for each type of air outlet and inlet.
 - 3. Schedule of diffusers, registers, and grilles indicating drawing designation, room location, quantity, model number, size, and accessories furnished.
 - 4. Assembly Drawing: For each type of air outlet and inlet; indicate materials and methods of assembly of components.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans and wall elevations drawn to scale to show locations and coordination of diffusers, registers, and grilles with other items installed in ceilings and walls.

1.5 QUALITY ASSURANCE

- A. NFPA Compliance: Install diffusers, registers, and grilles according to NFPA 90A, "Standard for the Installation of Air-Conditioning and Ventilating Systems."
- B. Diffusers and grilles shall be tested in accordance with ANSI/ASHRAE Standard 70-2006.

PART 2 - PRODUCTS

2.1 DIFFUSERS

- A. General: Except as otherwise indicated, provide manufacturer's standard ceiling air diffusers where shown; of size, shape, capacity and type indicated; constructed of materials and components as specified and as required for complete installation.
- B. Product Names: Where specific product names are listed in this Section, but specific product names are also indicated on the Drawings for diffusers, registers, and grilles of a generally similar type, the Drawing model name indication shall take precedence.
- C. Performance: Provide ceiling air diffusers that have, as minimum, temperature and velocity traverses, throw and drop and noise criteria ratings for each size device as listed in manufacturer's current data.
- D. Ceiling Compatibility: Provide diffusers with border styles and accessory panels and frames that are compatible with adjacent ceiling systems and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction Drawings and specifications for types of ceiling systems which will contain each type of ceiling air diffuser.
 - 1. Where specified diffusers are smaller than the ceiling system module in which the diffusers are intended to be placed, provide mounting panels of appropriate dimensions to set the diffusers and fill in an entire ceiling system module, and to center the diffuser within the mounting panel. The mounting panel shall have a material of construction and finish matching that of the diffuser.
- E. Paint Finishes: Where painted finishes are specified, the color shall be factory standard white, unless indicated otherwise on the Drawings.
- F. Ceiling Diffusers, Modular, Square Plaque / Panel Type: Diffusers shall be of the 24 by 24 inch modular type, furnished with round sheet metal duct collar to match the neck sizes indicated on the Drawings, back pan and face panel constructed of steel, with baked enamel or anodic acrylic factory finish. The exposed surface of the face panel shall be smooth, flat, and free of visible fasteners or welds. The face panel is removable without tools from four (4) hanger brackets. Diffusers shall be designed for installation in a lay-in tile ceiling grid system or in a drywall ceiling with plaster frame accessory provided. Provide at each supply diffuser. Provide pattern control baffles to provide 1, 2, or 3-way throw patterns where indicated on the Drawings.

- G. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ceiling Diffusers, Modular, Square Plaque / Panel Type:

- a. Price Industries ('SPD' / 'ASPD' Series)
- b. Titus ('Omni / Omni-AA' Series).
- c. Krueger HVAC
- d. Tuttle and Bailey

2.2 REGISTERS AND GRILLES

- A. General: Except as otherwise indicated, provide manufacturer's standard registers and grilles where shown; of size, shape, capacity and type indicated; constructed of materials and components as specified and as required for complete installation.
- B. Product Names: Where specific product names are listed in this Section, but specific product names are also indicated on the Drawings for diffusers, registers, and grilles of a generally similar type, the Drawing model name indication shall take precedence.
- C. Performance: Provide registers and grilles that have, as minimum, temperature and velocity traverses, throw and drop and noise criteria ratings for each size device and listed in manufacturer's current data.
- D. Ceiling Compatibility: Provide registers and grilles with border styles and accessory panels and frames that are compatible with adjacent wall and ceiling systems and that are specifically manufactured to fit into wall and ceiling construction with accurate fit and adequate support. Refer to general construction Drawings and specifications for types of wall and ceiling construction which will contain each type of register and grille.
1. Where specified diffusers are smaller than the ceiling system module in which the diffusers are intended to be placed, provide mounting panels of appropriate dimensions to set the diffusers and fill in an entire ceiling system module, and to center the diffuser within the mounting panel. The mounting panel shall have a material of construction and finish matching that of the diffuser.
- E. Paint Finishes: Where painted finishes are specified, the color shall be factory standard white, unless indicated otherwise on the Drawings.
- F. Exhaust, Relief, Transfer and Return Air Bar Grilles and Registers:
1. Grilles and registers shall be securely attached and supported from associated ductwork or, where not duct connected, shall be attached and supported from the building structural system. Grilles and registers shall not be supported by ceilings of any type.
 2. Grilles and register faces shall have baked enamel or anodic acrylic factory painted finishes.
 3. Generally, grilles shall be fabricated from steel and have horizontal steel louvers, spaced 1/2" on centers and fixed at 35 degrees deflection.

4. Grilles mounted in wall construction where the bottom of the grille is at or below 5 feet, 6 inches above finished floor, , and where indicated on the Drawings, shall be heavy-duty bar type fabricated from steel with 16 gauge border and 14 gauge louvers, spaced 1/2" on centers and fixed at 30 to 38 degrees, single deflection. Rear, reinforcing support bars shall be spaced 6" on-center.
- G. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Exhaust, Relief, Transfer and Return Air Bar Grilles and Registers:
 - a. Price Industries ('535 / 635' Series)
 - b. Krueger HVAC
 - c. Titus '355RL' / '355FL' Series)
 - d. Tuttle and Bailey

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb, according to manufacturer's written instructions, Coordination Drawings, original design, and referenced standards.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of the panel. Where architectural features or other items conflict with installation, notify the Architect for a determination of final location. Support grilles registers and diffusers located in ceilings from overhead building structural steel or from ductwork. Do not support from ceiling system.
- C. Install diffusers, registers, and grilles with airtight connection to ducts and to allow service and maintenance of dampers.

3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC".

3.4 CLEANING

- A. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.

END OF SECTION 233713

SECTION 237200 - 100% OUTDOOR AIR ENERGY RECOVERY VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Packaged air-to-air energy recovery ventilators for indoor applications.

1.3 ACTION SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories. Include information for the following:
 - 1. Certified fan-performance curves with system operating conditions indicated.
 - 2. Certified fan-sound power ratings.
 - 3. Certified energy recovery heat exchanger performance ratings with system operating conditions indicated. Provide recommended frost control setpoints.
 - 4. Motor ratings and electrical characteristics plus motor and fan accessories.
 - 5. Material gages and finishes.
 - 6. Filters with performance characteristics.
 - 7. Dampers, including housings, linkages, and operators.
 - 8. Unit mounted temperature controllers and motor controllers.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, details, and attachments to other Work. For installed products indicated to comply with design loads, include structural analysis data.
 - 2. Design Calculations: Calculate requirements for selecting vibration isolators.
 - 3. Wiring Diagrams: Power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings, including floor plans and sections drawn to scale. Submit with Shop Drawings. Show duct and unit layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.

- B. Field quality-control test reports. This shall include start up reports and functional test reports. Submit completed manufacturer's startup checklists.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data for units to include in the operation and maintenance manuals, including wiring diagrams, start-up and operating sequence and material list shall be provided to the Owner. The owner shall be provided with complete instruction of operating and maintenance procedures.

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Energy recovery heat exchangers shall be tested and rated in accordance with ASHRAE Standard 84, Method of Testing Air-to-Air Heat Exchangers and AHRI Standard 1060, Rating Air-to-Air Energy Recovery Ventilation Equipment. Products that are not AHRI certified shall not be acceptable.
- C. UL Compliance: Packaged heat recovery ventilators shall comply with requirements in UL 1812, "Ducted Heat Recovery Ventilators".
- D. Fans, except for fans with motors smaller than 5 HP, shall have a fan efficiency grade (FEG) of no less than 67, when tested in accordance with AMCA 205 "Energy Efficiency Classification for Fans", and shall have a design point efficiency within 15 percentage points of the maximum total efficiency, in compliance with the 2018 International Energy Conservation Code.

1.7 COORDINATION

- A. Coordinate layout and installation of air-handling units with ductwork and with other installations.
- B. Coordinate motor starting and control requirements with Division 26 and the ATC system supplier / sub-contractor.
- C. Coordinate the supply voltage and phase of motors and other electrical connections with Division 26.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. The manufacturer shall deliver products to site on a factory-installed base rail or shipping skid and ship units by truck with minimum 7 mil poly shrink wrap enclosing the entire unit (covering unit openings only is not acceptable). Tarping alone is not acceptable.

- B. Follow manufacturer's recommendations for handling, unloading and storage.
- C. Lift and support units with manufacturer's designated lifting or supporting points.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of air-to-air energy recovery equipment that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Energy Recovery Heat Exchanger: Non-prorated for five (5) years.

1.10 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Filters: Furnish one spare set of filters for each filter bank in each unit.
 - 2. Fan Belts: Furnish one spare set of belts for each belt-driven fan in energy recovery units.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Units Incorporating Fiber / Paper-Based Total Energy Fixed-Plate Cross/Counter-Flow Heat Exchangers:
 - a. Aventus by XeteX
 - b. Dais Analytic / ConsERV
 - c. Greenheck
 - d. RenewAire

2.2 PACKAGED ENERGY RECOVERY VENTILATORS

- A. General: Provide packaged energy recovery ventilators to include energy recovery heat exchanger, supply air and exhaust air blowers, motors with and relays, outside and exhaust air filters, and adjustable defrost control.
- B. Base Construction: Unit shall have a welded structural steel base with structural supports under blowers and components. Frame shall be coated with rust inhibiting

paint. Lifting lugs shall be an integral part of the base. Unit floor shall be minimum 16 gauge galvanized steel.

- C. Cabinet Construction: Unit cabinet shall be of formed heavy gauge galvanized steel supports (18 gauge minimum). Outer panel skin shall be minimum 22 gauge galvanized steel sheet. Unit shall be completely insulated with minimum 1" thick, closed-cell or expanded R-6 foam insulation. All interior casing surface shall have solid minimum 24 gauge galvanized sheet metal liners completely enclosing insulation (i.e. double wall construction). Unit shall have a full length and width drain pan minimum 3" deep with FPT drains on supply and exhaust air plenums.
1. Provide access to all exchanger surfaces, blowers, motors, filters, through double wall gasketed access doors held closed by adjustable cam-lock latches. Continuous hollow rubber gasket shall be applied to all access openings to provide water and air-tight seals.
 2. Provide a motorized outside air shut-off damper and exhaust air adjustable counterweighted backdraft damper.
- D. Fiber-Based Total Energy Fixed Plate Cross/Counter-Flow Heat Exchanger: The enthalpy exchanger shall provide high performance sensible and latent transfer between the airstreams. This transfer shall be accomplished by moving energy (both sensible and latent) molecularly through the enthalpy exchanger surface by way of hygroscopic resins while keeping the airstreams physically separated. Exhaust and fresh airstreams shall travel at all times in separate passages, and airstreams shall not mix. "Porous plate" mechanisms are not acceptable. The air to air enthalpy exchanger shall be of the fixed plate type and have no moving parts or surface adhered desiccants. The unit shall be capable of both summer and winter operation with no condensation buildup or condensate management without preheat or outdoor air bypass, as long as the indoor relative humidity is below 40% and outdoor air temperatures are above -10 deg. F. Frosting shall result in no permanent damage to the heat exchanger core. The energy recovery core shall be designed and constructed to permit removal for servicing, replacement, or cleaning.
- E. Fans: Fans shall be forward curved DWDI for quiet efficient operation arranged in a draw through configuration relative to exchanger. Motors shall be efficient TEFC or ODP T-frame, 1750 rpm nominal with minimum service factor of 1.15 mounted on adjustable base. Motor and blower shall be mounted on common frame and isolated from unit case with rubber-in-shear type vibration isolators and flexible duct connections. Motors and blowers shall be direct drive with ECM type motors allowing for both preset speeds or variable speed operation with a 0-10-volt DC control signal..
- F. Electrical: Factory wired for a single point electrical connection at the voltage and phase indicated on the Drawings. Electrical controls shall include, fuses, control transformer for low voltage controls, service switch and terminal points. A main non-fused disconnect switch in a NEMA 1 enclosure shall be provided.
- G. Filters: Outdoor air and return/exhaust air filters shall be 2" thick pleated, 30 percent efficient, MERV 8, throwaway type. Filters shall be mounted within unit in galvanized holding frames upstream of exchanger and accessible through access panels.

1. Provide factory installed filter monitors (differential pressure switches) for each airstream.
- H. Dampers: Provided on each airstream to isolate the building from the exterior, formed from 16 gauge galvanized hat channel frames and blades with 1/2" cadmium plated shafts and bronze bearings. Low leakage dampers have vinyl blade seals and stainless steel jamb seals. Outside air damper be parallel blade type with 2-position overload proof direct coupled actuator. Exhaust air damper may be an adjustable counterweighted backdraft damper to be parallel blade with extruded aluminum blades and frame, low leakage type with silicone seals, in lieu of motorized
- I. Controls: Controls shall be factory installed in the unit. Provide the following:
 1. Starting relay, factory mounted and wired, and magnetic motor starter for field wiring, for each fan.
 2. Motorized isolation dampers on OA intake airstream shall be interlocked with the respective fan.
 3. Temperature Control for Fixed Plate Heat Exchangers: Internal outdoor air and/or exhaust air bypass dampers provided by the unit manufacturer shall be modulated to deliver the desired discharge (supply) air temperature.
 4. Frost Prevention: Achieved by outside air bypass Frost setpoint temperatures shall be based on the scheduled design air conditions shall be provided by the unit manufacturer.
 - a. Winter design supply and exhaust air conditions leaving the energy recovery device shall be provided by the unit manufacturer and shall include any de-rating in performance due to frost prevention measures.

2.3 MOTORS

- A. Refer to Division 23 Section "Common Motor Requirements for HVAC Equipment" for general requirements for factory-installed motors, including NEMA designation, temperature rating, service factor, and efficiency requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine installation location for compliance with requirements for conditions affecting installation and performance of units. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Examine casing insulation materials and filter media before air-to-air energy recovery equipment installation. Reject insulation materials and filter media that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for electrical services to verify actual locations of connections before installation.

3.2 INSTALLATION

- A. Install energy recovery units level and plumb, and in accordance with manufacturer's recommendations.
- B. Connect ducts so supply and exhaust airstreams flow in opposite directions.
- C. Suspended Units: Suspend units from structural-steel support frame using threaded steel rods.
- D. Install units with clearances for service and maintenance.
- E. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with new, clean filters at the time of turnover. Provide an additional set(s) of filters as described herein under "Extra Materials".

3.3 CONNECTIONS

- A. Drawings indicate general arrangement of ducts, fittings, and specialties. Make final duct connections with flexible connectors as specified in Division 23 Section "Air Duct Accessories."
- B. Comply with requirements for ductwork specified in Division 23 Section "Ductwork."

3.4 CLEANING

- A. After completing installation, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes including chips, scratches, and abrasions.
- B. Clean fan interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheels, cabinets, and coils entering air face.
- C. Prior to startup, provide final cleaning of air handling units to remove road debris from interior and exterior of unit. The interior airstream surfaces of the unit shall be oil and grease free and wiped clean with 50-50 mix of denatured alcohol and water.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect equipment installation, including ductwork and electrical connections. Report results in writing.
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3. Specific procedures shall include:
 - a. Verify that installation is as indicated and specified.
 - b. Complete manufacturer's installation and startup checks and perform the following:
 - 1) Inspect for visible damage to unit casing.
 - 2) Verify that clearances have been provided for servicing.
 - 3) Check that labels are clearly visible.
 - 4) Verify that controls are connected and operable.
 - 5) Remove shipping bolts, blocks, and tie-down straps.
 - 6) Verify that filters are installed.
 - c. Adjust vibration isolators.
 - d. Check operation of dampers.
 - e. Lubricate bearings on fan.
 - f. Check fan-wheel rotation for correct direction without vibration and binding.
 - g. Start unit according to manufacturer's written instructions.
 - h. Check and record performance of interlocks and protection devices; verify sequences.
 - i. Operate unit for an initial period as recommended or required by manufacturer.
 - j. Check internal isolators.
 - k. Check damper for proper stroke and interlocks.
- B. Remove malfunctioning units, replace with new units, and retest as specified above.

3.6 DEMONSTRATION AND TRAINING

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 237200

SECTION 237439 - PACKAGED, OUTDOOR, UNITARY AIR-CONDITIONERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Control equipment and sequence of operation are specified in Division 23 Section[s] "Instrumentation and Control for HVAC" and "Sequence of Operations for HVAC Controls".
- C. General wind restraint requirements are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment".

1.2 SUMMARY

- A. This Section includes packaged outdoor unitary air conditioners with the following components and accessories:
 - 1. Direct-expansion cooling.
 - 2. Gas furnace.
 - 3. Hot gas reheat coil.
 - 4. Economizer outdoor- and return-air damper section.
 - 5. Integral temperature controls.
 - 6. Roof curbs.

1.3 ACTION SUBMITTALS

- A. Product Data: Include manufacturer's technical data for each model indicated, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection. Prepare the following by or under the supervision of a qualified professional engineer:
 - 1. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.
 - 2. Detail mounting, securing, and flashing of unit to support frame or base. Indicate coordinating requirements with roof membrane system.
 - 3. Wiring Diagrams: Power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: 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. Duct and unit layout and relationships between components and adjacent structural and mechanical elements.
 - 2. Structural members to which units will be attached.
 - 3. Roof openings
 - 4. Roof curbs and flashing. Detail mounting, securing, and flashing of roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
- B. Condensate Traps: Prepare a schedule detailing the necessary trap dimensions (trap seal depth and net 'fall') for each unit, based on the predicted maximum static pressure in the cabinet at the location of each trap, including the effect of loaded filters. The schedule shall detail unit tag, unit size, appropriate trap schematic with the recommended trap dimensions, and unit supplied base rail height.
- C. Field Quality Control Test Reports: Include startup report and functional testing report indicating and interpreting test results relative to compliance with specified requirements. Indicate results of startup and testing requirements. Submit copies of checklists.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For rooftop air conditioners to include in emergency, operation, and maintenance manuals.
- B. Warranties: Special warranties specified in this Section.

1.6 QUALITY ASSURANCE

- A. Factory Engineering: Except where explicitly permitted by these Specifications or the Drawings, no field- or contractor shop-modifications of the factory-engineered equipment package will be acceptable. No modifications that affect the unit's UL listing will be acceptable. No modifications made in a 3rd party factory (i.e. one other than that of the equipment manufacturer) will be acceptable.
- 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. UL Compliance:
 - 1. Comply with UL 1995.
 - 2. Comply with UL 60335-2-40 for refrigerant leak detectors and controls.
- D. Comply with NFPA 70 for components and installation.

- E. NEMA Compliance: Provide motors required as part of air conditioning units that are listed and labeled by UL and comply with applicable NEMA standards.
- F. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Code for Mechanical Refrigeration."
- G. Energy-Efficiency Ratio: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."
- H. Coefficient of Performance: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."
- I. Comply with NFPA 54 for gas-fired furnace section.
- J. AHRI Certification: Units shall be AHRI certified and listed.
- K. AHRI Compliance:
 - 1. Comply with AHRI 210/240 or AHRI 340/360 for testing and rating energy efficiencies for packaged unitary equipment.
 - 2. Comply with AHRI 270 for testing and rating exterior sound performance.
 - 3. DX cooling and ratings shall be in accordance with AHRI-410.
- L. Comply with AMCA 320 for testing and rating sound performance of airstream fans.
- M. NRCA Compliance: Roof curbs for roof-mounted equipment shall be constructed according to recommendations of NRCA.

1.7 COORDINATION

- A. Coordinate installation of roof curbs, equipment supports, and roof penetrations.
- B. Coordinate layout and installation of units with piping, ductwork, and other installations.
- C. Coordinate the controls scope of work between the DDC system supplier and the factory control package specified with the unit.
- D. Coordinate the quantity, supply voltage, amperage, and phase of electrical connections with the Division 26 Contractor.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. The manufacturer shall deliver products to site on a factory-installed base rail or shipping skid and ship units by truck with 10 mil poly shrink wrap enclosing the entire unit (covering unit openings only is not acceptable).
- B. Lift and support units with manufacturer's designated lifting or supporting points.

1.9 WARRANTY

- A. General Warranty: The manufacturer shall warrant all equipment for a period of one (1) year from date of substantial completion. Extended warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Extended Warranty: Manufacturer's standard form in which manufacturer agrees to replace components of rooftop air conditioners that fail in materials or workmanship within specified warranty period.
 - 1. Extended Warranty Period for Compressors: Manufacturer's standard, but not less than five (5) years from date of Substantial Completion.
 - 2. Extended Warranty Period for Furnace Heat Exchangers: Manufacturer's standard, but not less than five (5) years from date of Substantial Completion.

1.10 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fan Belts: One (1) set for each belt-drive fan.
 - 2. Filters: Two (2) sets of filters for each unit.
 - 3. Provide an allowance for one sheave and one belt change for each unit during balancing procedures.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Carrier Corp. (BASIS OF DESIGN)
 - 2. Johnson Controls Inc. / York
 - 3. Trane, a Div. of Ingersoll Rand
 - 4. Tempmaster; a Division of Johnson Controls Inc.

2.2 OPERATING CONDITIONS

- A. Outdoor Ambient Temperature Tolerance Range:
 - 1. Construct the units to tolerate operation in an outdoor air temperature as high as 105 deg. F. Provide a high ambient package as required to accommodate this

range. De-rating below the scheduled capacity and efficiency is acceptable at the high ambient temperature.

- a. The outdoor ambient temperature for rating the unit capacity and efficiency shall be as scheduled on the Drawings or 105 deg. F., whichever is higher.

2.3 PACKAGED OUTDOOR UNITARY AIR CONDITIONING UNITS

- A. Provide packaged air conditioning units and control systems for exterior installations as shown and scheduled on the contract documents. The units shall be installed in accordance with this specification and perform at the specified conditions as scheduled.
- B. Units shall consist of insulated weather-tight casing with compressors, air-cooled condenser coil, condenser fans, evaporator coil, air filters, economizer, motors and unit controls and drives, and all other features specified herein or indicated on the Drawings.
 1. Unit shall be 100% factory run tested and fully charged with R-32 or R-454B refrigerant.
 - a. Equipment utilizing Class A2L refrigerants shall be listed and conform to UL 60335-2-40 or ASHRAE 15 (latest editions), whichever is more demanding, and shall include factory-provided, UL listed refrigerant leak detection systems and related controls and output devices (e.g. valves, relays, etc.) to produce the required automatic mitigation response by the system/equipment when a leak above the detection threshold limit value is detected. The Contractor shall field install any detection system control devices, refrigerant sensors, wiring, and conduit that is not factory installed.
 2. Unit shall have labels, decals, and/or tags to aid in the service of the unit and indicate caution areas.
 3. Units shall be dedicated down-flow as indicated on the Drawings.
 4. Wiring internal to the unit shall be colored and numbered for identification.
- C. Cabinet: Galvanized steel, phosphatized, and finished with an air-dry paint coating with removable access panels. Structural members shall be 16 gauge with access doors and removable panels of minimum 20 gauge.
 1. Units cabinet surface shall show no visible effects at 600 hours in salt spray test in compliance with ASTM B117.
 2. Cabinet construction shall allow for all service/ maintenance from one side of the unit.
 3. Cabinet top cover shall be one-piece construction or where seams exists, it shall be double-hemmed and gasket-sealed.
 4. Access Panels: Water- and air-tight panels with handles shall provide access to filters, heating section, return air fan section, supply air fan section, evaporator coil section, and unit control section.
 5. Downflow unit's base pans shall have a raised 1 1/8-inch-high lip around the supply and return openings for water integrity.
 6. Insulation: Provide minimum 3/4-inch thick, 1.0 PCF density foil or neoprene faced fiberglass or expanded in place polyurethane foam insulation on side and roof

- panels in contact with the return and conditioned air stream. The unit base shall be insulated with 1/2" thick water impervious, closed cell insulation.
7. Provide openings through the base for power, control and gas connections.
 8. The base of the unit shall have provisions for forklift and crane lifting.
- D. Wind Resistance: The unit and curb assembly shall be factory-engineered and tested to resist wind loads in accordance with the 2018 International Building Code and ASCE Standard 7, as per the project location, Exposure Category B, and a Building Risk Category of III, without the use of supplemental straps or hold downs.
1. Units shall resist the greater of the following:
 - a. 3-Second Gust Design Wind Speed per ASCE Std. 7 - 2016.
 - b. 16 lb./sq. ft. multiplied by maximum area of equipment projected on vertical plane normal to wind direction, and 45 degrees either side of normal.
 2. Units that have been approved for use in Miami-Dade County, with a current NOA number, having successfully passed TAS 202 (Uniform Static Air Pressure Test), are also acceptable for meeting the wind resistance provisions above.
- E. Air Filters: Factory installed filters shall mount integral within the unit and shall be accessible through access panels. Provide two (2) sets of [2]-inch thick, MERV-8 efficient panel type filters in addition to those provided as 'extra materials'. Replace construction phase filters after final clean-up with the 2nd set.
- F. Fans and Motors:
1. Provide evaporator supply fan section with forward curved, double width, double inlet, or backward inclined inle inlet plenum type centrifugal fan.
 2. Provide self-aligning, grease lubricated, ball or sleeve bearings with permanent lubrication fittings.
 3. Provide unit with belt driven, supply fans with adjustable motor sheaves or direct drive supply fans with an ECM motor with an integral, adjustable speed control.
 4. Outdoor and indoor fan motors shall be permanently lubricated and have internal thermal overload protection.
 5. Outdoor condenser coil fans shall be direct drive, statically and dynamically balanced, draw through in the vertical discharge position.
 6. Provide shafts constructed of solid hot rolled steel, ground and polished, with key-way, and protectively coated with lubricating oil.
 7. Entire fan assemblies shall be mounted on factory installed and engineered spring or rubber-in-shear vibration isolators.
- G. Gas Fired Heating Section:
1. Completely assembled and factory installed heating system shall be integral to unit, UL or CSA approved specifically for outdoor applications for use downstream from refrigerant cooling coils. Threaded connection with plug or cap provided. Provide capability for gas piping through the side of the unit. The furnace shall be designed to operate with gas pressures between 7" w.c. and 14" w.c.
 2. Heating section shall be factory run tested prior to shipment.

3. Gas Burner shall be forced combustion type power burner, negative pressure gas valve, manual shut-off, hot surface ignition, and flame sensing safety control.
4. Gas Burner Safety Controls: Provide safety controls for the proving of combustion air prior to ignition, and continuous flame supervision. Upon a failure to ignite, two attempts of ignition will occur before lockout of the ignition system.
5. Combustion blower shall be centrifugal type fan with built- in thermal overload protection on fan motor.
6. Heat Exchanger: Provide drum and tube heat exchanger of free floating design manufactured from 18-gauge aluminized steel Type 409 stainless steel or Type 321 stainless steel, factory pressure and leak tested.
7. Limit controls: High temperature limit controls will shut off gas flow in the event of excessive temperatures resulting from restricted indoor airflow or loss of indoor airflow.
8. Flue Extension Kit: Factory-furnished to extend furnace combustion gasses no less than 2 feet above the unit outdoor air intake. The termination shall prevent the entry of precipitation and debris.
9. Output Control: Furnace shall be modulating with a minimum 4:1 turndown

H. Evaporator Coil:

1. Provide configured aluminum fin surface mechanically bonded to copper tubing coil.
2. Provide an independent expansion device for each refrigeration circuit. Factory pressure test at 450 psig and leak test at 200 psig.
3. Air Conditioning Condensate Drain Pans: Provide cooling coil drain pan that is sufficient to contain coil condensate. Pans shall be constructed of type 304 stainless steel or plastic or galvanized steel with mastic coating and shall meet the requirements of ASHRAE 62 with no un-sloped surfaces. Pans shall be minimum 2" deep and shall have a threaded nipple drain connection..
 - a. Drain pan shall be double wall with an R-value of 12 hr-ft²-°F/BTU. The entire area of the drain pan shall have this level of thermal performance.
 - b. Provide an intermediate drain pan on stacked cooling coils over 48" tall. Intermediate drain pan shall slope in a minimum of two planes toward a single drain connection. Provide copper tube downspouts to primary pan at the bottom of the unit.
 - c. Drain piping shall be constructed of HDPE pipe with socket fusion type fittings. Terminate piping over a 4-inch thick solid concrete splash block with underlying rubber pad on the roof.

I. Condenser Section:

1. Provide internally finned seamless copper tube mechanically bonded to aluminum fins or aluminum microchannel tube with aluminum fins. Factory pressure test to 450 psig.
2. Provide vertical discharge, direct drive fans with aluminum blades. Fans shall be statically balanced. Motors shall be permanently lubricated, with integral thermal overload protection in a weather tight casing.
3. Provide the manufacturer's factory hail guard accessory. Hail guard shall be fabricated of galvanized steel, and factory finished to match the unit casing.

J. Refrigeration System:

1. Compressors: Provide direct-drive hermetic, scroll type compressors with centrifugal oil pump providing positive lubrication to moving parts, internal suction and discharge valves, and a crankcase heater. Motor shall be suction gas-cooled with internal temperature and current sensitive motor overloads. A pair of service isolation valves, external high pressure cutout and low pressure switches, and phase-loss monitors, shall be provided for each compressor.
 - a. Units sized 15 tons and larger shall have a minimum of two (2) independent refrigerant circuits.
 - b. Minimum Number of Compressors and Temperature Control Stages: Two (2) compressor stages.
 - 1) In addition, also provide hot-gas bypass as the minimum capacity stage on the lead compressor. Hot-gas bypass solenoid valve with a replaceable magnetic coil. Hot gas bypass, shall have a capacity not exceeding the limits prescribed by the International Energy Conservation Code
 - a) Hot gas bypass may be omitted if one of the compressors is either a modulating variable speed type or is a digital-type scroll, and the minimum operating capacity of that compressor is no greater than 25% of the unit's total capacity.
 - 2) One compressor is acceptable if the compressor is either a modulating variable speed type or is a digital-type scroll, and the minimum operating capacity of that compressor is no greater than 20% of the unit's total capacity.
2. Phase monitors shall be a three-phase line monitor module that protects against phase loss, phase reversal and phase unbalance, and shall also protect compressors from reverse rotation. The module shall automatically reset from a fault condition.
3. Provide each unit with refrigerant circuits factory-supplied completely piped with liquid line filter-drier, suction and liquid line pressure ports, sight glass, and thermostatic expansion valves. Capillary tubes in lieu of thermostatic expansion valves are not acceptable.
4. Compressors shall be mounted on factory installed and engineered spring or rubber in shear vibration isolators.
5. Water level sensor complying with UL 508 to provide protection against drain pan overflow by sensing a high condensate level in the drain pan, in conformance with the 2018 International Mechanical Code. The sensor shall de-energize the compressors upon detection of a high water level.

- K. Hot Gas Reheat Coil: Fully modulating condenser reheat coil with stepper valve infinite modulating control to either independent condenser re-heat coil or remote condenser. System shall also include receiver(s), sub-cooling condenser circuit(s) and check valves. The reheat coil shall provide no less than 15 degrees F of reheat, or as scheduled on the Drawings, whichever is larger.

L. Outdoor Air Section:

1. Provide a fully integrated field-installed 100% modulating outside air economizer with motorized outside air and return air dampers, minimum position setting, preset linkage, wiring harness with plug. Unit operation is through primary temperature controls that automatically modulate dampers to maintain space temperature conditions.
2. Relief damper shall be barometric (gravity) or motorized type.
3. Provide economizer with comparative enthalpy control. The economizer controls shall meet the requirements of the 2018 International Energy Conservation Code (IECC), including economizer fault detection and diagnostics.
4. Provide adjustable minimum position controls.
5. Provide spring return motor for outside air damper closure during unit shutdown or power interruption.

M. Electrical:

1. Each unit shall be wired and tested at the factory before shipment. Wiring shall comply with NEC requirements and shall conform to all applicable UL standards. All electrical components shall be labeled according to the electrical diagram and shall be UL recognized where applicable. Each unit shall have a 24-volt circuit transformer and control circuit fuse.
2. The unit shall be wired for a single point connection.
3. A main unit non-fused disconnect switch in a NEMA 3R enclosure shall be provided.

2.4 FACTORY PACKAGE TEMPERATURE CONTROLS

A. Division of Controls Scope and Coordination Between Suppliers:

1. The unit shall be provided with both a factory control package as well as field applied DDC system controls. These Contract Documents delineate a particular division of work between these two control packages that is generally consistent with the factory control offerings provided by the basis of design manufacturer only.
2. Coordinate between the factory -provided controls and the work of the DDC system provider / sub-contractor to achieve the required control sequences of operation and make the required control points available through the building wide DDC system.
3. It is the responsibility of the bidding Contractor to coordinate the bids of various suppliers and sub-contractors in order to meet all requirements of the Contract. If a specified control feature or option is not available from the unit manufacturer as a factory installed item, the Contractor shall include in his bid the cost of field-applying controllers and devices as required to meet all specification and control requirements.
4. Control equipment and sequence of operation are specified in Division 23 Section "Sequence of Operation for HVAC Controls".

B. General: Provide factory-wired air conditioning units with 24-volt control circuit with control transformers, and terminal block for control wiring. Controls shall provide anti-

short cycle timing and time delay between compressors and other refrigerant and electrical monitoring safety devices to provide machine protection. Provide factory-installed evaporator defrost control to prevent compressor slugging by interrupting compressor operation. Unit package refrigerant pressure controls shall pilot the condenser fans.

1. The unit shall be equipped with a complete microprocessor control system. This system shall consist of temperature and pressure (thermistor and transducer) sensors, printed circuit boards (modules), and a unit mounted Human Interface Panel. Modules (boards) shall be individually replaceable for ease of service.
2. The microprocessor boards shall be stand-alone DDC controls not dependent on communications with the BAS system.
3. Control sequences integrated into the factory packaged controls shall comply with the 2018 International Energy Conservation Code (IECC).
4. The Human Interface Panel shall include a 16 key keypad, a 2-line x 40 character clear English display as standard to provide the operator with full adjustment and display of control data functions. Touchscreens are also acceptable.
5. The microprocessors shall be equipped with on-board diagnostics, indicating that all hardware, software and interconnecting wiring are in proper operating condition. The modules (boards) shall be protected to prevent RFI and voltage transients from affecting the board's circuits. All field wiring shall be terminated at separate, clearly marked terminal strip.
6. The controllers shall have non-volatile memory.
7. The controls shall be factory-installed and mounted in the main control panel. All factory-installed controls shall be fully commissioned (run tested) at the factory. All microprocessors, boards and sensors shall be factory mounted, wired and tested.

C. Control Programs:

1. The unit controls shall receive binary heating and cooling demand signals from the DDC system (e.g. thermostat signals). One output from the DDC system for each stage of heating and cooling provided in the unit shall be provided.
2. The unit controls shall control the unit mixing dampers to provide free cooling economizer cycle by way of comparative enthalpy. The economizer cycle shall be locked out by the unit controls when outdoor air enthalpy is higher than return air enthalpy. The economizer controls shall meet the requirements of the 2018 International Energy Conservation Code (IECC), including economizer fault detection and diagnostics.
3. The unit controls shall adjust the supply fan speed when in cooling mode to provide the design airflow rate when all stages of cooling are energized, and reduced airflow rates when fewer cooling stages are active.
4. The unit controls shall adjust the position of the return air outdoor air dampers to account for changes in supply fan speed to maintain the desired outdoor airflow rate.
5. The unit controls shall have a de-humidification mode by which refrigeration and hot gas reheat coil are energized simultaneously. The DDC system shall monitor the space RH and shall feed that signal forward to the packaged unit controls for controlling this mode.
6. The unit controls shall have an unoccupied operating mode whereby the unit operates with a zero (0) minimum outdoor air rate. The unit may still operate with

outdoor air for purposes of economizer cooling. The DDC system shall initiate this mode through a binary output signal or through the unit gateway interface.

2.5 MOTORS

- A. Refer to Division 23 Section "Common Motor Requirements for HVAC Equipment" for general requirements for factory-installed motors, including NEMA designation, temperature rating, service factor, and efficiency requirements.
 - 1. A shaft grounding ring shall be provided on VFD-driven motors as specified in Division 23 Section "Common Motor Requirements for HVAC Equipment" to provide a conductive discharge path away from the motor bearings to ground.

2.6 ROOF CURBS

- A. Materials: Minimum 16-gauge galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with National Roofing Contractors Association (NRCA) standards. Gasketing shall be provided for field mounting between the unit base and the roof curb. Curbs shall be assembled on the roof prior to unit shipment. The roof curbs shall be perimeter type with complete perimeter support of the unit. Curbs shall be constructed to accommodate the unit ductwork connections and recognize the roof slope and render the top of the curb flat and plumb in each direction. Curbs shall be laterally stable with internal bracing, and shall be constructed to resist the wind forces exerted on the curb by the supported equipment in a design wind as per the project conditions described in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment". Curbs shall be provided with a bottom flange suitable for securing the curb to the roof deck / building structural system in order to resist the design wind loads. Provide manufacturer's standard wind restraint curb clips.
 - 1. Curb Insulation and Adhesive: Comply with NFPA 90A.
 - a. Materials: Fibrous glass duct lining type insulation complying with ASTM C 1071, Type I or II.
 - b. Thickness: 2 inches.
 - c. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.
 - 1) Liner Adhesive: Comply with ASTM C 916, Type I.
 - 2) 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 cabinet.
 - 3) Liner materials applied in this location shall have air-stream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service air velocity.
 - 4) Liner Adhesive: Comply with ASTM C 916, Type I.
 - 2. Curb Height: Minimum 24 inches.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas and conditions, for compliance with requirements for installation tolerances and other conditions affecting installation of units.
- B. Examine roughing-in for piping, ducts, and electrical systems to verify actual locations of connections before equipment installation.
- C. Examine equipment supports and roof areas for suitable conditions where units will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install gas-fired units according to NFPA 54, "National Fuel Gas Code."
- B. Install units level and plumb, maintaining manufacturer's recommended service and airflow clearances.
- C. Install controls and equipment shipped by manufacturer for field installation with units.
- D. Roof Curb: Install on roof structure, level and secure, according to NRCA's "Low-Slope Membrane Roofing Construction Details Manual," Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts." Install units on curbs and coordinate roof penetrations and flashing with roof construction specified in applicable Division 07 Sections. Secure units to the curb, and secure the curb base flange to roof framing with anchor bolts and supplemental steel members. The installation shall provide the wind resistance required by the International Building Code and Division 23 Section "Hangers and Supports for HVAC".
 - 1. Install roof curbs in such manner as maintain roof bond.
 - 2. Provide roof opening, flashing, counter-flashing, sealant, roof insulation and structural framing members.
 - 3. Secure units to roof curbs with stainless steel hardware.
 - 4. Provide soft neoprene gasketing between the unit base and the top of the curb.
 - 5. If building roof insulation has been omitted on the roof deck inside the area surrounded by the curb, provide nominal 6" thick (R-19) fiberglass batt insulation with a vapor retarding foil-scrim-kraft (FSK) facing on the roof deck inside the curb. The FSK facing shall be in contact with the deck and shall be stapled and taped to the inside wall of the curb and sealed / taped to all penetrating items (ducts, piping, conduit, etc.).
- E. Install controls and equipment shipped by manufacturer for field installation with units.
- F. Identify units and connections according to Division 23 Section "Identification for HVAC."

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
 - 1. Gas Piping: Comply with applicable requirements in Division 22 Section "Facility Natural Gas Piping." Connect gas piping to burner, full size of gas train inlet, and connect with union and shutoff valve with sufficient clearance for burner removal and service.
- C. Duct installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:
 - 1. Install ducts to termination in roof curb.
 - 2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
 - 3. Connect ducts to rooftop unit with flexible duct connectors as specified in Division 23 Section "Air Duct Accessories."
- D. Electrical System Connections: Comply with applicable requirements in Division 26 Sections for power wiring, switches, and motor controls.
- E. Ground equipment according to Division 26 provisions.
- F. 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.

3.4 CLEANING

- A. After completing installation, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes including chips, scratches, and abrasions.
- B. Clean fan interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheels, cabinets, and coils entering air face.
- C. Prior to startup, provide final cleaning of air handling units to remove road debris from interior and exterior of unit. The interior airstream surfaces of the unit shall be oil and grease free and wiped clean with 50-50 mix of denatured alcohol and water.

3.5 FIELD QUALITY CONTROL

- A. Field Service: Perform the following field quality-control tests and inspections and prepare test reports.

1. After installing rooftop air conditioners and after electrical circuitry has been energized, test units for compliance with requirements.
2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
5. Verify that the refrigerant leak detection system affects the required mitigation response per UL 60335-2-40 upon detection of a refrigerant leak at the supply air refrigerant coil in the unit.

B. Remove malfunctioning units, replace with new units, and retest as specified above.

3.6 STARTUP SERVICE

A. Complete installation and startup checks according to manufacturer's written instructions and do the following:

1. Inspect for visible damage to unit casing.
2. Inspect for visible damage to furnace combustion chamber.
3. Inspect for visible damage to compressor, air-cooled outside coil, and fans.
4. Inspect internal insulation.
5. Verify that labels are clearly visible.
6. Verify that clearances have been provided for servicing.
7. Verify that controls are connected and operable.
8. Verify that filters are installed.
9. Clean outside coil and inspect for construction debris.
10. Clean furnace flue and inspect for construction debris.
11. Connect and purge gas line.
12. Adjust vibration isolators.
13. Inspect operation of barometric dampers.
14. Lubricate bearings on fan.
15. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
16. Adjust fan belts to proper alignment and tension.
17. Start unit according to manufacturer's written instructions.
 - a. Start refrigeration system in summer only.
 - b. Complete startup sheets and attach copy with Contractor's startup report.
18. Inspect and record performance of interlocks and protective devices; verify sequences.
19. Operate unit for an initial period as recommended or required by manufacturer.
20. Perform the following operations for both minimum and maximum firing and adjust burner for peak efficiency. Adjust pilot to stable flame.
 - a. Measure gas pressure on manifold.
 - b. Measure combustion-air temperature at inlet to combustion chamber.
 - c. Measure flue-gas temperature at furnace discharge.

- d. Perform flue-gas analysis. Measure and record flue-gas carbon dioxide and oxygen concentration.
 - e. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.
- 21. Calibrate thermostats and other sensors.
- 22. Adjust and inspect high-temperature limits.
- 23. Inspect outside-air dampers for proper stroke and interlock with return-air dampers.
- 24. Start refrigeration system and measure and record the following:
 - a. Coil leaving-air, dry- and wet-bulb temperatures.
 - b. Coil entering-air, dry- and wet-bulb temperatures.
 - c. Outside-air, dry-bulb temperature.
 - d. Outside-air-coil, discharge-air, dry-bulb temperature.
- 25. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
- 26. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.
 - a. Supply-air volume.
 - b. Return-air volume.
 - c. Relief-air volume.
 - d. Outside-air intake volume.
- 27. Simulate maximum cooling demand and inspect the following:
 - a. Compressor refrigerant suction and hot-gas pressures.
 - b. Short circuiting of air through outside coil or from outside coil to outside-air intake.
- 28. After startup and performance testing, change filters, vacuum heat exchanger and cooling and outside coils, lubricate bearings, adjust belt tension, and inspect operation of power vents.

3.7 ADJUSTING

- A. Adjust initial temperature and humidity set points.
- B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- C. 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 site outside normal occupancy hours for this purpose, without additional cost.
- D. After completing system installation and testing, adjusting, and balancing RTU and air-distribution systems, clean filter housings and install new filters.

3.8 FUNCTIONAL TESTING AFTER START UP

- A. All testing work described in this Article shall verify that the equipment and controls installation work is complete and fully functional / operational. This work is in addition to any commissioning, testing, and demonstration requirements involving the Commissioning Agent, as specified in Commissioning Sections, and shall be completed by the Division 23 Contractor and his sub-contractors and suppliers prior to beginning the formal commissioning process.
- B. Scope and Involved Parties: After installation, cleaning, start-up, and testing, adjusting, and balancing procedures have been satisfactorily completed, each unit installed shall be functionally tested.
 - 1. All problems encountered during equipment installation, start-up, and air balancing and water balancing shall be completed and debugged before functional testing may begin.
 - 2. The functional performance tests conducted shall demonstrate that each unit and system is operating according to the documented design intent, sequence of operations, and Contract Documents.
- C. Functional Testing Procedures: The completed unit shall be tested for correct functionality in all operating modes by the above parties. The functional testing shall consist of an in-unit test of the controller, inputs, outputs, safeties, and all aspects of the sequences of operation. All operating modes (occupied, unoccupied, etc.) shall be tested, as are start-up, shut-down, restart after power failure. Proper response to failure and alarm conditions (e.g. freeze condition, low oil pressure, no flow, equipment failure, etc.) shall also be tested. Also, part of the functional test will be verification of the operation of compressor(s), fan(s), damper and valve actuators, and associated electrical components.
 - 1. The Contractor shall:
 - a. Lead the functional testing effort as part of the DDC system commissioning specified in Division 23 Section "Instrumentation and Control for HVAC".
 - b. Devise the proposed test procedures in advance of the testing and distribute to involved parties.
 - c. Direct the efforts of the Division 23 Contractor and equipment supplier or manufacturer's representative during testing.
 - d. Compose and submit the functional testing report.
 - e. Review the proposed tests for feasibility, safety, and equipment and warranty protection.
 - f. Provide technicians, instrumentation, and tools to facilitate the tests.
 - g. Operate the equipment and systems they have previously installed during the tests.
 - h. Assist in tests of equipment and systems with which their work interfaces.
 - i. Ensure that the manufacturer's representatives have made all project-specific adjustments and settings during equipment start-up to the factory controllers prior to the joint field-commissioning efforts.

2. The equipment manufacturer or supplier representative shall:
 - a. Make all project-specific adjustments and settings during equipment start-up to the factory controllers prior to the joint field-commissioning efforts.
 - b. Provide a minimum of 8 hours of on-site factory technician time (time exclusive of travel to the site) per unit supplied to assist in functional testing, problem solving, and controls integration. This time shall be allocated as directed by the DDC System Sub-Contractor. The equipment representative shall anticipate that one dedicated site visit per unit installed may be required.
 - c. Refer to Division 23 Section "Instrumentation and Control for HVAC" for requirements regarding control integration responsibilities of the equipment manufacturer to the DDC System Contractor.
- D. Functional Testing Report: Report findings during functional testing. Identify testing procedures, problems encountered, corrective measures taken, and final results.

3.9 DEMONSTRATION

- A. Train owner's maintenance personnel as specified below:
 1. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
 2. Review data in the maintenance manuals.
 3. Schedule training with Owner, through the Architect, with at least 7 days' advance notice.

END OF SECTION 237439

SECTION 238216 - AIR COILS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Electric resistance heaters (coils).

1.3 ACTION SUBMITTALS

- A. Product data including rated capacities of selected models, pressure drop, weights (shipping, installed, and operating), installation instructions, and startup instructions.
- B. Shop drawings detailing fabrication and installation of air coils, including plans, elevations, sections, details of components, and attachments to other units of Work. Detail connections to piping. Indicate dimensions, weight loadings, weight distribution, and clearances required. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.
 - 1. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring. Clearly indicate the load, voltage, phase, and number of wires (e.g. requirement for a 3-wire vs. 4-wire connection with a neutral) for each unit.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating coil location and ceiling-mounted access panels.
- B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data for air coils to include in the operation and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. UL: Electric duct heaters shall be listed in accordance with UL 1996.

1.7 COORDINATION

- A. Coordinate layout and installation of air coils with duct, insulation, and with other installations. Revise locations and elevations from those indicated as required to suit field conditions, and as approved by the Architect.
- B. Coordinate with the Electrical Contractor the electrical connection requirements of electric duct heaters, including the load, voltage, phase, and number of wires (e.g. a requirement for a 3-wire vs. 4-wire connection with a neutral) prior to releasing the equipment for production.
- C. Arrange the work to provide no less than 42" of service clearance in front of electric duct heater power and control panels, for the full width of the panel, or 30", whichever is larger, as per the requirements of the National Electric Code.

PART 2 - PRODUCTS

2.1 ELECTRIC DUCT HEATERS

- A. Electrical Heating Coils, Controls, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. UL Compliance: Heater shall be listed in accordance with UL 1996.
- C. Casing Assembly: Slip-in type with galvanized-steel frame.
- D. 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.
- E. Overtemperature Protection: Disk-type, automatically reset, thermal-cutout, safety device; serviceable through terminal box without removing heater from duct or unit.
 - 1. Secondary Protection: Load-carrying, manually reset, thermal cutouts; factory wired in series with each heater stage. Fuses and cutouts that cannot be reset are not acceptable.

- F. Wiring Connection: Single point electrical connection at the control panel. 3-phase units shall be delta-connected, with no requirement for a neutral wire for the operation of the heater or the controls.
- G. Control Panel: Unit mounted with external single point disconnecting means and overcurrent protection. The panel shall be mounted on the side or bottom of the duct. Include the following controls and features:
 - 1. Toggle switches.
 - 2. Solid-state stepless pulse controller (SCR controller), receiving a 0-10VDC or 4-20 mA analog pilot signal
 - 3. Time-delay relay.
 - 4. Pilot light.
 - 5. Airflow proving switch.
- H. Thermostats: Duct-mounted analog temperature sensor / thermostat, with temperature range from 0 to 100 deg F, and 2.5 deg F throttling range; and with 1/2-by-4-1/2-inch sensing bulb and 60-inch capillary. Thermostat shall have an analog output to match the SCR controller.
 - 1. The heater control panel shall accept external 24V contact closure signal for energizing / de-energizing the heater. Once energized, the heater shall be controlled through the SCR controller using the duct-mounted analog temperature sensor to maintain the desired leaving air temperature setpoint.
- I. Thermostats: Wall-mounted, multi-stage thermostats, with thermometer and temperature setpoint range from 50 to 90 deg F., and adjustable differential.
- J. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Berko, a Div. of Marley Engineered Products
 - 2. Brasch Manufacturing Co., Inc.
 - 3. Chromalox; a Div. of Spirax-Sarco.
 - 4. Greenheck
 - 5. INDEECO
 - 6. Raywall; a Div. of TPI Corp.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine ducts to receive air coils for compliance with requirements for installation tolerances and other conditions affecting performance of the air coils. Verify piping rough-in dimensions. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install air coils level and plumb, and according to manufacturer's written instructions, rough-in drawings, the original design, and referenced standards.
- B. Install air coils in metal ducts constructed according to SMACNA "HVAC Duct Construction Standards."
- C. Provide a duct access door upstream of all duct coils.
- D. Anchor air coils in position using suitable supports. Support coils independently of connecting ductwork.
- E. Install piping connections, maintaining manufacturer's recommended clearances for service and maintenance of coils.
- F. Install shutoff valves at coil inlet and outlet connections.

3.3 CONNECTIONS

- A. Ground electric duct heaters.
 - 1. 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.

3.4 ADJUSTING

- A. Comb bent fins on each air coil.
- B. Set field-adjustable switches and circuit-breaker trip ranges.

3.5 CLEANING

- A. After completing system installation, including duct and fittings, clean coils using materials and methods recommended by manufacturers, and clean inside of casings and enclosures to remove dust and debris.

END OF SECTION 238216

SECTION 238249 - ELECTRIC UNIT HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Division 23 Section 230513 "Common Motor Requirements for HVAC Equipment".

1.2 SUMMARY

- A. This Section includes space heating units for electric resistance type applications.

1.3 ACTION SUBMITTALS

- A. Product data for each type of product specified.
- B. Wiring diagrams detailing power and control wiring and differentiating clearly between manufacturer-installed wiring and field-installed wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Samples of cabinet finish colors for approval.
- B. Field quality-control reports.
- C. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Suspended ceiling components.
 - 2. Structural members to which cabinet unit heaters will be attached.
 - 3. Method of attaching hangers to building structure.
 - 4. Size and location of initial access modules for acoustical tile.
 - 5. Items penetrating finished ceiling, including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data for units to include in the operation and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Comply with NFPA 70 for components and installation.
- B. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.

PART 2 - PRODUCTS

2.1 ELECTRIC PROPELLER UNIT HEATERS

- A. Cabinet: Minimum 18-gauge steel cabinet with fan guard and mounting bracket, factory finished with baked enamel
- B. Heating Elements: Nickel-chromium heating wire element; free from expansion noise and 60-Hz hum; embedded in magnesium oxide, insulating refractory; and sealed in high-mass steel or corrosion-resistant metallic sheath with fins no closer than 0.16 inch. Element ends shall be enclosed in terminal box. Fin surface temperature shall not exceed 550 deg F at any point during normal operation.
- C. Heater Circuit Protection: One-time fuses in terminal box for overcurrent protection and limit controls for overtemperature protection of heaters.
- D. Fan and Motor: Direct-drive propeller fan and manufacturer's standard motor. Motors shall include internal motor overload protection.
- E. Discharge Configuration: Horizontal discharge with horizontal, adjustable louvers.
- F. Controls and Accessories: Include the following:
 - 1. Remote wall-mounted low voltage thermostat with adjustable setpoint for those units with stand-alone control (i.e. non-DDC control). Refer to Section 230993 "Sequence of Operations for HVAC Controls".
 - 2. Disconnect switch, NEMA KS 1, Type HD disconnect switch, with lockable handle.
 - 3. Fan-delay relay to dissipate residual internal heat after elements have been de-energized.
 - 4. The thermal cutout devices shall disconnect the heating elements from the power supply should the temperature of the heating elements exceed normal conditions and shall be of the automatic reset type.
 - 5. Hanger bracket and rods with vibration isolators.

- G. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Berko; a Div. of Marley Electric Heating Co.
 2. Brasch Manufacturing Co., Inc.
 3. Dimplex North America
 4. Indeeco
 5. Markel Products Company; a Div. of TPI Corp.
 6. Qmark; a Div. of Marley Electric Heating Co.
 7. Ouellet
 8. Raywall; a Div. of TPI Corp.
 9. Reznor, a Nortek Company
 10. Stelpro Inc.
 11. Trane, a Division of Ingersoll Rand

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and supports to receive unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of units. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install unit heaters as indicated, according to manufacturer's written instructions and NFPA 90A.
- B. Install recessed wall units in finished wall assembly; seal joints. Joint-sealant materials and applications are specified in Division 07.
- C. Suspend unit heaters from structure with elastomeric hangers. Vibration isolators are specified in Division 23 Section "Vibration Controls for HVAC."
- D. Connect unit heaters and components to wiring systems and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torque requirements are not indicated, tighten connectors and terminals according to tightening requirements specified in UL 486A.
- E. Mount remote thermostats and provide low voltage control wiring between remote wall mounted thermostat and line voltage control contactors.

3.3 FIELD QUALITY CONTROL

- A. Testing: After installing unit heaters and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
- B. Remove and replace malfunctioning units with new units and retest.

3.4 CLEANING

- A. Replace filters in each cabinet unit heater at Substantial Completion.
- B. After completing system installation, including outlet fittings and devices, inspect exposed finish. Clean units to remove dirt and construction debris and repair damaged finishes.
 - 1. Touch-up Painting: Apply touchup paint to match factory finish on minor scratches in the cabinet finish. Large visible scratches will require cabinet replacement, at the direction of the Architect / Engineer.

3.5 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain unit heaters.
 - 1. Train Owner's maintenance personnel on procedures and schedules for troubleshooting, servicing, and maintaining equipment.
 - 2. Review data in maintenance manuals.
 - 3. Schedule training with Owner, through Architect, with at least seven days' advance notice.

END OF SECTION 238249

SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. General administrative and procedural requirements.
 - 2. Concrete equipment bases.
 - 3. Electrical demolition.
 - 4. Cutting and patching for electrical construction.
 - 5. Touch-up Painting.
 - 6. Access panels.
 - 7. Joint Sealers.
 - 8. Excavation and Backfill.

1.3 GENERAL STIPULATIONS

- A. The contractor shall procure all necessary permits to carry out their work. They shall also arrange for all tests required on any and all parts of their work by local authorities, paying all regular and proper chargers for same. They shall also obtain all certificates of inspection and approval from all required authorities and the Underwriters. Underwriters' certificates in duplicate shall be furnished to the owner at the completion of the project. Also, the contractor shall furnish two copies of each intermediate Underwriters' inspection report to the Architect and the owner. All fees and permits required shall be satisfied and obtained by the contractor and the cost shall be included in the contract price.
- B. When the installation is reported in writing by the Contractor to be complete and ready for acceptance, tests and inspection shall be made by the Contractor in the presence of representatives of the Architect to ascertain whether it complies with the specifications and Contract, and upon its failure to do so, the Contractor shall at once remedy all defects and short-comings, and any additional tests that may be required shall be entirely at the Contractor's expense.
- C. The Contractor shall have a managerial representative at each and every regularly scheduled job conference to receive the items that are furnished by others, to inventory them and coordinate his work with the other trades

- D. This Contractor shall be entirely responsible for all apparatus, equipment, and appurtenances furnished under this Contract in connection with the work, and special care shall be taken to protect all parts thereof in such a manner as may be necessary or as may be directed. Protection shall include covers, crating, sheds, or other means to prevent dirt, grit, plaster, or other foreign substances from entering the working parts of machinery or equipment. Special care shall be taken to keep all open ends of conduit and other equipment closed while in storage and during the course of installation. Where equipment must be stored outside the building, it shall be totally covered and secured with heavy waterproof tarps and kept dry at all times. Where equipment has been subjected to moisture, it shall be suitably dried out before placed in service. All apparatus, equipment, conduit and other appurtenances shall be stored in areas designated by the Architect.
- E. The Contractor shall be responsible for coordinating with all Utility Companies that will provide services to this job site. This Contractor shall communicate with each and every public utility company and incorporate into this project's scope of work all Utility requirements for this project. This shall include, but not be limited to, all working clearances, fees, materials, equipment, conduits, conductors, excavation, service charges, etc.

1.4 DEFINITIONS

- A. Approved Equal: The term "approved equal", "approved", "equal", "equivalent", etc. shall mean equal in all respects in the opinion of the Architect.
- B. As Required: The term "as required" refers to making final connections to and/or coordinating with the appropriate authorities regarding the installation of the indicated equipment.
- C. Contractor: The term "Contractor", "this Contractor" or "Electrical Contractor" when used in the Contract Documents refers to the Contractor responsible for all work specified in Division 26 and as indicated on the Electrical Drawings.
- D. Directed: Terms such as "directed," "requested," "authorized," "selected," and "permitted" when used separately without referencing any authority, shall mean directed by the Architect, requested by the Architect, and similar phrases.
- E. Disconnect: Disconnect electrical service to indicated items. Associated conduit and wire shall be disconnected and removed, complete, back to its source. Where electrical equipment (i.e. generator) is connected to radiator, fuel, and exhaust piping, intake and exhaust ductwork, etc., this Contractor shall disconnect and remove all associated appurtenances, complete, back to their source unless noted otherwise.
- F. Existing to Remain: Protect construction and/or indicated items to remain against damage and soiling during selective demolition. When permitted by the Architect, items may be removed to a suitable, protected storage location during selective demolition and then cleaned and reinstalled in their original locations.
- G. Finished/Unfinished Space: The term "finished space" shall mean areas where drywall is hung and installed with wall coverings and/or painted, floors are polished or

coverings are installed on the floor, and the ceiling is plaster/gypsum board and/or suspended A.C.T. The term "unfinished space" refers to any area that does not meet the definition for a "finished space" as specified above. Mechanical rooms, electrical rooms, garages, etc. are typically considered "unfinished spaces".

- H. Furnish: The term "furnish" when used separately, shall mean to supply and deliver to the Project site, ready for unloading, unpacking, assembly, installation, and similar operations by others.
- I. Indicated: The term "indicated", "shown," "noted," "scheduled," and "specified" refers to graphic representations, notes, or schedules on the Drawings; or to other paragraphs or schedules in the Specifications and similar requirements in the Contract Documents.
- J. Install: The term "install" when used separately, shall mean to mount in place, connect and make operable. Installation operations at the Project site shall include, but not be limited to, the actual unloading, temporary storage, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- K. Provide: The term "provide" when used in these specifications, shall mean to furnish and install, complete and ready for the intended use. See above definitions for additional requirements.
- L. Regulations: The term "regulations" includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.
- M. Reinstall: Remove items indicated; clean, service, and otherwise prepare them for reuse; store and protect against damage. Reinstall items in the same locations or in locations indicated.
- N. Remove: Remove and legally dispose of items except those indicated to be reinstalled or salvaged or to remain the Owner's property as directed.
- O. Salvage (Turn Over to Owner): Items indicated to be salvaged remain the Owner's property. Remove, clean, and pack or crate items to protect against damage. Identify contents of containers and deliver to Owner's designated storage area.
- P. Subcontractor: The term "Subcontractor" when used in these Contract Documents refers to an experienced installer (i.e. manufacturer, vendor, etc.) whom has successfully completed a minimum of five (5) previous projects similar in size and scope to this Project; being familiar with the special requirements indicated; and having complied with requirements of authorities having jurisdiction. Any reference to, or letting of work contained in these Contract Documents to any Subcontractor does not relieve this Contractor of his/her responsibility for all work, material and equipment indicated in these Contract Documents.
- Q. Work: The term "work" refers to all labor and materials provided by the Contractor and/or Subcontractor to make a complete and operable system.

1.5 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and as indicated below.
1. Collect Product Data into a single submittal for each element of construction or system. Product Data includes printed information, such as manufacturer's installation instructions, catalog cuts, standard color charts, roughing-in diagrams and templates, standard wiring diagrams, and performance curves.
 2. Mark each copy to show applicable choices and options. Where printed Product Data includes information on several products that are not required, mark copies to indicate the applicable information. Include the following information:
 - a. Manufacturer's printed recommendations.
 - b. Compliance with trade association standards.
 - c. Compliance with recognized testing agency standards.
 - d. Application of testing agency labels and seals.
 - e. Notation of dimensions verified by field measurement.
 - f. Notation of coordination requirements.
 3. Do not submit Product Data on the following items and/or systems until compliance with requirements of the Contract Documents has been confirmed. See "Substitutions" article specified elsewhere in Part 1 for the Compliance Report requirements
- B. If the Contractor submits a product of a manufacturer which appears as a second or third name without corresponding catalog numbers and/or the manufacturer is not listed by name, the submittal shall include a Compliance Report. See "Substitutions" article specified elsewhere in Part 1 for the Compliance Report requirements and additional substitution requirements.
- C. All drawings, etc., submitted for approval shall be marked with the name of the project and shall bear the stamp of approval of the Contractor as evidence that the material has been checked by the Contractor. Any drawings, etc., submitted without this stamp of approval will not be considered and will be returned to the Contractor for resubmission.
- D. Additional copies may be required by individual sections of these Specifications.
- E. None of the items throughout the electrical specifications which require a submission and/or review, shall be installed in the work or orders placed for same until final review has been given by the Architect.
- F. Submit product data for the following products:
1. Access panels and doors.
 2. Joint Sealers.
- G. Welder certificates, signed by Contractor, certifying that welders comply with requirements specified under "Quality Control" article of this Section.

H. Selective Demolition

1. Schedules indicating proposed methods and sequence of operations for selective demolition prior to commencement of Work. Include coordination for shut off of electrical service, and details for dust and noise control.
 - a. Coordinate sequencing with construction phasing and Owner occupancy as directed.
2. Inventory of items removed and salvaged by the Contractor for the Owner for inclusion in the Operation and Maintenance Manuals.
3. Photographs or videotape, sufficiently detailed, of existing conditions of adjoining construction and site improvements that might be misconstrued as damage caused by selective demolition operations.
4. Record drawings at Project closeout according to Division 1 Section "Contract Closeout."
 - a. Identify and accurately locate capped utilities and other subsurface structural, electrical, or mechanical conditions.

1.6 SUBSTITUTIONS

- A. Throughout the project specifications and drawings, materials and equipment may be indicated as the "basis of design" material or equipment. If the bidding Contractor desires to furnish equipment of a manufacturer other than that which is indicated to be the "basis of design", even if alternative manufacturer and product names are also listed, it is the full burden of the bidding Contractor to verify, prior to submitting a bid price, that the proposed product meets all of the project requirements and specifications. Any changes to the work, including changes to the work of other trades / Divisions, shall be borne by the Contractor at no additional cost to the Owner, and the proposed changes shall meet with the approval of the Architect / Engineer.
1. Bidders may elect, during the bidding period, to request the Architect / Engineer's pre-approval, in writing, to substitute such item for the specified item and shall submit supporting data and samples if required, to permit a fair evaluation of the proposed substitution with respect to quality, serviceability and warranty. This request shall be made no less than 10 days prior to the Bid Date.
 2. When submitting for approval a product that was not listed as the basis of design, the Contractor shall explicitly indicate the following in the submittal no later than (5) days prior to the bid date:
 - a. All changes to the work which are required to accommodate the substitution. If no changes are required, then this should be stated instead. The Contractor is responsible for coordinating these changes with the affected trades.
 - b. All deviations from the contract requirements.
 - c. Written application with explanation of why it should be considered.
 - d. Accredited testing laboratory certificate comparing substitute's physical/performance attributes to those specified.

- e. Product data:
 - 1) Data sheets for each product.
 - 2) Material safety data sheets for each product.
 - 3) Samples of each material specified, properly labeled.
 - f. Copy of manufacturer's warranty.
 - g. Copy of product liability insurance certificate.
 - h. Copy of job reference list.
3. For the purposes of provision 2 above, when counting days prior to the bid date, the first day shall be determined to be the first business day after the owner/engineer's receipt of the substitute proposal.
- B. Where a product model number is indicated on the drawings or specifications and that product model is no longer available, the bid price shall include the currently available product model with the equal or greater quality, capacity, features, and warranty as the unavailable model listed.
- C. The Contractor is responsible for confirming that all specified products will be available in a timely manner to meet the contract schedule. Should the delivery time schedule of any specified product be an issue that could adversely affect the project schedule, the Contractor shall notify the Architect, in writing, within 14 days following the award of the Contract. Documentation as to when specified products were ordered and anticipated delivery dates will be required to be submitted to the Architect at this time.

1.7 WARRANTY

- A. Defective equipment, materials or workmanship, including damage to the work provided under other Divisions of this contract, shall be replaced or repaired at no extra cost to the Owner for the duration of the stipulated guarantee periods.
- B. Unless specifically indicated otherwise in Division 1, the duration of the guarantee period shall be one (1) year following the date of Substantial Completion. Temporary operation of the equipment for temporary conditioning, testing, etc., prior to occupancy will not be considered part of the warranty period.
- C. Special manufacturers' warranties that extend beyond the general warranty period are specified in other Division 23 sections.
- 1. Where the duration of a manufacturer's standard warrantee exceeds that specified, the manufacturer's warrantee shall take precedence.
 - 2. Where the duration of a manufacturer's standard warrantee is less than that specified, the manufacturer shall provide a special warrantee extension as required, and shall provide a certificate attesting to that extension with the equipment submittal. Failure to include that certificate with the submittal shall be grounds for rejection of the submittal.

1.8 REGULATIONS

- A. All laws, ordinances, rules and regulations of public bodies bearing on the conduct of the work are hereby incorporated and made a part of these specifications.
 - 1. Americans with Disabilities Act.
 - 2. Pennsylvania Uniform Construction Code.
 - 3. City and Local Codes.
 - 4. National Fire Protection Association (NFPA), i.e. National Electric Code - NFPA 70, Electrical Safety in the Workplace – NFPA 70E, National Fire Alarm Code – NFPA 72, Life Safety Code - NFPA 101 and Emergency and Standby Power Systems – NFPA 110.
 - 5. National Electrical Safety Code - ANSI C2.
 - 6. Owner's insuring agency.
 - 7. International Building Code (IBC)
- B. The Contractor shall comply with all rules, regulations and recommendations of any public utility serving this project.
- C. The entire electrical system shall be installed in accordance with the latest edition of the National Electrical Code, approved by the governmental body having jurisdiction, including amendments thereto.

1.9 DRAWINGS AND SPECIFICATIONS

- A. The drawings are generally diagrammatic and indicative of the work to be installed. Exact locations of equipment and points of termination shall be reviewed with the Architect. Should it be found that any system or equipment cannot be installed as shown on the drawings, the Architect shall be consulted before installing or making changes to the layout.
- B. The drawings and specifications are intended to function as a common set of documents. Anything shown on the drawings but not in the specifications, or mentioned in the specifications and not shown on the drawings, shall be equally binding as if both noted on the drawings and called for in the specifications.
- C. No measurement of a drawing by scale shall be used as a working dimension. Working measurements shall be taken from figured dimensions and through cooperation with all other Contractors.
- D. This Contractor shall carefully examine the Architectural, Structural, HVAC, Plumbing and Miscellaneous Contract Drawings and Specifications. If any discrepancies occur between the drawings or between the drawings and specifications, the discrepancies shall be reported to the Architect in writing and obtain written instructions as to the manner in which to proceed. No departures from the Contract Drawings shall be made without prior written instructions from the Architect.
- E. All items of labor, material and equipment not specified in detail or shown on the drawings but incidental to or necessary for the complete and proper installation and proper operation of the several branches of the work described herein or reasonably

implied in connection therewith, shall be furnished as if called for in detail by the specifications or drawings.

1.10 FAMILIARITY WITH CONTRACT REQUIREMENTS

- A. It is the responsibility of the Contractor, prior to submitting a bid on this Project, to satisfy himself as to the nature and location of the work, the conformation of the ground, soil characteristics, the character, quality and quantity of the materials which will be required, the character of equipment and facilities needed preliminary to and during the prosecution of the work, the general and local conditions, and of all other matters which can in any way affect the work under this Contract.
- B. Failure to make an on-site inspection prior to submitting a bid, or failure to comply with any or all of the above requirements will not relieve this Contractor from the responsibilities of properly estimating the requirements or costs of successful completion of the work nor from the responsibility for the faithful performance of the provisions of this Contract.
- C. The Electrical Contractor shall confer with all other Contractors and shall apply for detailed and specific information regarding the location of all equipment as the final location may differ from that indicated on the drawings. Outlets, equipment or wiring improperly placed because of the Electrical Contractor's failure to obtain this information shall be relocated and reinstalled by the Electrical Contractor without additional expense to the Owner.

1.11 ELECTRICAL COORDINATION DRAWINGS

- A. Prepare coordination drawings at a scale of 1/4"=1' 0" or larger; detailing major elements, components, and systems of electrical equipment and materials in relationship with other systems, installations, and building components for the following:
 - 1. Electrical equipment room
 - 2. Generator room
 - 3. Telephone/Communication room
 - 4. Main Data Equipment Room
- B. Indicate the proposed locations of major raceway systems, equipment, and materials. Include the following:
 - 1. Clearances for servicing equipment, including space for equipment disassembly required for periodic maintenance.
 - 2. Exterior wall and foundation penetrations.
 - 3. Equipment connections and support details.
 - 4. Sizes and location of required concrete pads and bases.
- C. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

- D. The Contractor shall obtain written approval of the coordination drawings from all other Contractors involved in the project. Once written approval is obtained, the Contractor shall submit the signed documents to the Architect for review and approval prior to the start of work.

1.12 COORDINATION DRAWINGS:

- A. Coordination drawings shall be initiated by the contractor responsible for the ductwork installation. That contractor shall indicate, on the architectural floor plans, equipment and duct locations and dimensions drawn to scale, taking into consideration and incorporating proper clearances. The drawing shall then be given to the contractors installing piping, conduit, and cable tray for the inclusion of their work on the coordination drawing. Diffusers, grilles, sprinkler heads, lighting fixtures, fire alarm devices, speakers, and any entity installed in reflected ceiling shall be indicated on the coordination drawings. All discrepancies and conflicts with the architectural layout of the building shall be noted on the coordination drawings. The contractors shall meet as required to resolve discrepancies with ductwork, piping, and conduit prior and to coordinate those elements on the coordination drawing. The contractor who initiated the coordination drawings shall submit them for review. Coordination and installation of any equipment not indicated on the coordination drawing shall be the responsibility of the contractor responsible for that equipment. Any modifications required by any contractor for equipment to be installed that is not shown on the coordination drawing shall be the responsibility of the contractor who failed to indicate that equipment.
 - 1. Planned piping layout, including valve and specialty locations and valve-stem movement.
 - 2. Clearances for installing and maintaining insulation.
 - 3. Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly required for periodic maintenance.
 - 4. Equipment and accessory service connections and support details.
 - 5. Exterior wall and foundation penetrations.
 - 6. Fire-rated wall and floor penetrations.
 - 7. Sizes and location of required concrete pads and bases.
 - 8. Scheduling, sequencing, movement, and positioning of large equipment into building during construction.
 - 9. Floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
 - 10. Reflected ceiling plans to coordinate and integrate installation of air outlets and inlets, light fixtures, communication system components, sprinklers, and other ceiling-mounted items.
- B. Electronic Files: Provide electronic files of all shop drawings and coordination drawings in Autocad 2010 format or later version unless directed to provide a specific vintage in Division 1. Also provide drawings in a PDF format.
- C. Refer to Specifications Section 013113.

1.13 RECORD DOCUMENTS

- A. Prepare record documents in accordance with the requirements as defined by Part 1 paragraph "Related Documents" and the following:
- B. Markup Procedure: During construction, maintain a set of blue or black line white prints of Contract Drawings and Shop Drawings for Project Record Document purposes.
 - 1. Mark these Drawings to show the actual installation where the installation varies from the installation shown originally. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later. Items required to be marked include, but are not limited to, the following:
 - a. Revisions to details shown on the Drawings.
 - b. Locations and depths of all underground utilities and underslab conduits.
 - c. Locations of interior conduits larger than 2" diameter not installed underslab.
 - d. Locations of all feeder conduits.
 - e. Revisions to Branch and Feeder Circuits: Record circuit numbers and associated panelboard space numbers for all existing, new, or relocated electrical appurtenances, mechanical equipment, owner furnished equipment, etc. that required power or reconnection of existing electrical services. Each circuit number shall be shown with a homerun coming off the equipment it serves. Circuit numbers indicated on the record drawings shall match the new or updated panelboard indexes.
 - f. Actual installed equipment locations.
 - g. Changes made by change order, Architect's written orders, and Owner requested.
 - 2. Mark record sets with red erasable 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 alternate numbers, change order numbers, and similar identification.
 - 5. Accurately record information in an understandable drawing technique.
 - 6. Record data as soon as possible after obtaining it. Record and check the markup prior to enclosing concealed installations.
 - 7. At time of final payment, submit record drawings to the Architect for the Owner's records. Organize into sets and bind and label sets for the Owner's continued use.
- C. Copies and Distribution: After completing the record drawings, print/copy 3 blue or black line prints of each drawing, whether or not changes and additional information were recorded. Organize the copies into manageable sets. Bind each set with durable paper cover sheets. Include appropriate identification, including titles, dates, and other information on the cover sheets.

1. Organize and bind original marked up set of prints that were maintained during the construction period in the same manner.
2. Submit the marked up record set and a minimum 3 copy sets to the Architect for the Owner's records. Should more copies be requested by the Architect, they shall be provided at no cost to the Owner.

1.14 OPERATION MAINTENANCE MANUALS

- A. General: Prepare maintenance manuals in accordance with Part 1 paragraph "Related Documents" and the following:
- B. Form of Submittal: Prepare operation and maintenance manuals in the form of an instructional manual for use by the Owner's operating personnel. Organize into suitable sets of manageable size. Where possible, assemble instructions for similar equipment into a single binder.
 1. Binders: For each manual, provide heavy duty, commercial quality, 3 ring, vinyl covered, loose leaf binders, in thickness necessary to accommodate contents, sized to receive 8 1/2 by 11 inch paper. Provide a clear plastic sleeve on the spine to hold labels describing contents. Provide pockets in the covers to receive folded sheets.
 - a. Where two (2) or more binders are necessary to accommodate data, correlate data in each binder into related groupings according to the Project Manual table of contents. Cross reference other binders where necessary to provide essential information for proper operation or maintenance of the piece of equipment or system.
 - b. Identify each binder on front and spine, with the printed title "ELECTRICAL OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter covered. Indicate volume number for multiple volume sets of manuals.
 2. Dividers: Provide heavy paper dividers with celluloid covered tabs for each separate Section. Mark each tab to indicate contents. Provide a typed description of the product and major parts of equipment included in the Section on each divider.
 3. Protective Plastic Jackets: Provide protective, transparent, plastic jackets designed to enclose diagnostic software for computerized electronic equipment.
 4. Text Material: Where maintenance manuals require written material, use the manufacturer's standard printed material. If manufacturer's standard printed material is not available, provide specially prepared data, neatly typewritten, on 8 1/2 by 11 inch, 20 lb/sq. ft. white bond paper.
 5. Drawings: Where maintenance manuals require drawings or diagrams, provide reinforced, punched binder tabs on drawings and bind in with text.
 - a. Where oversize drawings are necessary, fold drawings to the same size as text pages and use as a foldout.
 - b. If drawings are too large to be used practically as a foldout, place the drawing, neatly folded, in front or rear pocket of binder. Insert a typewritten

page indicating drawing title, description of contents, and drawing location at the appropriate location in the manual

C. Manual Content

1. In each manual include information specified in the individual Specification Section and the following information for each major component of building equipment and its controls:
 - a. General system or equipment description.
 - b. Design factors and assumptions.
 - c. Copies of all approved Shop Drawings and Product Data, including products/systems installed during construction by change order, etc.
 - d. System or equipment identification, including:
 - 1) Name of manufacturer.
 - 2) Model number.
 - 3) Serial number of each component.
 - e. Operating instructions.
 - f. Emergency instructions.
 - g. Wiring diagrams.
 - h. Inspection and test procedures.
 - i. Inspection reports and certificates.
 - j. Maintenance procedures and schedules.
 - k. Precautions against improper use and maintenance.
 - l. Copies of warranties.
 - m. Repair instructions including spare parts listing.
 - n. Sources of required maintenance materials and related services.
 - o. Manual index.
2. Organize each manual into separate Sections for each piece of related equipment. As a minimum, each manual shall contain a title page; a table of contents; copies of Product Data, supplemented by Drawings and written text; and copies of each warranty, bond, and service contract issued.
 - a. Title Page: Provide a title page in a transparent, plastic envelope as the first sheet of each manual. Provide the following information:
 - 1) Subject matter covered by the manual.
 - 2) Name and address of the Project.
 - 3) Date of submittal.
 - 4) Name, address, and telephone number of the Contractor.
 - 5) Name and address of the Architect.
 - 6) Cross reference to related systems in other operation and maintenance manuals.
 - b. Table of Contents: After title page, include a typewritten table of contents for each volume, arranged systematically according to the Project Manual format. Include a list of each product included, identified by product name

or other appropriate identifying symbol and indexed to the content of the volume.

- 1) Where a system requires more than one volume to accommodate data, provide a comprehensive table of contents for all volumes in each volume of the set.
- c. General Information: Provide a general information Section immediately following table of contents, listing each product included in the manual, identified by product name. Under each product, list the name, address, and telephone number of the Subcontractor or Manufacturer and the maintenance contractor. Clearly delineate the extent of responsibility of each of these entities. Include a local source for replacement parts and equipment.
- d. Product Data: Where the manuals include manufacturer's standard printed data, include only sheets that are pertinent to the part or product installed. Mark each sheet to identify each part or product included in the installation. Where the Project includes more than one item in a tabular format, identify each item, using appropriate references from the Contract Documents. Identify data that is applicable to the installation, and delete references to information that is not applicable.
- e. Written Text: Prepare written text to provide necessary information where manufacturer's standard printed data is not available, and the information is necessary for proper operation and maintenance of equipment or systems. Prepare written text where it is necessary to provide additional information or to supplement data included in the manual. Organize text in a consistent format under separate headings for different procedures. Where necessary, provide a logical sequence of instruction for each operation or maintenance procedure.
- f. Drawings: Provide specially prepared drawings where necessary to supplement manufacturer's printed data to illustrate the relationship of component parts of equipment or systems or to provide control or flow diagrams. Coordinate these drawings with information contained in project record drawings to assure correct illustration of the completed installation.
 - 1) Do not use original project record documents as part of operation and maintenance manuals.
- g. Warranties, Bonds, and Service Contracts: Provide a copy of each warranty, bond, or service contract in the appropriate manual for the information of the Owner's operating personnel. Provide written data outlining procedures to follow in the event of product failure. List circumstances and conditions that would affect validity of warranty or bond.
- h. Approval letters from the following:
 - 1) Local authority having jurisdiction
 - 2) Inspection agency
 - 3) Field representative for specific systems, i.e. fire alarm, signal/communication, intrusion detection, etc.

D. Electrical Maintenance Manual

1. Equipment and Systems: Provide the following information for each piece of equipment, each building operating system, and each electric or electronic system.
 - a. Description: Provide a complete description of each unit and related component parts, including the following:
 - 1) Equipment or system function.
 - 2) Operating characteristics.
 - 3) Limiting conditions.
 - 4) Performance curves.
 - 5) Engineering data and tests.
 - 6) Complete nomenclature and number of replacement parts.
 - b. Manufacturer's Information: For each manufacturer of a component part or piece of equipment, provide the following:
 - 1) Printed operation and maintenance instructions.
 - 2) Assembly drawings and diagrams required for maintenance.
 - 3) List of items recommended to be stocked as spare parts.
 - c. Maintenance Procedures: Provide information detailing essential maintenance procedures, including the following:
 - 1) Routine operations.
 - 2) Troubleshooting guide.
 - 3) Disassembly, repair, and reassembly.
 - 4) Alignment, adjusting, and checking.
 - d. Operating Procedures: Provide information on equipment and system operating procedures, including the following:
 - 1) Startup procedures.
 - 2) Equipment or system break in.
 - 3) Routine and normal operating instructions.
 - 4) Regulation and control procedures.
 - 5) Instructions on stopping.
 - 6) Shutdown and emergency instructions.
 - 7) Summer and winter operating instructions.
 - 8) Required sequences for electric or electronic systems.
 - 9) Special operating instructions.
 - e. Servicing Schedule: Provide a schedule of routine servicing and lubrication requirements, including a list of required lubricants for equipment with moving parts.
 - f. Controls: Provide a description of the sequence of operation and as installed control diagrams by the control manufacturer for systems requiring controls.

- g. Circuit Directories: For electric and electronic systems, provide complete circuit directories of panelboards, including the following:
 - 1) Electric service.
 - 2) Controls.
 - 3) Communication.
- E. In addition to the number of maintenance manuals referenced in the "Related Documents" paragraph, prepare one (1) additional copy to be kept by the Engineer.
- F. Refer to Specifications Section 017700 for additional requirements.

1.15 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Labels and Listings: "Labels and Listings" for appliances and equipment provided meet the requirements of the Underwriters Laboratories, Inc. (UL), Electrical Testing Laboratories (ETL) and other standards organizations.
- C. Seismic Requirements: Provide equipment anchoring and support to resist shear and overturning moments.
- D. Current Models:
 - 1. Manufactured items furnished shall be the current, cataloged product of the manufacturer.
 - 2. Replacement parts shall be available.
 - 3. There shall be a permanent service organization maintained or trained by the manufacturer to provide satisfactory service.
- E. Experience: Manufactured items shall have been installed and used, without modification, renovation or repair, on other projects for not less than three years prior to the date of bid opening for this project.
- F. All work shall be installed in a first class, neat and workmanlike manner by mechanics skilled in the trade involved. The quality of workmanship shall be subject to the approval of the Architect. Any work found by the Architect to be of inferior quality and/or workmanship shall be replaced and/or reworked until approval of the Architect is obtained. Any cost involved in obtaining said approval shall be the responsibility of the Electrical Contractor.

1.16 CONTINUITY OF SERVICE

- A. The Contractor shall maintain electrical service to the Existing Buildings during the course of construction. Temporary equipment, switches, cable and whatever else necessary shall be provided as required to maintain electric service. Rules and

regulations of local, state and federal authorities respecting safety provisions shall be observed. The Contractor shall use all precautions so as not to endanger the lives of the building occupants or the public. The Contractor shall furnish and install a temporary service should it be required and remove same after need is satisfied. All charges and costs shall be included in the Electrical Contract.

- B. When it becomes necessary to temporarily interrupt electric service to any portion of the buildings, the Contractor shall notify the Architect and the Owner in writing at least seven days in advance to enable necessary arrangements to be made. No interruptions will be permitted without the expressed written permission of the Owner.
- C. The existing fire alarm, PA, Security, emergency lighting, and other systems shall be fully maintained in service during the execution of work under this Contract. The Contractor shall furnish and install, and later remove any temporary equipment, wiring or other appurtenances necessary to provide the continuity of service for the systems.

1.17 INSTRUCTIONS TO OPERATING PERSONNEL

- A. The Contractor shall furnish the services of a person, or persons, approved by the Architect and thoroughly familiar with the completed installation to instruct the Owner's Operating Personnel in the proper operation of the electrical systems and the proper care of all equipment and apparatus included under this Contract. These services shall be furnished for a minimum of two 8-hour days.
- B. During the instruction period, the Contractor and his approved qualified personnel shall demonstrate to the Owner, in the presence of the Architect's representative, the complete operation of the various systems installed under this Contract. Manufacturers' certificates of tests and performance shall be delivered to the Architect and the Owner as hereinafter specified with the various systems or equipment.
- C. When instructions are provided under this Contract, the Contractor shall have in his possession three copies of an identifying letter which shall list the names of the Contractor's qualified instruction personnel including manufacturer's representatives and subcontractors that will be giving the instructions. Likewise on this same letter, spaces shall be provided for the Owner's personnel who will receive the instructions. After instructions have been given and received for each system, the Contractor's representatives and subcontractors shall sign and date the letter, and the Owner's personnel shall also sign and date the letter acknowledging that they have received adequate instructions for operating and maintaining the systems and equipment. One signed copy shall be delivered to the Owner, one copy to the Architect, and one copy shall be retained by the Contractor.
- D. In addition to the verbal instructions outlined above, the Contractor and his manufacturers' representatives and subcontractors shall furnish written basic instructions indicating the proper operation of each system and associated equipment. Each manufacturer shall also submit a brochure on his equipment, including instructions on operation, lubrication, recommended spare parts, and instructions on preventative, routine, and breakdown maintenance.

- E. The Contractor shall combine the written instructions and the manufacturers' equipment brochures in complete volumes with hard back binders which shall be turned over to the Owner before final acceptance of the Contract work. Unless otherwise directed, three (3) copies of the volumes shall be furnished.
- F. All brochures and formats must be approved by the Architect.
- G. It is the intent that this entire system, with its complement of equipment and auxiliary equipment, operate properly in accordance with the design concept and functional intent. It is also the intent that the Owner be given complete instructions for the proper operation and maintenance of the entire system.
- H. All training defined herein shall be video-taped by the contractor, and a DVD of said training sessions turned over to the owner at the completion of the training.

1.18 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

1.19 GUARANTEE/WARRANTY

- A. Written one (1) year full warranty guarantees shall be submitted for the entire electrical installation installed under this project (except for lamps). Where manufacturer's standard guarantee provides for a longer period, the longer period shall apply. All warranties start at the date of final payment for the project.
- B. Where defects in the material, equipment and/or workmanship become evident within this guarantee period, the Contractor shall be responsible for replacing such material and equipment with the approved type of new items; and/or correcting the defective workmanship without any costs to the Owner.
- C. Refer to Specification Section 017700 for additional information.

1.20 SEQUENCING, SCHEDULING AND COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right of way for piping and conduit installed at required slope.
 - 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

- C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified.
- E. Arrange selective demolition so as not to interfere with Owner's on site operations.
- F. Coordinate electrical equipment installation with other building components.
- G. Arrange for chases, slots, and openings in building structure during progress of construction to allow for electrical installations.
- H. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning prior to closing in the building.
- I. Coordinate connecting electrical service to components furnished under other Sections.
- J. Coordinate connecting electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
- K. Notify the Architect at least 5 days prior to commencing demolition operations.
- L. Perform selective demolition in phases as indicated.

PART 2 - PRODUCTS

2.1 CONCRETE BASES

- A. Comply with Specification Section 033000.5.

2.2 SLEEVE SEALS

- A. The Contractor shall furnish and install modular wall seals where conduits pass through exterior walls. Seals shall be "Link-Seal" modular wall and casing seal, as manufactured by Thunderline Corporation, or approved equal. Sleeves shall be of appropriate size for the size of conduits to be installed, in accordance with the manufacturer's recommendations. The seal shall be composed of identical solid rubber links, bolted and interlocked to form a belt. As belt bolts are tightened, rubber links form an automatic protective seal. The seal shall be rated for 40 feet of head or 20 psig. Seal shall be capable of absorbing shock transmitted either from changes in internal pipe pressures or from ground disturbances. Seal shall be made of synthetic rubber material especially compounded to resist aging, ozone, sunlight, water, and chemical action, and shall provide low temperature flexibility and resistance to high temperature environments. Bolts and metal parts shall be of carbon steel and zinc phosphate plated to resist corrosion. The seal shall be capable of providing air

tightness in above ground installations and hydrostatic sealing in below grade installations. Seal shall be capable of maintaining cathodic protection with Delrin plastic pressure plates. Install seals in accordance with Manufacturer's Bulletin LS-104. Brush underground metal parts with a good grade of mastic before backfill.

2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.4 MISCELLANEOUS METALS

- A. Steel plates, shapes, bars, and bar grating: ASTM A 36.
- B. Cold Formed Steel Tubing: ASTM A 500.
- C. Hot Rolled Steel Tubing: ASTM A 501.
- D. Steel Pipe: ASTM A 53, Schedule 40, welded.
- E. Fasteners: Zinc coated, type, grade, and class as required.

2.5 MISCELLANEOUS LUMBER

- A. Framing Materials: Standard Grade, light framing size lumber of any species. Number 3 Common or Standard Grade boards complying with WCLIB or AWPB rules, or Number 3 boards complying with SPIB rules. Lumber shall be preservative treated in accordance with AWPB LP 2, and kiln dried to a moisture content of not more than 19 percent.
- B. Construction Panels: Plywood panels; APA C D PLUGGED INT, with exterior glue; thickness as indicated, or if not indicated, not less than 15/32 inches.

2.6 TOUCHUP PAINT

- A. For Equipment: Provided by equipment manufacturer and selected to match equipment finish.
- B. For Nonequipment Surfaces: Matching type and color of undamaged, existing adjacent finish.
- C. For Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

2.7 JOINT SEALERS

- A. General: Joint sealers, joint fillers, and other related materials compatible with each other and with joint substrates under conditions of service and application.
- B. Colors: As selected by the Architect from manufacturer's standard colors.
- C. Elastomeric Joint Sealers: Provide the following types:
 - 1. One-part, nonacid-curing, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for masonry, glass, aluminum, and other substrates recommended by the sealant manufacturer.
 - 2. One-part, mildew-resistant, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for glass, aluminum, and nonporous joint substrates; formulated with fungicide; intended for sealing interior joints with nonporous substrates; and subject to in-service exposure to conditions of high humidity and temperature extremes.
 - 3. Available Products: Subject to compliance with requirements, products which may be incorporated in the Work include, but are not limited to, the following:
 - a. One-Part, Nonacid-Curing, Silicone Sealant:
 - 1) "Chem-Calk N-Cure 2000," Bostic Construction Products Div.
 - 2) "Dow Corning 790," Dow Corning Corp.
 - 3) "Silglaze N SCS 2501," General Electric Co.
 - 4) "Silpruf SCS 2000," General Electric Co.
 - b. One-Part, Mildew-Resistant, Silicone Sealant:
 - 1) "Dow Corning 786," Dow Corning Corp.
 - 2) "SCS 1702 Sanitary," General Electric Co.
 - 3) "863 #345 White," Pecora Corp.
 - 4) "Rhodorsil 6B White," Rhone-Poulenc, Inc.
 - 5) "Proglaze White," Tremco Corp.
 - 6) "OmniPlus," Sonneborn Building Products Div.
- D. Acrylic-Emulsion Sealants: One-part, nonsag, mildew-resistant, paintable complying with ASTM C 834 recommended for exposed applications on interior and protected exterior locations involving joint movement of not more than plus or minus 5 percent.
 - 1. Available Products: Subject to compliance with requirements, products which may be incorporated in the Work include, but are not limited to, the following:
 - a. "Chem-Calk 600," Bostik Construction Products Div.
 - b. "AC-20," Pecora Corp.
 - c. "Sonolac," Sonneborn Building Products Div.
 - d. "Tremco Acrylic Latex 834," Tremco, Inc.
- E. Fire-Resistant Joint Sealers: Two-part, foamed-in-place, silicone sealant formulated for use in through-penetration fire-stopping around cables, conduit, pipes, and duct penetrations through fire-rated walls and floors. Sealants and accessories shall have

fire- resistance ratings indicated, as established by testing identical assemblies in accordance with ASTM E 814, by Underwriters' Laboratories, Inc., or other testing and inspection agency acceptable to authorities having jurisdiction.

1. Available Products: Subject to compliance with requirements, products which may be incorporated in the Work include, but are not limited to, the following:
 - a. "Dow Corning Fire Stop Foam," Dow Corning Corp.
 - b. "Pensil 851," General Electric Co.

2.8 ACCESS DOORS

- A. Steel Access Doors and Frames: Factory-fabricated and assembled units, complete with attachment devices and fasteners ready for installation. Joints and seams shall be continuously welded steel, with welds ground smooth and flush with adjacent surfaces.
- B. Size: Install access panels not smaller than 12" by 6" for access to concealed pull boxes, junction boxes or similar items where no other means of access is provided.
- C. Fire Rating: All access panels and doors in walls and in ceilings shall be "1 ½ hour fire rated" and must bear the Underwriters' Laboratory 1 ½ hour B label.
- D. Frames: 16-gage steel, with a 1-inch-wide exposed perimeter flange for units installed in unit masonry, pre-cast, or cast-in-place concrete, ceramic tile, or wood paneling.
 1. For installation in masonry, concrete, ceramic tile, or wood paneling: 1 inch-wide-exposed perimeter flange and adjustable metal masonry anchors.
 2. For gypsum wallboard or plaster: perforated flanges with wallboard bead.
 3. For full-bed plaster applications: galvanized expanded metal lath and exposed casing bead, welded to perimeter of frame.
- E. Flush Panel Doors: 14-gage sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees; factory-applied prime paint.
 1. Fire-Rated Units: Insulated flush panel doors, with continuous piano hinge and self-closing mechanism.
- F. Locking Devices: Flush, screwdriver-operated cam locks.
- G. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the Work include, but are not limited to, the following:
 1. Bar-Co., Inc.
 2. J.L. Industries.
 3. Karp Associates, Inc.
 4. Milcor Div. Inryco, Inc.
 5. Nystrom, Inc.

2.9 REPAIR MATERIALS

- A. Use repair materials identical to existing materials. Where identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible. Use materials whose installed performance equals or surpasses that of existing materials.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. This Contractor shall expedite the work for a specific area, section or part of the Project to make provision for, or protect equipment or to permit the installation of another part of the work.
- B. All materials and equipment supplied by this Contractor shall be new, of the best of their respective kinds, without imperfections and blemishes, and shall be protected from the elements prior to installation.
- C. All conduits, wire, cable, wiring devices and equipment shall be installed in such a manner as to preserve access to any existing equipment or to any new equipment installed under this specification or under other specifications or contracts for this Project and with sufficient space provided for proper operation and maintenance.
- D. The drawings are generally indicative of the work to be installed but do not indicate all bends, fittings, boxes, etc., which may be required. The Contractor shall carefully investigate the structural and furnish conditions affecting his work, arrange his work accordingly, and furnish such fittings as may be required to meet such conditions.
- E. This Contractor shall coordinate his work with other trades so that all work may be installed in the most direct manner and so that interference between piping, ducts, equipment, architectural or structural features will be avoided. In cases of interference, conflicts, or fouling results, the Architect shall decide which work is to be relocated, regardless of which was installed first. Such relocation shall be at no additional expense to the Owner.
- F. All materials and equipment installed by the Contractor shall be firmly supported and secured to the building structure/construction as required.
- G. Scaffolding with ladders shall be furnished and erected, where required for the proper installation of wiring, equipment and fixtures.

3.2 EXCAVATION AND BACKFILL

- A. The Contractor shall do all excavating required for the installation of underground conduits and wiring, exterior lighting circuits, and for other work included under this Contract.

- B. Prior to submitting his bid price and prior to any work, the Electrical Contractor shall familiarize himself with local ordinances and amendments, and shall contact local authorities to obtain all regulations and requirements which must be followed. The Contractor shall secure all necessary permits before the start of any work.
- C. The Contractor shall conform with Act No. 187 of 1996 (formerly Act No. 287) of the General Assembly of the Commonwealth of Pennsylvania which was enacted to protect public health and safety.
- D. Exterior underground conduits shall be installed with top not less than 2'-6" below finished grade line. Conduits shall be installed at depth required to properly enter building. Directly buried cable shall be installed in clean trenches free from stones, rock and other debris. Cable shall be installed not less than 2'-6" below finished grade and in strict accordance with the cable manufacturer's recommendations. Furnish and install plastic warning sheets above all underground electrical installations as hereinafter specified. Excavation and backfill for the Power Company's primary service shall be in strict accordance with the Power Company's requirements.
- E. The bottoms of all excavations shall be properly leveled off and concrete placed on undisturbed soil. All loose materials shall be removed and the excavations shall be brought into approved condition to receive concrete or other material. No earth filling will be allowed under bases or slabs. All excavation shall be carried down to firm formation. However, if additional depths are required to reach firm earth, the extra excavation and materials required to perform the work shall be done at no extra cost to the Owner. If, through an error on the part of the Contractor, any part of the excavation is carried below the depth indicated or required for the work, the Contractor shall maintain the excavation and shall start concrete from the excavated level, and no extra compensation will be considered. Excavate and pour concrete only on the basis of approved shop drawings. Excavation below footings shall be filled with concrete as directed by the Architect.
- F. The Contractor shall notify the Construction Architect as soon as excavations are completed, in order that the bearing quality of the bottoms may be inspected before concrete is poured, or before formwork is erected. Concrete shall be poured as soon as weather conditions permit after excavation is completed and inspected. In case bottoms of excavations become wet and soft, all soft material shall be removed and the concrete poured to the required extra depth, at no extra cost to the Owner.
- G. The excavation shall be kept safe at all times. Shoring and sheathing shall be used when necessary or required by applicable regulating agencies. The excavation shall be kept free of water at all times. Additional shoring and sheathing shall be provided at any time to safeguard the work. Shoring and sheathing shall be provided in strict accordance with all applicable Federal, State, county and local ordinances and regulations. Existing structures shall be shored and underpinned where necessary and as directed by the Architect.
- H. After the underground conduits and cable, etc. are installed and tested, the Contractor shall backfill all excavations with selected earth placed in layers not exceeding 6" in thickness with each layer thoroughly compacted. All backfill shall be clean and free of rocks, stones or other debris.

- I. Adequate protection shall be provided for all existing or new structures, services, or utilities encountered in the excavation. The protection shall include bracing, sheathing, shoring, supports, etc., as required to maintain grade and alignment and to provide proper mechanical strength. Any structures, services, or utilities damaged by the work of the Contractor shall be promptly repaired and placed in same condition as they originally were prior to such damage. Adequate barricades, guards, signs, red lanterns, audible signals, etc., shall be placed and maintained to protect persons from injury. Rules and regulations of federal, state and local authorities respecting safety provisions shall be observed.
- J. The proposal shall be for unclassified excavation and shall include all excavation that may be necessary to complete the Project, including any rock or other debris that may be encountered.
- K. All excess excavated materials shall be disposed of as directed by the Architect. The number of points at which the Contractor will be permitted to work and length of open trenches that will be permitted will be governed by the Architect. All excavated debris shall be immediately removed from the site.
- L. Excavation shall be conducted in a manner to cause the least interruption of traffic. Where traffic must cross open trenches, the Contractor shall provide bridges suitable for the traffic involved in accordance with local, State and Federal Regulations.
- M. No conduit or masonry shall be laid in water and new laid masonry or conduit shall be protected, in a manner satisfactory to the Architect, so that no flood or surface water may enter same. The Contract shall include any required pumping, bailing or drainage of water that may have accumulated or be found in excavations.
- N. As the work progresses, the Contractor shall record on the drawings all changes and deviations from the Contract Drawings. Measurements shall include elevations and sufficient offset measurements from building to definitely locate all equipment and underground lines. Two prints of marked drawings shall be delivered to the Architect before final acceptance.
- O. All surfaces shall be restored to their original condition, including paved or unpaved areas, streets, roadways and turf to the satisfaction of the Architect. Final grading, finishing, paving and seeding of all excavated areas shall be included under this Contract, except where new surfaces are being provided as a part of the site work under the General Contract.
- P. Any settling, deterioration or washing out of earth or repaired surfaces after the initial installation shall be corrected by this Contractor.
- Q. Restore the surface of all excavations performed under this Contract to their original condition. This shall include paved or unpaved streets, sidewalks, curbs, steps, roadways, avenues, driveways, parking areas, or turf. Include all necessary raking, fertilizing, seeding, rough and finish grading. Restore all surfaces to the satisfaction of the Architect. Coordinate all of the restoration work with the extent of work included under the General Contract. Existing trees, shrubs, or turf damaged under this Contract shall be replaced to the satisfaction of the Construction Manager.

- R. Excavation and backfill shall comply with Specification Section 312000.5.

3.3 ROUGH-IN

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- B. Refer to equipment specifications in other Specification Divisions and approved product data and shop drawings for rough-in requirements.

3.4 ELECTRICAL INSTALLATIONS

- A. General: Sequence, coordinate, and integrate the various elements of electrical systems, materials, and equipment. Comply with the following requirements:
1. Coordinate electrical systems, equipment, and materials installation with other building components.
 2. Verify all dimensions by field measurements.
 3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for electrical installations.
 4. Coordinate the installation of required supporting devices and sleeves to be set in poured in place concrete and other structural components, as they are constructed.
 5. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
 6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
 7. Coordinate connection of electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
 8. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Architect.
 9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
 10. Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
 11. Install access panel or doors where units are concealed behind finished surfaces.
 12. Install systems, materials, and equipment giving right of way priority to systems required to be installed at a specified slope.

B. Performance of Equipment

1. All materials, equipment and appurtenances of any kind, shown on the drawings, hereinafter specified or required for the completion of the Project in accordance with the intent of these specifications, shall be completely satisfactory and acceptable in operation, performance, and capacity. No approval either in written or verbal of any drawings, descriptive data, or samples of such material, equipment and/or appurtenances shall relieve this Contractor of his responsibility to turn over the same to the Owner in perfect working order at the completion of the Project.
2. Any material, equipment or appurtenances, the operation, capacity or performance of which does not comply with the drawings and/or specification requirements or which is not new or which is damaged prior to acceptance by the Owner will be held to be defective material and shall be removed and replaced with the proper acceptable materials, equipment and/or appurtenances or put in proper acceptable working order, satisfactory to the Architect with no additional expense to the Owner.
3. All auxiliary systems specified herein including the emergency lighting system, fire alarm system, intercommunication system, telephone distribution system, MATV system, or other similar systems shall be furnished by manufacturers who have been regularly engaged in the manufacture of these products for a period of not less than five (5) years. This Contractor shall deliver to the Architect, prior to final payment, a statement from the manufacturer or his authorized representative, certifying that the equipment has been inspected by him and found to be properly installed and functioning satisfactorily. Installation, final connections and testing of such systems shall be performed under the direct supervision of competent authorized service engineers who shall be in the employ of the respective equipment manufacturer. Any and all expenses incurred by these equipment manufacturer's representatives shall be borne by the Contractor.
4. All details of the installation of all equipment shall be electrically and mechanically correct. All equipment shall operate without objectional noise or vibration should be produced and transmitted to occupied portions of the building by apparatus, conduit or other parts of a system, any corrections to eliminate noise and vibration shall be at no expense to the Owner.

3.5 CUTTING AND PATCHING

- A. General: Perform cutting and patching in accordance with Part 1 paragraph "Related Documents." In addition to the requirements referenced in the "Related Documents" paragraph, the following requirements apply:
1. Perform cutting, fitting, and patching of electrical equipment and materials required to:
 - a. Uncover Work to provide for installation of ill timed Work.
 - b. Remove and replace defective Work.
 - c. Remove and replace Work not conforming to requirements of the Contract Documents.
 - d. Install equipment and materials in existing structures.

- e. Upon written instructions from the Architect, uncover and restore Work to provide for Architect observation of concealed Work.
 - 2. Cut, remove, and legally dispose of selected electrical equipment, components, and materials as indicated, including but not limited to removal of electrical items indicated to be removed and items made obsolete by the new Work.
 - 3. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.
 - 4. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.
 - 5. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.
 - 6. Patch existing finished surfaces and building components using new materials matching existing materials and experienced Installers. Installers' qualifications refer to the materials and methods required for the surface and building components being patched.
- B. Cutting, Patching, and Finishing (Existing Building)
- 1. Electrical Contractor shall be responsible for all cutting, patching, and finishing of existing construction for the proper installation of all electrical equipment and materials to be installed in the existing portion of this project. This will also be required for the removal of the existing equipment and materials. All cutting shall be kept to an absolute minimum consistent with the requirements of the project. Cutting, patching and finishing shall be done by workmen skilled in this type of work. All patching shall be done utilizing materials of the same quality and texture as the adjacent undisturbed areas perfectly and to the satisfaction of the Architect.
 - a. Cutting: Cut and remove existing construction only to the extent required by new Work and as indicated. Use methods required to complete Work within limitations of governing regulations and as follows:
 - 1) 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. To minimize disturbance of adjacent surfaces, use hand or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
 - 2) Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 - 3) 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.
 - 4) Maintain adequate ventilation when using cutting torches.
 - 5) Cut concrete and masonry at junctures with construction to remain, using power driven masonry saw or hand tools; do not use power driven impact tools.

- b. Patching: Return elements of construction and surfaces to remain to condition existing before start of cutting operations.
- c. Painting
 - 1) Painting of the final finished areas will be by the General Contractor as shown in the "Interior Finish Schedule" on the Architectural Drawings.
 - 2) Where cutting and patching occurs in areas that the General Contractor does not have any work and/or the General Contractor is not required to finish the wall and/or ceiling that was affected by this Contractor's work, the Electrical Contractor shall paint the affected surface from "natural" break to "natural" break as directed by the Architect. When other trades other than the General Contractor damage the same wall and/or ceiling, the Electrical Contractor shall coordinate his painting responsibilities with the other trades before proceeding with any work in that area.
 - 3) All surfaces to be painted shall receive an undercoat 24 hours before the final coat is applied. Undercoats which show lumps or rough areas shall be smoothed with fine sandpaper or steel wool and dusted off before the final coat is applied. Final coat shall be solid, even color, free of lumps, drops, sags, run brush marks, laps, or other defects, finished to a line where they adjoin other colors or unpainted surfaces.
 - 4) Drop cloths shall be used to protect floors and all other work from damage. Any covering temporarily removed from any part of the work or finish shall be promptly replaced and any damage from neglect to so protect all surfaces shall be good at the Contractor's expense.
 - 5) Paint color shall match adjoining surfaces as closely as possible and to the satisfaction of the Architect.
- 2. No cutting shall be done which may affect the building structurally or architecturally including building systems without first securing the approval of the Architect. Cutting shall be accomplished in such a manner as not to cause damage to the building or leave unsightly surfaces which cannot be concealed by plates, escutcheons, or other construction. Where unsightly conditions are caused, the Contractor shall be required, at his own expense, to repair the damaged areas.
- 3. Cutting of the construction excessively or carelessly done shall be repaired by this Contractor to match the original work and to the satisfaction of the Architect who will make the final decision with respect to excessive or careless cutting work.
- 4. This Contractor shall seal all openings he has made in plenum spaces, fire rated floors, ceilings or partitions after his work has been installed. The material used for sealing the openings shall have a fire rating equal to or greater than the rating of the floor, ceiling or partition material. Openings shall be suitably treated to prevent passage of stray light, air or sound.
- 5. Where present equipment is removed and unused openings remain in walls, floors, partitions, etc., this Contractor shall properly patch all such openings. All patching and repairing shall be done by workmen skilled by this type of work and shall match present or new finishes.

6. All holes or openings for the passage of conduit to be put in existing concrete shall be bored.
7. Cutting, patching, and repairing of openings in the existing exterior walls and roof shall be by the General Contractor.

C. Chases and Openings (New Building)

1. All openings or chases required for the installation of the work in the new portion of the building shall be provided by the General Contractor, providing the Electrical Contractor notifies the General Contractor of the size and location of the required openings or chases in sufficient time before the work is closed in, so that the work of the General Contractor will not be delayed.
2. If the Electrical Contractor fails to notify the General Contractor in sufficient time, the Electrical Contractor shall cut and patch the openings at his expense.
3. The Electrical Contractor shall set all sleeves, hangers, and anchors required for his work and shall be responsible for their proper and permanent location.
4. The Electrical Contractor shall seal all openings he has utilized in fire rated floors, ceilings, or partitions after his work has been installed. The material used for sealing the openings shall have a fire rating equal for greater than the rating of the floor, ceiling, or partition material. Openings shall be suitably treated to prevent passage of stray light, air or sound.

3.6 PROTECTION OF WORK, MATERIALS, AND EQUIPMENT

- A. This Contractor shall effectually protect at his own expense, all existing facilities and such of his new work, materials or equipment as is liable to injury during the construction period. All openings in to any part of the conduit system as well as all associated fixtures, equipment, etc. both before and after being set in place shall be securely covered or otherwise protected to prevent obstruction, damage, or injury due to carelessly or maliciously dropped tools or materials, grit, dirt moisture, water or any foreign matter. This Contractor shall be held responsible for all damage so done, until his work is fully accepted by the Architect. Conduit ends shall be covered with capped bushings.
- B. All surfaces, either finished or in preparation for finishing or finish material application, shall be protected against damage from painting, welding, cutting, burning, soldering or similar construction functions. The protection shall be accomplished by care in operations, covering and shielding. Special care shall be directed to exposed finished masonry, metal or wood surfaces and painted surfaces. Corrective measures required shall be accomplished by the trade which made the original installation and shall be at the expense of the Contractor causing the damage with no cost to the Owner.
- C. Any damage caused by neglect on the part of this Contractor or his representative, or by the elements due to neglect on the part of this Contractor or his representatives, either to the existing work, or to his work or to the work of any other Contractor, shall be repaired at his expense to the Architect's satisfaction.

3.7 CONCRETE BASES

A. Forms and Reinforcing Materials

1. Form concrete pads with framing lumber with form release compounds. Chamfer top edge and corners of pad. Anchor or key to floor slab.
2. Install reinforcing bars where required, tied to frame, and place anchor bolts and sleeves to facilitate securing units.

B. Mounting: Anchor electrical equipment and other system components on concrete housekeeping bases. Provide anchorage according to manufacturer's written instructions, unless otherwise indicated.

1. Concrete Pad: Housekeeping bases shall be 4" high with 1" chamfer edges minimum and shall extend 4" beyond the edge of the electrical equipment on all accessible sides unless indicated otherwise. Coordinate size of equipment with actual unit size before proceeding with any formwork.
2. Clearance: Maintain minimum workspace around components according to manufacturer's Shop Drawings and National Electrical Code.
3. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.
5. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

C. Concrete: Comply with Specification Section 033000.5.

3.8 SLEEVE-SEAL INSTALLATION

A. Install to seal exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.9 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly.

3.10 CLEAN-UP

A. Daily, and when directed by the Architect, the Electrical Contractor shall remove all waste and debris resulting from his work.

- B. Upon completion of his work and when directed by the Architect, the Electrical Contractor shall remove all dirt, foreign materials, stains and fingerprints from all equipment, fixtures, panels, plates, etc., installed under this contract. Internal areas of all equipment must be cleaned of all construction dust etc., prior to pre-final and/or final inspection.
1. Clean paint, varnish spots and stains caused by finishing materials used by this Contractor from all walls, floors, trim, glass, hardware, fixtures, masonry or any other surface that is damaged by this Contractor's work.
 2. Do not use solvents that would remove or damage the finish of the finish hardware or other factory-finished materials. If damage occurs, the affected materials shall be returned to the factory for refinishing at not expense to the Owner.
 3. Repair all finishes damaged by this Contractor in areas that the General Contractor does not have any work and/or the General Contractor is not required to finish the space that was affected by this Contractor's work and leave all work clean and perfect at completion.

END OF SECTION 260500

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Building wires and cables rated 600 V and less.
 - 2. Connectors, splices, and terminations rated 600 V and less.
 - 3. Sleeves and sleeve seals for cables.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Qualification Data: For testing agency.
- C. Field quality-control test reports: Indicate and interpret test results for compliance with performance requirements.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

1.5 COORDINATION

- A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- B. Coordinate layout and installation of cables with other installations.
- C. Revise locations and elevations from those indicated, as required to suit field conditions and as approved by Architect.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Southwire Company, LLC
 - 2. General Cable Technologies Corporation
 - 3. American Bare Conductor
 - 4. Cerro Wire, LLC.
 - 5. The Okonite Company
- 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 Types THHN-THWN and XHHW.
- D. Multi-conductor Cable: Comply with NEMA WC 70/ICEA S-95-658 for metal-clad cable, Type MC and mineral-insulated, Type MI with ground wire.
- E. UL-listed building wires and cables with conductor material, insulation type, cable construction, and rating as specified in Part 3 "Wire and Insulation Applications" Article.
- F. Conductor Material: Copper.
- G. Stranding: Conductors No. 10 and smaller, except where herein specified otherwise, shall be solid, and conductors No. 8 and larger shall be stranded.

2.2 METAL-CLAD CABLE

- A. Metal-Clad Cable (Type MC) may be installed in concealed locations for branch circuits of 30 amperes or less. Type MC cable shall be a galvanized sheathed assembly of one or more 600 volt, 90 degree C., copper conductors, each insulated and enclosed in a metallic sheath of interlocking corrugated tubes and shall comply with Article 334 and also applicable provisions of Article 300 of the National Electrical Code. Type MC cable shall be provided with an integral insulated ground conductor and shall be as manufactured by Southwire Company, LLC., General Cable Technologies Corp., AFC Cable Systems, The Okonite Company, or approved equal.
- B. Type MC cable shall be installed in compliance with the aforementioned Articles and shall be supported and secured at intervals not to exceed six feet. Support wires utilized for suspended ceiling or the suspended ceiling grid system shall not be utilized as the support for this cable. Type MC cable which must be installed exposed to view, in such areas as Mechanical and Electrical Equipment Rooms, shall be installed within rigid steel conduit, intermediate metal conduit, or electrical metallic tubing.

2.3 CONNECTORS AND SPLICES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Amp Incorporated.
 - 2. O-Z/Gedney; EGS Electrical Group LLC.
 - 3. 3M; Electrical Markets Division.
 - 4. Square D Co.; Anderson.
 - 5. AFC Cable Systems, Inc
 - 6. Hubbell Power Systems, Inc.
 - 7. Ideal Industries, Inc.
 - 8. NSi Industries LLC.
- B. Fittings utilized for the connection of Type MC cable to electrical boxes, cabinets, or other equipment shall be identified for use with Type MC cable and shall be of the type to provide effective bonding between the metallic sheath and such boxes, cabinets, and other equipment and shall be UL and CSA listed. Fittings shall be Thomas and Betts Catalog No. 2-050-008-B, or approved equal. Fittings and supports for Type MC cable shall comply with NEMA FB1 Standard Publication titled "Fittings and Supports for Conduit and Cable Assemblies" and shall be approved by the Architect/Engineer prior to installation.
- C. UL-listed, factory-fabricated wiring connectors of size, ampacity rating, material, type, and class for application and service indicated. Comply with Project's installation requirements and as specified in Part 3 "Wire and Insulation Applications" Article.

2.4 LUGS AND CONNECTORS

- A. The Contractor shall furnish and install all necessary lugs and connectors of proper size and type as required by the work under these specifications. Lugs and connectors shall be installed in strict accordance with the cable and lug manufacturer's recommendations. Lugs and connectors must be suitable, marked and UL listed for the size, type of cable, bus, bolts, etc., connected. All connections shall be hydraulic crimp-type and made tight and solid.

2.5 SLEEVES FOR CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch thickness as indicated and of length to suit application.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine raceways and building finishes to receive wires and cables for compliance with requirements for installation tolerances and other conditions affecting performance of wires and cables. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 WIRE AND INSULATION APPLICATIONS

- A. Underground Feeders and Branch Circuits: Type XHHW 2, in raceway.
- B. Feeders: Type THHN/THWN, in raceway.
- C. Exposed Branch Circuits, Including in Crawlspace: Type THHN/THWN, in raceway.
- D. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type MC Cable in existing walls where walls are not being opened under this contract. Type THHN/THWN in raceway Concealed in Ceilings, Walls, and Partitions that are being opened under this contract.
- E. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2, single conductors in raceway.
- F. Variable Frequency Drive Output Circuits: Type XHHW-2 in metal conduit.
- G. Fire Alarm Circuits: Type THHN/THWN, in raceway.
- H. Class 1 Control Circuits: Type THHN/THWN, in raceway.
- I. Class 2 Control Circuits: Type THHN/THWN, in raceway.
- J. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Install wires and cables as indicated, according to manufacturer's written instructions and NECA's "Standard of Installation."
- B. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- C. Complete raceway installation between conductor and cable termination points according to Division 26 Section "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- D. Type MC cable shall be installed in compliance with the aforementioned Articles and shall be supported and secured at intervals not to exceed six feet. Support wires

utilized for suspended ceiling or the suspended ceiling grid system shall not be utilized as the support for this cable. Type MC cable shall not be installed exposed to view, in such areas as Mechanical and Electrical Equipment Rooms. These areas shall have circuits in conduit.

- E. 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.
- F. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- G. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- H. Seal around cables penetrating fire-rated elements.
- I. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."
- J. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."
- K. No conductors smaller than No. 12 AWG shall be used. No. 10 AWG conductors shall be installed for all 120 volt circuit runs greater than 100 ft. one way from panel to last outlet. No. 10 AWG conductors shall also be installed for all 277 volt circuit runs greater than 150 feet one way from panelboard to last outlet.
- L. Neutral conductors, shown or not shown, shall be installed for all single phase and for all three phase circuits in which a neutral is required for control circuit voltage.
- M. The conductor ampacities utilized for design purposes are based on 75 degrees C. conductor temperature rating. Where conductors are connected to or run within equipment which are U.L. listed for 60 degrees C., the conductor ampacities shall be based on 60 degrees C. The Contractor shall be responsible for providing the correct size conductors based upon ampacities and temperature ratings of equipment and conductors should any 60 degrees C. equipment be utilized.
- N. Conductors installed in high ambient locations such as electrical resistance heating equipment, in lighting fixture housings or channels, etc., shall be suitable for heat resisting service in accordance with Underwriters' requirements and NFPA 70.
- O. Each bundle or reel of conductors shall bear the maker's name and the Underwriters' label, together with the grade, size, length and manufacturing date. Similar information shall be included on the insulation jacket of the conductors. Secondary conductors shall comply with Federal Specifications JC-30A.
- P. All conductors underground, in or under slabs on grade and to outside outlets shall be continuous from switch to outlet. Conductors no smaller than No. 12 AWG shall be installed for light and power circuits.

- Q. Conductors installed directly in Ducts, Plenums, or other spaces used for environmental air shall comply with Article 300.22 of NFPA 70.
- R. The Contractor shall tag and identify each circuit and phase in all accessible locations such as outlet boxes, junction boxes, pull boxes, panelboards, disconnect switches, starters, equipment, etc. Tags or identification bands shall be nonmetallic, durable type. Paper or cardboard tags are not permitted.
- S. This Contractor shall verify prior to installation that there exists coordination between the overcurrent protective device and the respective circuit conductor sizes shown on the drawings. The Contractor is responsible for identifying discrepancies, between the overcurrent protective device and the respective circuit conductor sizes indicated, and notifying the Architect of such discrepancies prior to purchasing and/or installation of such materials.
- T. The conductor sizes are based on allowable current carrying capacities listed in the National Electrical Code for copper conductors. .

3.4 CONNECTIONS

- A. Conductor Splices: No splices are permitted. Conductors shall be continuous between terminations.
- B. Use splice and tap connectors compatible with conductor material.
- C. Connect outlets and components to wiring and to ground as indicated and instructed by manufacturer.
- D. 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.
- E. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
 - 1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.
- F. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

3.5 DISTRIBUTION SYSTEM

- A. The electrical distribution system shall be installed, generally, as shown on the drawings. The drawings are diagrammatic and are not intended to show actual conduit locations and routing or exact equipment location. Such items are the responsibility of the Electrical Contractor.
- B. A separate conduit shall be provided for each set of mains, feeders, and branch circuits, except for single pole work on branch circuits where conductors may be grouped in accordance with the National Electrical Code; however, the maximum

number of conductors installed in one conduit shall not exceed nine and the use of common neutral conductors is not permitted. More than nine conductors may be installed in one conduit for special systems and locations specifically shown on the drawings or where permitted by the Architect. Grouped conductors shall be derated by the Electrical Contractor in accordance with the requirements of the National Electrical Code Table 310.15(B)(2)(a). Main service conductors or feeders conductors shall not be grouped.

- C. Unless specifically indicated otherwise, all circuitry indicated on the drawings shall be interpreted as 3 #12 awg. conductors within a 1/2" conduit. (One #12 awg. phase conductor, One #12 awg. neutral conductor and One #12 awg. ground conductor.) The use of a common neutral conductor in a multiple circuit arrangement is prohibited. Each single phase circuit shall be provided with a separate neutral conductor. Sharing of a neutral conductor between two or more single phase circuits is not permitted.

3.6 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test for compliance with requirements.
 - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification, Section 7.3.2 Certify compliance with test parameters. Meggar tests are not required on low voltage conductors and cables.
 - 3. Infrared Scanning: After final payment, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in cables and conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner.
 - a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - b. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- C. Test Reports: Prepare a written report to record the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.

3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- D. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 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. This Section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.
- B. The Contractor shall furnish and install all necessary materials and accessories to solidly ground all non-current carrying metal parts of the electrical system.
- C. The Contractor shall measure the resistance of the existing grounding system and supplement the existing to reach the required value specified.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in Part 3 "Field Quality Control" Article, including the following:
 - 1. Ground rods.
 - 2. Ground rings.
 - 3. Grounding arrangements and connections for separately derived systems.
 - 4. Grounding for sensitive electronic equipment.
- C. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
- D. Field quality-control test reports. Submit written test reports to include the following:
 - 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.
- E. Operation and Maintenance Data: For grounding to include the following in emergency, operation, and maintenance manuals:

1. In addition to items specified in Division 1 "Operation and Maintenance Data," include the following:
 - a. Instructions for periodic testing and inspection of grounding features at test wells and grounding connections for separately derived systems based on NFPA 70B.
 - 1) Tests shall be to determine if ground resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if they do not.
 - 2) Include recommended testing intervals.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING PRODUCT MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 1. Anixter Brox., Inc
 2. ERICO, Inc.
 3. Ideal Industries, Inc.
 4. O-Z/Gedney Co., A Brand of the EGS Electrical Group
 5. Thomas & Betts Corp.

2.2 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 UL 467 for grounding and bonding materials and equipment.

2.3 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare copper conductors shall not be used.

- C. Grounding Bus: Rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32 inch holes spaced 1 1/8 inches apart. unless otherwise indicated. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, - 600V and shall be Lexan or PVC impulse tested at 5000 V.
- D. Braided Bonding Jumpers: Copper tape, braided No. 30 gage insulated copper wire, terminated with copper ferrules, 1 5/8 inches wide and 1/16 inch thick.
- E. Bonding Strap Conductors/Connectors: Soft copper, 0.05 inch thick and 2 inches wide, unless indicated otherwise.

2.4 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, heavy duty bolted pressure-type, with at least two bolts.
 - 1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.5 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel with high-strength steel core and electrolytic-grade copper outer sheath, molten welded to core.
 - 1. Size: 3/4" in diameter x 120" in length.
- B. Chemical-Enhanced Grounding Electrodes: Copper tube, straight or L-shaped, charged with nonhazardous electrolytic chemical salts.
 - 1. Termination: Factory-attached No. 4/0 AWG bare conductor at least 48 inches long.
 - 2. Backfill Material: Electrode manufacturer's recommended material.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated
- B. Underground Grounding Conductors: Install bare tinned copper conductor, No. 2/0 AWG minimum.

1. Bury at least 30 inches below grade.
 2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.
- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- D. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
1. Install bus on insulated spacers 2 inch, minimum, from wall 6 inches above finished floor, unless otherwise indicated.
 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, down to specified height above floor, and connect to horizontal bus.
- E. Conductor Terminations and Connections:
1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 2. Underground Connections: Welded connectors, except at test wells and as otherwise indicated.
 3. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Duct Banks: Install a grounding conductor with at least 50 percent ampacity of the largest phase conductor in the duct bank.
- C. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.
- D. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.
- E. Pad-Mounted Transformers and Switches: Install three ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items

associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches from the foundation.

3.3 EQUIPMENT GROUNDING

- A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.
- B. Install a separate insulated equipment grounding conductors with all feeders and circuits. The use of the metallic raceway or cable sheath as the equipment grounding conductor is prohibited.
- C. Computer Outlet Circuits: Install insulated equipment grounding conductor in branch-circuit runs from computer-area power panels or power-distribution units.
- D. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- E. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- F. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
- G. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
- H. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
 - 1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-4-by-12-inch grounding bus.
 - 2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

- I. Metallic Fences: Comply with requirements of IEEE C2.
 - 1. Grounding Conductor: Bare, tinned copper, not less than No. 8 AWG.
 - 2. Gates: Shall be bonded to the grounding conductor with a flexible bonding jumper.
 - 3. Barbed Wire: Strands shall be bonded to the grounding conductor.
- J. Metal and Wood Poles Supporting Outdoor Lighting Fixtures: Install a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors and bond all metal parts on the pole, pole base, and fixture.

3.4 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
 - 2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.
- D. Grounding and Bonding for Piping:
 - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.

3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- E. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install braided type bonding jumpers to bond across flexible duct connections to achieve continuity.
- F. Grounding for Steel Building Structure: Install a driven ground rod at base of each new corner column and at new intermediate exterior columns at distances not more than 60 feet apart.
- J. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column, extending around the perimeter of building.
 1. Install tinned-copper conductor not less than No. 2/0 AWG for ground ring and for taps to building steel.
 2. Bury ground ring not less than 24 inches from building's foundation.

3.5 CONNECTIONS

- A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
 2. Make connections with clean, bare metal at points of contact.
- B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.
- C. Equipment Grounding Conductor Terminations: Use pressure-type grounding lugs. All lugs used in the building system shall be rated copper only, copper-aluminum rated lugs shall not be acceptable.
- D. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.
- E. Tighten screws and bolts for grounding and bonding 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.
- F. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies

recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

- G. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:
- B. Perform the following tests and inspections and prepare test reports:
 - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 - 2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal and at ground test wells. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance not less 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.
 - 3. Prepare dimensioned drawings locating each test well, ground rod and ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- C. Report measured ground resistances that exceed the following values:
 - 1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 5 ohms.
 - 2. Power and Lighting Equipment or System with Capacity 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 ohms.
 - 5. Substations and Pad-Mounted Equipment: 5 ohms.
 - 6. Manhole Grounds: 10 ohms.
- D. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

3.7 GRADING AND PLANTING

- A. Restore surface features, including vegetation, at areas disturbed by Work of this Section. Reestablish original grades, unless otherwise indicated. If sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other activities to their original condition. Include application of topsoil, fertilizer, lime, seed, sod, sprig, and mulch. Restore disturbed paving as indicated.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.
 - 2. Construction requirements for concrete bases.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel slotted support systems.

- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
 - 1. Equipment supports.
 - 2. Trapeze hangers. Include Product Data for components.
 - 3. Steel slotted channel systems. Include Product Data for components.
- C. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

1.7 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 033000.5.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
 - 1. 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. Thomas & Betts Corporation.
 - e. Unistrut; Tyco International, Ltd.
 - 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 3. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 - 4. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

- C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron casting with hot-dip galvanized finish.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- F. 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. Powder-Actuated Fasteners should not be used in lightweight concrete or slabs less than 4 inches thick.
 - b. 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) Fastenal Company
 - 4) MKT Fastening, LLC.
 - 5) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
 - 2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2) Hilti Inc.
 - 3) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 4) Fastenal Company
 - 5) MKT Fastening, LLC.
 - 3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
 - 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 - 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 - 6. Toggle Bolts: All-steel springhead type.
 - 7. Hanger Rods: Zinc plated low carbon threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with two-bolt conduit clamps.
- D. Spring-steel fasteners specifically designed for supporting single conduits or tubing may be used instead of malleable-iron hangers for 1-1/2-inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings and for fastening raceways to slotted channel and angle supports.

3.2 HANGERS AND PLATES

- A. All horizontal conduit or equipment within the building that is hung shall be hung from building construction with beam clamps or inserts in concrete, galvanized threaded extension rods, and approved hangers. Hangers and supports shall be arranged to distribute the weight of conduit and equipment uniformly on the structure. All conduits shall be securely fastened in place by means of galvanized malleable or galvanized stamped steel clamps, hanger rings, inserts or other approved galvanized supports.
- B. Spring steel clips may be used for supporting conduit. The spring steel clips, the arrangement of the spring steel clips and the method of fastening is subject to review by the Architect prior to installation.
- C. All necessary structural supports and inserts to hang all conduit and other miscellaneous equipment shall be provided by this Contractor. Steel plates and other supports shall be installed in the concrete construction. Hanger rods shall be securely attached to plates. Where cutting is required for the installation of hangers, conduit and supports, all openings must be neatly drilled by the Electrical Contractor.

Punching or chipping of concrete will not be permitted. All necessary openings shall be drilled in a location and manner satisfactory to the Architect. All concrete damaged by the Electrical Contractor shall be patched, reinforced, or replaced as directed by the Architect. Location of all holes and openings shall clear reinforcing steel in floor and roof decks. The Electrical Contractor shall coordinate all work with the General Contractor and shall determine exact locations of all supports and openings.

- D. Furnish and install all required concrete inserts. Multiple inserts shall not be installed in a concrete structural slab less than 4" thick. For concrete structural slabs less than 4" thick, the Contractor shall furnish and install structural beams, angles, etc., built into general construction, as required. Multiple inserts may be installed only where approved by the Architect.
- E. The Contractor shall place all hanger and support inserts in concrete. Fish plates shall be installed where hangers are attached through steel decking.
- F. Safe working load shall not exceed 1/4 of proof test load of fastening devices.
- G. Use pipe straps or individual conduit hangers for supporting individual conduits.
- H. Support multiple conduit runs with trapeze hangers. Use trapeze hangers that are designed to support a load equal to or greater than the sum of the weights of the conduits, wires, hanger itself, and 200 pounds. Secure each conduit with U-bolts or other approved fasteners.
- I. Support conduit independently of junction boxes, pull boxes, fixtures, suspended ceiling T-bars, angle supports, and similar items.
- J. Independently support conduit. Do not use other supports i.e., (suspended ceilings, suspended ceiling supporting members, lighting fixtures, mechanical piping, or mechanical ducts).
- K. Fasteners and Supports in Solid Masonry and Concrete:
 - 1. New Construction: Use steel or malleable iron concrete inserts set in place prior to placing the concrete.
- L. Hollow Masonry: Toggle bolts are permitted. Bolts supported only by plaster are not acceptable.
- M. Metal Structures: Use machine screw fasteners or other devices specifically designed and approved for the application.
- N. Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.
- O. Chain, wire, or perforated strap shall not be used to support or fasten conduit.
- P. Vertical Supports: Vertical conduit runs shall have riser clamps and supports in accordance with the NEC and as shown. Provide supports for cable and wire with fittings that include internal wedges and retaining collars.

3.3 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. 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.
- C. 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: Welded threaded studs or spring-tension clamps on steel.
 - a. Field Welding: Comply with AWS D1.1/D1.1M.
 - 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 by means that meet seismic-restraint strength and anchorage requirements.
- D. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.4 INSTALLATION OF FABRICATED METAL SUPPORTS

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

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. 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 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

- 1. Raceways include the following:

- a. RMC.
 - b. RNC.
 - c. EMT.
 - d. Wireways.

- 2. Boxes, enclosures, and cabinets include the following:

- a. Device boxes.
 - b. Outlet boxes.
 - c. Pull and junction boxes.
 - d. Cabinets and hinged-cover enclosures.

- B. Related Sections include the following:

- 1. Division 26 Section "Common Work Results for Electrical" for raceways and box supports.
 - 2. Division 27 Section "Pathways for Communications Systems" for conduits, wireways, surface pathways, innerduct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. FMC: Flexible metal conduit.
- C. IMC: Intermediate metal conduit.
- D. LFMC: Liquidtight flexible metal conduit.
- E. LFNC: Liquidtight flexible nonmetallic conduit.

- F. RMC: Rigid metallic conduit.
- G. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.
- C. 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.
- D. Qualification Data: For professional engineer.
- E. Seismic Qualification Certificates: For enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal 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.
 - 4. Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.
- F. Source quality-control reports.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Metal Conduit and Tubing
 - a. Allied Tube & Conduit; a Tyco International Ltd. Co
 - b. Anamet Electrical, Inc.; Anaconda Metal Hose.
 - c. Anixter Brothers, Inc.
 - d. Triangle PWC, Inc.
 - e. Wheatland Tube Company.
 - f. Thomas & Betts Corporation.
 - g. Robroy Industries.
 - h. Southwire Company.
 - i. O-Z/Gedney.
 - 2. Conduit Fittings:
 - a. Crouse-Hinds; Div. of Cooper Industries.
 - b. Emerson Electric Co.; Appleton Electric Co.
 - c. Hubbell, Inc.; Killark Electric Manufacturing Co.
 - d. Lamson & Sessions; Carlon Electrical Products.
 - e. O-Z/Gedney; Unit of General Signal.
- B. Rigid Steel Conduit: ANSI C80.1 and UL 6.
 - 1. Rigid steel conduit shall be zinc coated, or galvanized or sherardized on all surfaces. An additional bituminous coating shall be applied over the zinc where installed in wet locations. Conduit fittings shall be made from the same grade of steel as rigid steel zinc coated conduit and shall be treated, protected, threaded, etc., in every way according to the requirements for rigid steel zinc coated, conduit, insofar as they apply.
- C. IMC: ANSI C80.6 and UL 1242.
 - 1. Galvanized intermediate metal conduit may be used for the installation of conductors where permitted by the National Electrical Code. Intermediate metal conduit shall be assembled with threaded couplings and connectors similar to that specified for rigid conduit. Conduit shall conform with Article 342 of the National Electrical Code. Conduit shall be hot-dipped galvanized steel manufactured in accordance with UL Standard No. 6, or UL Standard No. 1242.
- D. EMT: ANSI C80.3 and UL 797.
 - 1. Electrical metallic tubing shall be zinc coated, galvanized or sherardized on all surfaces. Tubing shall bear the Underwriters' and manufacturer's label and shall conform to Federal Specifications WW-C-563. Maximum size of electrical

metallic tubing permitted is 4" size. Electrical metallic tubing shall not be installed in wet locations

E. FMC: UL 1

1. Zinc-coated steel. Shall only be used for connection to motors, pumps, and transformers. Maximum length 18 inches for motors/pumps and 42 inches for transformers.

F. LFMC: UL 360

1. Flexible steel conduit with PVC jacket. Shall only be used for connection to motors, pumps, and transformers. Maximum length 18 inches for motors/pumps and 42 inches for transformers.

G. Fittings for Metal Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1 and UL 514B; listed for type and size raceway with which used, and for application and environment in which installed

1. Compression fittings shall be used for EMT.
2. Threaded rigid steel fittings shall be used for RMC and IMC.
3. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
4. 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 Rigid Steel Conduit or IMC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 NONMETALLIC CONDUIT AND TUBING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Certainteed Corp.; Pipe & Plastics Group.
2. George-Ingraham Corp.
3. Lamson & Sessions; Carlon Electrical Products.
4. R&G Sloan Manufacturing Co., Inc.
5. Thomas & Betts Corp.

B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. ENT: Not Permitted.

D. RNC: NEMA TC 2 and UL 651, Type EPC-40-PVC, unless otherwise indicated.

- E. LFNC: UL 1660.
- F. Fittings for RNC: NEMA TC 3; match to conduit or tubing type and material.
- G. Fittings for LFNC: UL 514B.
- H. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- I. Solvent cements and adhesive primers 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."

2.3 METAL WIREWAYS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Hoffman.
 - 2. Keystone/Rees, Inc.
 - 3. Square D; Schneider Electric.
 - 4. Mono-Systems, Inc
 - 5. Cooper B-Line, Inc.
- B. Description: Sheet metal sized and shaped as indicated, complying with UL870 and NEMA 250, Type 1, 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.
- E. Finish: Manufacturer's standard enamel finish.

2.4 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Allied Moulded Products, Inc.
 - 2. Hoffman.
 - 3. Lamson & Sessions; Carlon Electrical Products.
 - 4. Niedax-Kleinhuis USA, Inc.

- B. Listing and Labeling: Nonmetallic wireways and auxiliary gutters shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.
- D. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.
- E. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- F. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- G. Solvent cements and adhesive primers 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."

2.5 SURFACE RACEWAYS

- A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Surface Metal Raceways: Galvanized steel with snap-on covers. Manufacturer's standard enamel finish in color selected by Architect.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hubbell.
 - b. Wiremold / Legrand.
 - c. Mono-Systems, Inc.
 - d. Panduit Corp.
- C. Surface Nonmetallic Raceways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:

- a. Hubbell Incorporated.
- b. Mono-Systems, Inc.
- c. Panduit Corp.
- d. Wiremold / Legrand.

D. Tele-Power Poles:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Mono-Systems, Inc.
 - b. Panduit Corp.
 - c. Wiremold / Legrand.
2. Material: Galvanized steel with ivory baked-enamel finish.
3. Fittings and Accessories: Dividers, end caps, covers, cutouts, wiring harnesses, devices, mounting materials, and other fittings shall match and mate with tele-power pole as required for complete system.

2.6 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Cooper Technologies Company; Cooper Crouse-Hinds.
 2. Hoffman Engineering Co.; Federal-Hoffman, Inc..
 3. O-Z/Gedney; a unit of General Signal.
 4. RACO; a Hubbell Company.
 5. Thomas & Betts Corporation.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, cast box with gasketed cover.
- E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- F. Metal Floor Boxes: Cast metal, fully adjustable, rectangular.
 1. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- G. Nonmetallic Floor Boxes: Nonadjustable, round.
 1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- H. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.
- I. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- J. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.
- K. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- L. Provide and install steel outlet box. Boxes shall be of approved design and construction and in every instance be of such form and dimensions as to be best adapted to its specific location, kind of fixtures to be used, and the number, size, and arrangements of conduits connecting thereto. The boxes and covers shall be made of pressed steel galvanized, of not less than 1/16" thickness. Boxes in Mechanical and Electrical Equipment Rooms and all other locations shall be installed flush with wall or ceiling construction where possible.
- M. Cast aluminum device boxes with rounded edges and corners, complete with matching coverplates, shall be used in connection with exposed conduit work for switches and receptacles in all unfinished locations including pipe spaces. Boxes shall be of the Cast Hub type as manufactured by Crouse-Hinds, Appleton or Thomas and Betts. Exposed boxes and conduit may be used only when specifically approved at each location designated. All exposed box locations must be approved by the Architect prior to installation.
- N. Boxes at exterior of building shall be flush mounted, cast iron, water tight, with gaskets and bolted-on covers. Boxes for all exterior fixtures, exterior receptacles, etc., mounted in exterior walls of the building or flush mounted at other exterior locations shall be cast iron or cast aluminum gasketed and made weathertight.
- O. Where the space limitations or other local conditions influence the arrangement and details of the outlet, special forms and design of outlet boxes shall be used to secure a proper, complete, and workmanlike arrangement at the outlet.
- P. Diamond expansion, cinch, or Rawl plug anchors shall be used in all cases for securing boxes to masonry walls or partitions.
- Q. All outlet boxes shall be provided with covers and they shall be of such construction and design as to exactly fit and match the box in which they are installed. Covers in exposed locations shall be stainless steel unless specified otherwise herein.
- R. Ceiling and wall outlet boxes generally shall be 4" square or octagon with plaster rings and shall have two screw holes for mounting receptacles when same are specified. Gang boxes and adjustable covers shall be used where wall switches occur in gangs. Metal partitions shall be provided in all gang boxes where dissimilar services are installed. Thermal switches furnished by other contractors, to the Electrical Contractor for installation, will have separate wall plates and may be mounted separately but adjacent to wall switches. Boxes for telephone system shall be of type approved by

the Telephone Company and shall be sized as required to conform with the conduits connecting thereto. All boxes for switches, receptacles, special outlets, etc. shall be provided with stainless steel coverplates as herein specified.

- S. Boxes installed in concrete block or other masonry walls without a plaster finish shall be of the square corner type, single or multiple gang, made specifically for that purpose.
- T. Boxes on prewired fixtures shall not be used for through-circuit wiring, except where the fixtures are specifically UL approved for that purpose.
- U. Multiple-gang boxes shall not be used for 277 volt switches, unless the switches are connected to the same phase. Separate boxes or barriers shall be installed for multiple switches where phase-to-phase exceeds 277 volts between switches.
- V. Provide a minimum of 1'-0" of physical separation between outlet boxes on opposing sides of the same wall. Boxes shall not be mounted back to back or within 1'-0" of any outlet box on the opposing sides of the same wall.
- W. Furnish and install metal pull boxes at least every 100 feet of run and as may be required to facilitate the pulling of wires. Pull boxes shall be of not less than No. 12 gauge galvanized steel metal of such design, construction and dimensions as to be best adapted to their respective location, number, size, and arrangement of conduit connecting thereto, and shall be provided with suitable doors, securely fastened to box with machine screws. Holes shall be provided in all boxes to receive entering conduits, but there shall be no holes except those used by conduits. Pull boxes installed flush with ceilings shall be provided with hinged doors, adjustable trim and screwdriver latch.
- X. Hinged-Cover Enclosures: UL 50 and NEMA 250, Type 1, 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.
 - 3. Nonmetallic Enclosures: Fiberglass.
- Y. Cabinets:
 - 1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 - 2. Hinged door in front cover with flush latch and concealed hinge.
 - 3. Key latch to match panelboards.
 - 4. Metal barriers to separate wiring of different systems and voltage.
 - 5. Accessory feet where required for freestanding equipment.
 - 6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.7 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. NewBasis.
 - d. Oldcastle Precast, Inc.
 - e. Quazite: Hubbell Power System, Inc.
 - f. Synertech Moulded Products.
2. Standard: Comply with SCTE 77.
3. Configuration: Designed for flush burial with closed bottom unless otherwise indicated.
4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, **"ELECTRIC."**
7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
8. Handholes 12 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

C. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of hot-dip galvanized-steel diamond plate.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. NewBasis.
 - d. Nordic Fiberglass, Inc.
 - e. Oldcastle Precast, Inc; Christy Concrete Products.
 - f. Quazite: Hubbell Power System, Inc; Hubbell Power Systems.
 - g. Synertech Moulded Products.

2. Standard: Comply with SCTE 77.
3. Color of Frame and Cover: Gray.
4. Configuration: Designed for flush burial with closed bottom unless otherwise indicated.
5. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
6. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
7. Cover Legend: Molded lettering, **"ELECTRIC."**
8. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
9. Handholes 12 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.8 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

- A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
 1. Tests of materials shall be performed by an independent testing agency.
 2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
 3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
 1. Exposed Conduit: Rigid Steel conduit
 2. Concealed Conduit, Aboveground: Rigid Steel conduit.
 3. Underground Conduit: RNC, Type EPC-40-PVC
 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC. Maximum length 18 inches for motors/pumps and 42 inches for transformers.
 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R or 4.
- B. Comply with the following indoor applications, unless otherwise indicated:
 1. Exposed: EMT or RMC.
 2. Exposed and Subject to Severe Physical Damage: Rigid steel conduit. Includes raceways in the following locations:
 - a. Loading dock.

- b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
 - 3. Concealed in Ceilings and Interior Walls and Partitions: EMT or RMC.
 - 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. Maximum length 18 inches for motors/pumps and 42 inches for transformers.
 - 5. Damp or Wet Locations: Rigid steel conduit.
 - 6. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations.
- C. Raceway Fittings: Compatible with raceways and suitable for use and location.
- 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings.
 - 2. EMT Conduit: Use Steel Compression fittings
 - 3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20

3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors
- B. Minimum Raceway Size: 3/4 inch trade size.
- C. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- D. Complete raceway installation before starting conductor installation.
- E. Install raceways level and square and at proper elevations. Provide adequate headroom.
- F. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- G. Protect stub-ups from damage where conduits rise through floor slabs. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
- H. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- I. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

- J. Support conduit within 12 inches of enclosures to which attached.
- K. Use steel raceway fittings compatible with raceways and suitable for use and location. For rigid steel conduit, use threaded rigid steel conduit fittings.
- L. Raceways Embedded in Slabs: Do not install raceways in floor slabs with a slab thickness of less than 4". Install in middle third of slab thickness where practical, and leave at least 1-inch concrete cover.
 - 1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
 - 2. Space raceways laterally to prevent voids in concrete.
 - 3. Run conduit larger than 1-inch trade size parallel to or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
 - 4. Transition from nonmetallic conduit to rigid steel conduit, or IMC before rising above floor.
 - 5. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 - 6. Arrange raceways to keep a minimum of 2 inches of concrete cover in all directions.
- M. 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.
- N. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- O. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- P. Terminations: Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against the box. Where terminations are not secure with 1 locknut, use 2 locknuts: 1 inside and 1 outside the box.
- Q. 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.
- R. 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.
- S. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into the hub so the end bears against the wire protection shoulder. Where chase

nipples are used, align raceways so the coupling is square to the box and tighten the chase nipple so no threads are exposed.

T. Surface Raceways:

1. Install surface raceway with a minimum 2-inch radius control at bend points.
2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

U. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.

V. Telephone and Signal System Raceways, 2-Inch Trade Size and Smaller: In addition to the above requirements, install raceways in maximum lengths of 150 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.

W. Install raceway sealing fittings according to manufacturer's written instructions. Locate fittings at suitable, approved, and accessible locations and fill them with UL-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 at the following points:

1. Where conduits pass from warm to cold locations.
2. Where otherwise required by NFPA 70.
3. Where conduit sleeves penetrate smoke and/or fire walls.
4. Where an underground service raceway enters a building or structure

X. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with the finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6 inches above the floor. Install screwdriver-operated, threaded flush plugs flush with floor for future equipment connections.

Y. Flexible Connections: Use maximum of 6 feet of flexible conduit for recessed and semi-recessed lighting fixtures. Use maximum of 3 feet of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for all motors. Use liquidtight flexible conduit in wet or damp locations. Install separate ground conductor across flexible connections.

Z. Expansion-Joint Fitting

1. Install in each run of aboveground RNC conduit that is located where environmental temperature change may exceed 30 deg F, and that has straight-run length that exceeds 25 feet.

2. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
 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.
 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 the time of installation.
 6. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
 - d. Attics: 135 deg F temperature change.
- AA. 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.
- BB. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- CC. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- DD. Locate boxes so that cover or plate will not span different building finishes.
- EE. 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.
- FF. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- GG. Set floor boxes level and flush with finished floor surface.
- HH. All conduits shall be installed in a neat, craftsman-like manner and be concealed in all finished areas. Conduit shall be installed parallel or perpendicular to walls, ceilings and other building components to present a neat appearance.
- II. Under no circumstances will horizontal runs of conduit or tubing be permitted within walls or partitions.

JJ. The installation of all types of conduit and tubing shall comply with the following:

1. Where conduits are fastened to masonry the use of screws is permitted only with expansion sleeves or Rawl plugs.
2. The exact routes and location of conduit shall be determined at the site by the Contractor as the drawings are diagrammatic only and not intended to convey that information.
3. Conduit that is cut shall be sawed and properly reamed.
4. The ends of all conduit shall be capped or plugged to exclude dirt and debris and prevent condensation.
5. Conduit that is damaged or deformed shall not be installed.
6. Bending of conduits and tubing will be permitted in small sizes (less than 2" in diameter). Standard ells and fittings shall be used for larger sizes (greater than 2" in diameter) of conduit or tubing. Bends, where approved, shall be made with an approved hickey or conduit bending machine.
7. Conduits and wiring shall be located to prevent their contact with heated surfaces and the conduit and wiring shall be suitably insulated, where required, to resist excessive heat. All work must be done in a manner that will not interfere with or detract from the fireproofing and smokeproofing of the building structure. Openings around conduits and penetrations through fire-rated floors, walls, partitions and ceilings shall be sealed with high temperature fire-resistant and fireproof materials and sealed with metal fire stops. O.Z./Gedney "Fire Seal" fittings, or equivalent, shall be used.
8. Sleeves shall be installed in concrete and masonry. Sleeves shall be large enough to receive the conduit.
9. Where vertical conduits pass through floors in mechanical or electrical equipment areas, chases or pipe spaces, the Contractor shall construct watertight sleeves made up of a section of Schedule 40 steel pipe extending 2" above the floor.
10. Where vertical conduits pass through floors in finished spaces, the Contractor shall construct watertight sleeves made up of a section of steel pipe of proper length to extend through masonry and terminate flush on finish side.
11. Where horizontal conduits pass through walls, sleeves shall be as specified above terminating flush with finish on each side.
12. Where vertical conduits pass through plaster ceilings, sleeves shall be No. 18 gauge galvanized steel flush with ceiling.
13. Space between sleeve and conduit shall be filled with sealant to level of sleeve. Sealant shall be approved "Fire Stopping" and shall maintain the fire rating of the wall or floor in which it passes through. "Fire Stopping" shall conform with manufacturer's recommended installation procedures.
14. Seal openings through walls of air plenum spaces and relief air shafts, where conduits are installed under this Contract to assure airtight plenum spaces. Coordinate work with contractors of other trades.
15. Where conduits pass through fire and smoke barrier stops, ceilings, floors or walls, this Contractor shall thoroughly seal such openings with fire-rated sealant as required to maintain fire-rating of adjacent construction.
16. The Contractor shall furnish and install modular wall seals where conduits pass through exterior walls. Seals shall be "Link-Seal" modular wall and casing seal, as manufactured by Thunderline Corporation, or approved equal. Sleeves shall be of appropriate size for the size of conduits to be installed, in accordance with the manufacturer's recommendations. The seal shall be composed of identical

solid rubber links, bolted and interlocked to form a belt. As belt bolts are tightened, rubber links form an automatic protective seal. The seal shall be rated for 40 feet of head or 20 psig. Seal shall be capable of absorbing shock transmitted either from changes in internal pipe pressures or from ground disturbances. Seal shall be made of synthetic rubber material especially compounded to resist aging, ozone, sunlight, water, and chemical action, and shall provide low temperature flexibility and resistance to high temperature environments. Bolts and metal parts shall be of carbon steel and zinc phosphate plated to resist corrosion. The seal shall be capable of providing air tightness in above ground installations and hydrostatic sealing in below grade installations. Seal shall be capable of maintaining cathodic protection with Delrin plastic pressure plates. Install seals in accordance with Manufacturer's Bulletin LS-104. Brush underground metal parts with a good grade of mastic before backfill.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 3 Section "Earth Moving" for pipe less than 6 inches in nominal diameter.
2. Install backfill as specified in Division 3 Section "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 3 Section "Earth Moving."
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
 - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
6. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits but a minimum of 6 inches below grade. Align planks along centerline of conduit.
7. Underground Warning Tape: Comply with requirements in Division 26 Section "Identification for Electrical Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.
- D. Install handholes with bottom below frost line, 36 inches below grade.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.
- F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

3.6 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of final payment.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC 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 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Identification for raceways.
 - 2. Identification of power and control cables.
 - 3. Identification for conductors.
 - 4. Underground-line warning tape.
 - 5. Warning labels and signs.
 - 6. Equipment identification labels.
 - 7. Miscellaneous identification products.

1.3 SUBMITTALS

- A. Product Data: For each electrical identification product indicated.
- B. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.
- C. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.4 QUALITY ASSURANCE

- A. Comply with ANSI A13.1 and IEEE C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 POWER RACEWAY IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Colors for Raceways Carrying Circuits at 600 V or Less:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage.
- C. Colors for Raceways Carrying Circuits at More Than 600 V:
 - 1. Black letters on an orange field.
 - 2. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch high letters on 20-inch centers.
- D. Snap-Around Labels for Raceways Carrying Circuits at 600 V or more: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

2.2 CONDUCTOR IDENTIFICATION MATERIALS

- A. Conductors rated at 600V or Less:
 - 1. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- B. Conductors rated at more than 600V:
 - 1. Identified by a durable nonmetallic engraved tag at every point of access at both ingress and egress points of manholes. Tags shall be white with black lettering.

2.3 UNDERGROUND-LINE WARNING TAPE

- A. Warning Tape: Bury warning tape above the buried conduits 6-8" below finished grade. The tape shall not be less than 6" wide by 4 mils thick and read "Caution buried electric line below" in black lettering on a red background. All warning tape shall have a detectable metallic strip and not be broken the length of the duct bank. Align tape parallel to and within 3 inches of the centerline of duct bank.

Provide an additional warning tape for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional tapes 12 inches apart, horizontally.

- B. Color and Printing:

1. Comply with ANSI Z535.1 through ANSI Z535.5.
2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE, or as otherwise indicated on the drawings.
3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE, or as otherwise indicated on the drawings.

2.4 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 for interior use:

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 for exterior use:

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. Provide arc flash hazard labels with the following information:

1. Flash Protection Boundary.
2. Incident Energy at 18" expressed in cal/cm².
3. Hazard Risk Category.
4. PPE Required.
5. Voltage Shock Hazard.

6. Limited shock approach boundary.
7. Restricted shock approach boundary.
8. Prohibited shock approach boundary.

2.5 EQUIPMENT IDENTIFICATION LABELS

- A. Engraved Plastic Nameplates and Signs: Engraving stock, melamine plastic laminate, minimum 1/8 inch thick.
 1. Engraved legend with black letters on white face
 2. Punched or drilled for mechanical fasteners.

2.6 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.
- C. Receptacle and switch cover plates shall have self adhesive labels that indicate panel and circuit number and durable wire markers or tags shall be used inside the outlet boxes.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- F. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas or use solid colored conduit as manufactured by Allied Tube and Conduit or equal.

1. Apply the following colors to the systems listed below:
 - a. Fire Alarm System: Red.
 - b. Data/Communication: Blue.
- G. Painted Identification: Comply with requirements in Division 09 painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

- A. Concealed Raceways, Duct Banks, More Than 600 V, within Buildings: Tape and stencil 4-inch wide black stripes on 10-inch centers over orange background that extends full length of raceway or duct and is 12 inches wide. Stencil legend "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch- high black letters on 20-inch centers. Stop stripes at legends. Apply to the following finished surfaces:
 1. Floor surface directly above conduits running beneath and within 12 inches of a floor that is in contact with earth or is framed above unexcavated space.
 2. Wall surfaces directly external to raceways concealed within wall.
 3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.
- B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
 1. Emergency Power.
 2. Power.
 3. UPS.
- C. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
 1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.
 - a. Color shall be factory applied or field applied for sizes larger than No. 4 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.
 - 4) Neutral: White.
 - 5) Ground: Green.
 - 6) Isolated Ground: Green with yellow stripe.

- c. Colors for 480/277-V Circuits:
 - 1) Phase A: Brown.
 - 2) Phase B: Orange.
 - 3) Phase C: Yellow.
 - 4) Neutral: White.
 - 5) Ground: Green.
- 2. 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.
- 3. Power-Circuit Conductor Identification, More than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use Tags that bear the following information:
 - a. Circuit voltage; i.e. 4160V.
 - b. Points of Origin and Termination; e.g. PANTHER HALL SWITCH #390 to PA HALL SWITCH #336.
 - c. Size and number of conductors, including equipment ground; e.g. (3) 500KCMIL + #4GRD.
 - d. Class of insulation; i.e., 5kV, 133%.
- D. Date of installation; e.g. INSTALLED JULY 2006.
- E. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.
- F. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.
- G. 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.
- H. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
- I. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

- J. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.
 - 1. Comply with 29 CFR 1910.145.
 - 2. Identify system voltage with black letters on an orange background.
 - 3. Apply to exterior of door, cover, or other access.
 - 4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
 - a. Power transfer switches.
 - b. Controls with external control power connections.
- K. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
- L. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
 - 1. Labeling Instructions:
 - a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch high letters on 1-1/2-inch high label; where two lines of text are required, use labels 2 inches high.
 - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
 - 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: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be engraved, laminated acrylic or melamine label.
 - b. Enclosures and electrical cabinets.
 - c. Access doors and panels for concealed electrical items.
 - d. Switchgear.
 - e. Switchboards.
 - f. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
 - g. Substations.
 - h. Emergency system boxes and enclosures.

- i. Motor-control centers.
- j. Enclosed switches.
- k. Enclosed circuit breakers.
- l. Enclosed controllers.
- m. Variable-speed controllers.
- n. Push-button stations.
- o. Power transfer equipment.
- p. Contactors.
- q. Remote-controlled switches, dimmer modules, and control devices.
- r. Battery-inverter units.
- s. Battery racks.
- t. Power-generating units.
- u. Monitoring and control equipment.
- v. UPS equipment.
- w. Receptacles.
- x. Lighting Switches.

END OF SECTION 260553

SECTION 260573 - ELECTRICAL SYSTEM AND PROTECTIVE DEVICE STUDIES

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. Scope: This Section covers the furnishing of a computer based electrical short circuit (fault- current) study, overcurrent protective device coordination study, including an arc-flash hazard study, Motor Start Study, Power Factor Study, Harmonic Study, and Electro-Magnetic Transient Program (EMTP) Simulation for the building electrical system required under this construction contract. The scope of the studies shall include all new distribution equipment supplied under this contract by any and all manufacturers as well as all existing distribution equipment at the customer facility.
- B. Preparer: The electrical system protective device study required by this Section shall be prepared by a professional electrical engineer skilled in performing and interpreting the power systems studies and registered in the State in which the project is being constructed. The Registered Professional Electrical Engineer shall have a minimum of five (5) years of experience in performing power system studies and in the fulltime employment of the manufacturer of the electrical distribution equipment. All studies shall be prepared by the same professional engineer.

1.3 REFERENCES

- A. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - 1. IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems
 - 2. IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
 - 3. IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis
 - 4. IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings
 - 5. IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems
 - 6. IEEE 1584 – Guide for Performing Arc-Flash Hazard Calculations
- B. American National Standards Institute (ANSI):
 - 1. ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers

2. ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures
3. ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis
4. ANSI C 37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories
5. ANSI C37.5 – Methods for Determining the RMS Value of a Sinusoidal Current Wave and Normal-Frequency Recovery Voltage, and for Simplified Calculation of Fault Currents

C. The National Fire Protection Association (NFPA)

1. NFPA 70 - National Electrical Code, latest edition
2. NFPA 70E – Standard for Electrical Safety in the Workplace

1.4 SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections:

1. In addition to the requirements of Division 1, the short circuit, protection coordination, Arc-Flash, Motor Start, Power Factor, Harmonic, and EMTP studies shall be bound in 8-1/2" by 11 " hard cover bound volumes with drawings and diagrams folded to fit the in 8-1/2" by 11 " hard format and securely retained in pockets or compartments of the rigid binder.
2. An additional copy of the one-line drawings shall be provided on full size 24"x36" or larger drawings in each copy.
3. Ten copies of the study shall be submitted.
4. Provide five (5) bound copies of the complete final report. Provide a CD with report in PDF format.
5. The study shall include each medium and low voltage distribution system.
6. The studies at a minimum shall include in the submittal the following:
 - a. Short-Circuit and Coordination-study input data, including completed computer program input data sheets.
 - b. Study and Equipment Evaluation Reports.
 - c. Coordination-Study Report.
 - d. Short-Circuit Study Report.
 - e. Arc-Flash Study Report.
 - f. Motor Start Study Report.
 - g. Power Factor Study Report.
 - h. Harmonic Study Report.
 - i. EMTP Study Report.
 - j. One-line diagram showing protective device ampere ratings and associated designations, cable size & lengths, transformer kVA & voltage ratings, motor & generator kVA ratings, and switchgear/switchboard/panelboard/transfer switch designations.
 - k. Descriptions, purpose, basis and scope of the study.

- l. Tabulations of the worst-case calculated short circuit duties as a percentage of the applied device rating (automatic transfer switches, circuit breakers, fuses, etc.); the short circuit duties shall be upward-adjusted for X/R ratios that are above the device design ratings .
 - m. Protective device time versus current coordination curves with associated one line diagram identifying the plotted devices, tabulations of ANSI protective relay functions, adjustable circuit breaker trip unit settings, and fuse selection.
 - n. Fault study input data, case descriptions, and current calculations including a definition of terms and guide for interpretation of the computer printout.
 - o. Incident energy and flash protection boundary calculations.
 - p. Comments and recommendations for system improvements, where needed.
 - q. Executive Summary including source of information and assumptions made.
 - r. Refer to "Study Requirements" Article for other submittal requirements.
 - 7. Provide the study project files to the Owner in electronic format. For example if the SKM or E-TAP program was used, provide the project files so that the owner can load the files into their version of the program. In addition, a copy of the computer analysis software viewer program shall be provided to accompany the electronic project files, to allow the Owner to review all aspects of the project and print arc flash labels, one-line diagrams, etc.
 - 8. Arc flash labels in hard copy and in electronic format with a copy of the computer analysis software viewer program.
- B. Industry Standards: Provide, for each section of the study, an identification and description of the industry testing standards on which the study is based.
- C. Certification: Certification by the Contractor that the protective devices have been adjusted and set in accordance with the approved protective device study shall be included for each adjustable protective overcurrent, over/under voltage, or related protective device.
- D. Product Data: For computer software program to be used for studies.
- E. Qualification Data: For coordination-study specialist.
- F. Product Certificates: For coordination-study and fault-current-study computer software programs, certifying compliance with IEEE 399.
- 1.5 QUALITY ASSURANCE
- A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.
- B. Electrical Systems and Coordination-Study Specialist Qualifications: An entity experienced in the application of computer software used for studies, having performed

successful studies of similar magnitude on electrical distribution systems using similar devices.

- C. Comply with IEEE 242 for short-circuit currents and coordination time intervals.
- D. Comply with IEEE 399 for general study procedures.

1.6 MINIMUM COMPUTER SOFTWARE PROGRAM REQUIREMENTS

- A. Comply with IEEE 399.
- B. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.
- D. Program shall be capable of analyzing Arcing faults, Simultaneous faults, Explicit negative sequence, and Mutual coupling in zero sequence.
- E. Provide functions as necessary to provide functional requirements listed within this specification section.

1.7 DATA COLLECTION FOR THE STUDY

- A. The Contractor shall furnish all field data as required by the power system studies. The Entity performing the analysis studies shall furnish the Contractor with a listing of required data immediately after award of the contract. The Contractor shall be responsible for and shall expedite collection of the data to eliminate unnecessary delays and assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to release of the equipment for manufacturing. Refer to Section "Preliminary Short Circuit (Fault-Current) Study."
- B. Gather and tabulate the input data to include but not limited the following to support coordination study:
 - 1. Product Data for overcurrent protective devices specified in other Division 26 Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
 - 2. Impedance of utility service entrance.
 - 3. Ratings for existing next two upstream and downstream overcurrent protective devices and associated equipment from the devices being provided under the work to verify that the ratings of the existing equipment are not being exceeded as part of the new work.

4. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:
 - a. Circuit-breaker and fuse-current ratings and types.
 - b. Relays and associated power and current transformer ratings and ratios.
 - c. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.
 - d. Generator kilovolt amperes, size, voltage, and source impedance.
 - e. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.
 - f. Busway ampacity and impedance.
 - g. Motor horsepower and code letter designation according to NEMA MG 1.
 - h. Panelboards, switchboards, switchgear, disconnects, automatic transfer switches, variable frequency drives, motor starters, combination motor starters, mechanical equipment, motor-control centers.
5. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:
 - a. Special load considerations, including starting inrush currents and frequent starting and stopping.
 - b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
 - c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
 - d. Generator thermal-damage curve.
 - e. Ratings, types, and settings of utility company's overcurrent protective devices.
 - f. Special overcurrent protective device settings or types stipulated by utility company.
 - g. Time-current-characteristic curves of devices indicated to be coordinated.
 - h. Manufacturer, frame size, interrupting ratings in amperes RMS symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
 - i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
 - j. Panelboards, switchboards, switchgear, disconnects, automatic transfer switches, variable frequency drives, mechanical equipment, motor-control center ampacity, and interrupting rating in amperes RMS symmetrical.
 - k. X/R ratios, amperage ratings, short-circuit ratings for automatic transfer switches.

1.8 STUDY REQUIREMENTS

- A. Power Company: The study shall include the utility power company's system and relay characteristics.

- B. General Content: Provide calculations, impedance diagrams, conclusions and recommendations as part of the general content of the study.
- C. Ground Fault Study: Include a ground fault study for each medium voltage switchgear line-up, medium voltage controller, low voltage switchgear line-up, switchboard, motor control center, distribution panelboard, branch circuit panelboards and other significant locations throughout the system.
- D. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.
- E. One Line Diagram:
 - 1. Show, on the one line diagram, all electrical equipment and wiring to be protected by the overcurrent devices installed under this project. Clearly show, on the one line, the schematic wiring of the electrical distribution system.
 - 2. Also show on the one line diagram the following specific information:
 - a. Calculated fault impedance, X/R ratios, and short circuit values at each 480V switchboard and switchgear bus, each automatic transfer switch, each busway, on each transformer at each 480 volt and 208 power distribution panelboard, switchgear, switchboard, motor control center and variable frequency drive. Provide short circuit value for each branch panelboard.
 - b. Breaker and fuse ratings.
 - c. Transformer KVA and voltage ratings, percent impedance, X/R ratios, and wiring connections.
 - d. Voltage at each bus.
 - e. Identification of each bus.
 - f. Conduit material, feeder sizes, length, and X/R ratios.
 - 3. One set of the One-Line Diagrams shall be submitted on full size drawings 24"x36" or larger in each copy.
- F. Short Circuit: Provide short circuit tabulations which include the system impedance's, X/R ratio, asymmetry factor, KVA, symmetrical and asymmetrical fault currents.
- G. General Study Requirements: Provide each study with the following items as a minimum:
 - 1. Provide coordination plots which graphically indicate the coordination proposed for the several systems. Provide plots centered on full scale log-log forms.
 - 2. Provide coordination plots with complete titles, representative one-line diagrams and legends, associated power company's relay or system characteristics, motor controller fuses and relays, significant motor starting characteristics, complete parameters for power, network and substation transformers, complete operating bands for low voltage switchboard and switchgear circuit breaker trip devices, fuses, if applicable, and the associated system load protective devices.

3. Provide coordination plots which define the types of protective devices selected, together with the proposed coil taps, time dial settings and pick-up settings required.
4. The long time region of the coordination plots shall indicate a complete tap scale for each medium voltage relay and full load current transformer parameters and designate the pick-ups required for the low voltage circuit breakers.
5. The short time region shall indicate the medium voltage relay instantaneous elements, the magnetizing inrush, and American National Standards Institute (ANSI) withstand transformer parameters, the low voltage circuit breaker, short time and instantaneous trip devices, fuse manufacturing tolerance bands, including the low voltage network protector fuses, when applicable, and significant symmetrical and asymmetrical fault currents.
6. Provide multiple study cases where the Source includes a combination of present and future utility supplies, motors, and generators.

H. Equipment Selection: Coordinate each item of equipment as follows:

1. Select each primary protective device required for a delta-to-wye-connected transformer so the characteristic or operating band is within the transformer parameters, which includes a parameter equivalent to 58 percent of the ANSI withstand point to afford protection for secondary line-to-ground faults.
2. Provide the transformer damage curve for each transformer when the selected protective device is not within the associated parameters.
3. Separate low voltage power circuit breakers from each other and the associated primary protective device by a 16 percent current margin for coordination and protection in the event of secondary line-to-line faults.
4. Separate medium voltage relays by a 0.4 second time margin when the maximum three-phase fault flows, to assure proper selectivity.
5. The protective device characteristics or operating band shall be suitably terminated to reflect the actual symmetrical and asymmetrical fault currents sensed by the device.
6. Source combinations include proposed and future power company feeders, large motors, or generators.
7. Studies based on written calculations shall include sample calculations for each voltage category.

I. Contract Drawings: The drawings and specifications indicate the general requirements for the motors, motor starter equipment, and medium voltage and low voltage equipment. Determine additional specific characteristics of equipment furnished in accordance with the results of the short circuit and protective device coordination study.

1. Submit any equipment design discrepancies and the proposed corrective modifications, if required, with the short circuit and protective device coordination study. Identify any variations clearly on the subsequent shop drawings.
2. Provide the necessary field settings, adjustments and minor modifications for conformance with the approved short circuit and protective device coordination study, without additional expense.
3. Do not submit equipment shop drawings until the short circuit and protective device coordination study has been approved by the Engineer.

PART 2 - PRODUCTS

2.1 PRELIMINARY SHORT CIRCUIT (FAULT-CURRENT) STUDY

- A. If the short circuit study can not be 100% completed upon equipment release for manufacture, a preliminary short circuit study only shall be made available to authorities at no additional charge for evaluation to determine the adequacy of equipment ratings prior to release. A final version of the short circuit study shall be submitted with the coordination study prior to shipment of the equipment. Use actual conductor impedances if known. If unknown, use typical conductor impedances based on IEEE Standards 141, latest edition. Transformer design impedances and standard X/R ratios shall be used when test values are not available.

2.2 SHORT CIRCUIT (FAULT-CURRENT) STUDY

- A. The short circuit study shall be performed with the aid of a digital computer program and shall be in accordance with the latest applicable IEEE and ANSI standards.
- B. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 141, IEEE 24 and IEEE 242:
 - 1. Transformers:
 - a. ANSI C57.12.10
 - b. ANSI C57.12.22
 - c. IEEE C57.12.00
 - d. IEEE C57.96
 - 2. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1.
 - 3. Low-Voltage Fuses: IEEE C37.46
- C. In the short circuit study, provide calculation methods and assumptions, the base per unit quantities selected, one-line diagrams, source impedance data including power company system characteristics, typical calculations, tabulations of calculation quantities and results, conclusions, and recommendations. Calculate short circuit interrupting and momentary (when applicable) duties for an assumed 3-phase bolted fault at Electric utility's supply termination point, each supply switchgear lineup, unit substation primary and secondary terminals, medium-voltage and low-voltage switchgear lineup, switchboard, motor control center, distribution panelboard, pertinent branch circuit panelboard, automatic transfer switch, variable frequency drive, disconnects, mechanical equipment, generators, and other significant locations throughout the system. Provide a ground fault current study for the same system areas, including the associated zero sequence impedance data. Include in tabulations fault impedance, X to R ratios, asymmetry factors, motor contribution, short circuit kVA, and symmetrical and asymmetrical fault currents.
- D. Include on the curve sheets power company relay and fuse characteristics, system medium-voltage equipment relay and fuse characteristics, low-voltage equipment circuit breaker trip device characteristics, pertinent transformer characteristics,

pertinent motor and generator characteristics, and characteristic of other system load protective devices. Include at least all devices down to largest branch circuit and largest feeder circuit breaker in each motor control center, and main breaker in branch panelboards. Include the next two (2) existing upstream and downstream overcurrent protective devices and associated existing panelboard, switchboard, switchgear, etc. from the new work tie in points to verify that the equipment and remaining system is properly rated. Include all adjustable settings for ground fault protective devices. Include manufacturing tolerance and damage bands in plotted fuse characteristics. Show transformer full load and 150, 400, or 600 percent currents, transformer magnetizing inrush, ANSI transformer withstand parameters, and significant symmetrical and asymmetrical fault currents. Terminate device characteristic curves at a point reflecting the maximum symmetrical or asymmetrical fault current to which the device is exposed.

- E. Include complete fault calculations as specified herein for each proposed and ultimate source combination. Note that source combinations may include present and future supply circuits, large motors, or generators as noted on Contract Drawing One-Lines diagrams.
- F. Submit qualifications of individual(s) who will perform the work for approval prior to commencement of the studies. Provide studies in conjunction with equipment submittals to verify equipment ratings required. Submit a draft of the study to Engineer for review prior to delivery of the study to the Owner. Make all additions or changes as required by the reviewer at no additional cost to the Owner.
- G. Utilize equipment load data for the study obtained by the Contractor from Contract Documents, including Contract Addenda issued prior to bid openings.
- H. Include fault contribution of all motors in the study. Notify the Engineer in writing of circuit protective devices not properly rated for fault conditions.
- I. Provide settings for the air handling unit motor starters or obtain from the mechanical contractor, include in the study package, and comment.
- J. For the emergency generator provided, include phase and ground coordination of the generator protective devices. Show the generator decrement curve and damage curve along with the operating characteristic of the protective devices. Obtain the information from the generator manufacturer and include the generator actual impedance value, time constants and current boost data in the study. Do not use typical values for the generator.
- K. Evaluate proper operation of the ground relays in 4-wire distributions with more than one main service circuit breaker, or when generators are provided, and discuss the neutral grounds and ground fault current flows during a neutral to ground fault.
- L. Do not estimate or use typical values for the service or power distribution transformer impedances, use actual impedance values.

M. Study Report:

1. Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.
2. Show interrupting (5-cycle) and time-delayed currents (6 cycles and above) on medium voltage breakers as needed to set relays and assess the sensitivity of overcurrent relays.
3. Refer to "Study Requirements."

N. Equipment Evaluation Report:

1. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical RMS fault current.
2. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical RMS fault current to achieve the asymmetrical peak interrupting amps at 1/2-cycle or provide computer program calculation results for asymmetrical peak interrupting amps at 1/2 cycle to provide verification of the unpublished peak rating the equipment would carry according to the short-circuit test procedures outlined in the applicable equipment standard. Provide in the report the asymmetrical peak interrupting amps at 1/2 cycle for review by the Engineer.
3. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical RMS fault current.
4. Verify adequacy of transformer windings to withstand short-circuit stresses.
5. Verify cable and busway sizes for ability to withstand short-circuit heating.
6. Notify Engineer in writing, of existing, circuit protective devices improperly rated for the calculated available fault current.
7. Refer to "Study Requirements."

2.3 COORDINATION STUDY

- A. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.
1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.
 2. Calculate the maximum and minimum interrupting duty (5 cycles to 2 seconds) short-circuit currents.
 3. Calculate the maximum and minimum ground-fault currents.
- B. Comply with IEEE 141, IEEE 241 and IEEE 242 recommendations for fault currents and time intervals.
- C. Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.

- D. Selective Coordination: Selective coordination shall be provided as required by NEC Articles 517, 620, 700, 701, 708, and other applicable codes. Selective coordination shall be 100% selective such that an overcurrent condition or fault condition shall restrict outages to the circuit or equipment affected. This shall be accomplished by the choice of overcurrent protective devices and their ratings or settings. The contractor and manufacturer shall be responsible for all labor and material costs required to provide a 100% selectively coordinated system as described herein.
- E. Include on the curve sheets power company relay and fuse characteristics, system medium-voltage equipment relay and fuse characteristics, low-voltage equipment circuit breaker trip device characteristics, pertinent transformer characteristics, pertinent motor and generator characteristics including damage points, and characteristic of other system load protective devices. Include at least all devices down to largest branch circuit and largest feeder circuit breaker in each motor control center, and main breaker in branch panelboards. Include all adjustable settings for ground fault protective devices. Include manufacturing tolerance and damage bands in plotted fuse characteristics. Show transformer full load and 150, 400, or 600 percent currents, transformer magnetizing inrush, ANSI transformer withstand parameters, conductor damage curves, and significant symmetrical and asymmetrical fault currents. Terminate device characteristic curves at a point reflecting the maximum symmetrical or asymmetrical fault current to which the device is exposed.
- F. For the emergency generator provided, include phase and ground coordination of the generator protective devices. Show the generator decrement curve and damage curve along with the operating characteristic of the protective devices. Obtain the information from the generator manufacturer and include the generator actual impedance value, time constants and current boost data in the study. Do not use typical values for the generator.
- G. Transformer Primary Overcurrent Protective Devices:
 - 1. Device shall not operate in response to the following:
 - a. Inrush current when first energized.
 - b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
 - c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
 - 2. Device settings shall protect transformers according to IEEE C57.12.00 for fault currents.
- H. Motors served by voltages more than 600 V shall be protected according to IEEE 620.
- I. Conductor Protection: Protect cables against damage from fault currents according to ICEA P32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

J. Coordination Study Report: Prepare a written report indicating the following results of coordination study:

1. Tabular Format of Settings Selected for Overcurrent Protective Devices:
 - a. Device tag.
 - b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.
 - c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
 - d. Fuse-current rating and type.
 - e. Ground-fault relay-pickup and time-delay settings.
 - f. Refer to "Study Requirements."
2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:
 - a. Device tag.
 - b. Voltage and current ratio for curves.
 - c. Three-phase and single-phase damage points for each transformer.
 - d. No damage, melting, and clearing curves for fuses.
 - e. Cable damage curves.
 - f. Transformer inrush points (FLA), magnetizing, and withstand parameters.
 - g. Transformer damage curve.
 - h. Maximum fault-current cutoff point.
 - i. Generator decrement curve and damage curve.
 - j. Motor starting and damage curve.
 - k. Ground fault protective devices.
 - l. Refer to "Study Requirements."
3. Refer to "Study Requirements."

K. Completed data sheets for setting of overcurrent protective devices.

2.4 ARC-FLASH HAZARD STUDY SPECIFICATION

A. Study Requirements

1. A detailed arc-flash hazard study shall be performed in accordance with the latest versions of all appropriate and applicable codes and standards including, but not limited to, NFPA 70E and IEEE Std. 1584.
2. The scope of this evaluation is the system as defined by the short-circuit study but is limited to all system voltages of 250V and up as well as 208V and 240V systems fed from 125 kVA transformers and larger.
3. The study work shall be performed by the equipment manufacturer's engineers involved in the analysis of power systems for a period of at least five years.

4. The arc-flash hazard study shall be conducted by the same personnel performing the project's short-circuit and coordination studies, the output data of which shall form the input basis for the arc-flash hazard calculations and analysis. Equipment layouts and configurations shall be obtained from the manufacturer's final submittals and project layout drawings.
5. The results of this study shall include the calculated arc-flash boundary and incident energy (in cal/cm²) at key points throughout the scope of the system defined for the short-circuit and coordination studies. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system where work could be performed on energized parts. The study report shall also provide a detailed verbal discussion and explanation of the tabulated outputs, and an executive summary of these results.
 - a. Three bound copies of this report shall be provided.
6. Safe working distances shall be specified for calculated fault locations based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm².
7. The Arc Flash Hazard analysis shall include calculations for maximum and minimum contributions of fault current magnitude. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume a minimum motor load. Conversely, the maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.
8. Arc flash computation shall include both line and load side of main breaker calculations.
9. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-2002 section B.1.2.
10. Provide one study with any arc reduction methods deactivated to show hazard levels in the system. Provide a second study with any arc reduction methods activated such as an Arc Reduction Maintenance Switch or other methods that lower the Arc Flash Incident Energy to document the Arc Flash Incident Energy levels when the maintenance switch or other device is engaged.

B. Hazard Label Requirements

1. Properly detailed shock and arc-flash hazard labels shall be provided at all appropriate electrical equipment locations.
2. Each label shall be at least 5" x 3.5" in size, black ink laser-printed on a white background with a prominent red danger symbol and two yellow triangles—one for arc-flash hazard and one for shock hazard, with no field markings.
3. Each label shall be of durable polyester stock-thermal transfer type, high self adhesive, and designed to resist degradation from scuffing, chemicals, moisture and wide temperature fluctuations. It shall also incorporate a polyvinyl polymer over-laminate to assure color stability, and resistance to UV, chemicals, and common cleaning solvents.
4. Each label shall incorporate the short-circuit Bus ID for the bus behind the cover/door on which it is to be mounted, nominal voltage, the calculated incident energy and its corresponding hazard/risk PPE (personal protective equipment) category number, the calculated arc-flash protection boundary, the shock hazard

boundaries, working distance, Engineering report number, revision number, issue date, and a description of the combined level of PPE.

5. An Excel spreadsheet shall be provided prior to printing the labels to identify the content for each label and its targeted equipment location. One comment line on each label will provide details for its mounting location.
6. The printed labels shall be provided to the contractor for installation on the equipment.
7. Provide a full size drawing 24"x36" or larger depicting the exact locations for the labels to be installed for the Installer. Submit a copy of the drawing to the Engineer.
8. All panels and equipment shall be provided with a label including Level 0.

2.5 MOTOR STARTING STUDY

- A. General: Submit drawings and studies which include a starting study for each low voltage or medium voltage motor 50 HP and larger or motors requiring conformity with the specified power company inrush limitations.
 1. Provide written calculations and an equivalent impedance diagram to assure that the selected motors and controller equipment restrict the starting current within the specific power company inrush requirements and within the voltage drop limitations for the motors and the principal incandescent lamp manufacturers.
 2. Determine the percentage voltage drop from a consideration of the above factors, the frequency of starts, borderline of irritation, and borderline of flicker visibility.
 3. The calculations and impedance diagram shall be complete and clearly define the base quantities selected, system, motor and starting equivalent impedances, conclusions, and recommendations.
- B. Contract Drawings: The drawings and specifications indicate the general requirements for the motors, motor starting equipment, and medium voltage and low voltage equipment. Determine additional specific characteristics of equipment furnished and provide requirements in accordance with the results of the motor starting study.
 1. Submit the equipment design discrepancies and the proposed corrective modifications, if required, with the motor starting study. Identify any variations clearly on the subsequent shop drawings.
 2. Provide the necessary field settings, adjustments and minor modifications for conformance with the approved motor starting study, without additional expense.
 3. Do not submit shop drawings until the motor starting study has been approved by the Engineer.

2.6 POWER FACTOR STUDY

- A. The objective of the Power Factor study is to analyze the building electrical system power factor to determine levels and determine appropriate size of the corrective equipment.

- B. After building occupation, when the building is fully occupied, monitor the building power factor for a period of six months. Provide a report of the power factor levels with recommendations for corrective measures to the Engineer. Provide labor, material, and protection as needed to access the test points. Verify findings with copies of the utility bills for the facility over the same time period.
- C. Contract shall adjust settings of power factor equipment as directed by the Engineer.

2.7 HARMONIC STUDY

- A. The objective of the Harmonic study is to analyze the building electrical system power system harmonic content projected back on the Utility power system to determine levels and determine appropriate size of the corrective equipment.
- B. Perform a harmonic analysis and provide recommendations for reducing harmonics to the power line. Perform harmonic measurements at the point where the utility feeds multiple customers (PCC) to verify compliance with IEEE 519.1992. A report of the voltage THD and current TDD shall be sent to the Engineer. Provide labor, material, and protection as needed to access the test points. The readings shall be taken with all variable frequency drives and all other loads at full load, or as close as field conditions allow.

2.8 ELECTRO-MAGNETIC TRANSIENT PROGRAM (EMTP) Study

- A. The objective of the EMTP study is to investigate the possible failure of the transformers and generators during the circuit switching of the vacuum circuit breakers. The study shall analyze the vacuum circuit breaker induced switching transients that are amplified with short cable lengths due to the VCB chopped current and the system stray capacitance.
- B. The study shall also provide recommended products for corrective actions and size the proper insulation, capacitance, resistance, and surge arrestors required to include lead lengths of cables.
- C. All medium and high voltage distribution transformers on the project shall be analyzed to include both liquid filled and dry type transformers as part of the study. Special attention shall be give to the dry type transformers since the BIL ratings of VPI, Cast Coil and other dry-type transformers have less withstand capabilities to steep-fronted waves compared with the liquid-filled transformers. Both the magnitude and the dv/dt shall be controlled in all cases.
- D. The study shall include but not limited to the contributions from the following:
 - 1. High frequency voltage amplification due to short cables.
 - 2. Dry-type/VPI transformer technology.
 - 3. Sustained impulses at the BIL ratings of the transformers.
- E. Vacuum circuit breakers shall be simulated with 6 Amperes chopped current to provide a small safety margin since most breakers chop at 3 to 5 Amperes.

- F. The study cases shall evaluate both the opening and closing of the vacuum circuit breaker to illustrate the transient overvoltage and high frequency resonance due to short line cable or bus and other associated phenomenally when operating under load. The recommended solutions provided shall be capable of solving both the opening and closing problems.
- G. Provide study cases for medium voltage generators to include analysis for opening vacuum circuit breaker under load and energy required to be dissipated by the generator windings. Determine if any damage will occur and recommend corrective measures to be taken to resolve. Provide a separate study case with recommended corrective measures so that results can be reviewed by the Engineer.
- H. Include all large motors in study.
- I. Provide various cases of study with color graphs.
 - 1. Provide study cases without recommended protection such as surge arrestors, surge capacitors, and snubbers.
 - 2. Provide study cases with recommended protection such as surge arrestors, surge capacitors, and snubbers.
- J. Each study case shall include the transient overvoltage magnitude @ the medium voltage side of the transformer or generator and the associated oscillating frequency. Provide a graph for each plotting transient voltage (KV) verse time in (mS).
- K. Cable length from the Short-Circuit study shall be used between components.
- L. Provide recommendations and locations for corrective components.
- M. Provide insulation coordination recommendations for recommended corrective devices.

PART 3 - EXECUTION

3.1 POWER COMPANY APPROVAL

- A. Copies of the final report shall be submitted to the power company for their review and approval. Approved copies of the report shall be submitted to the Engineer. Approval of the Studies by the utility shall not delay the equipment releases necessary to meet the construction deadlines and milestones established by the Owner; the Studies are given to the Utility for their information regarding coordination with the customer's services and the utility upstream overcurrent protective devices.

3.2 ANALYSIS

- A. Analyze the short circuit calculations, and highlight any equipment that is determined to be underrated as specified. Verify that all current transformers are the proper size to meet equipment requirements. Propose approaches to effectively protect the underrated equipment. Proposed major corrective modifications will be taken under

advisement by the Engineer, and the Contractor will be given further instructions. Provide minor modifications to conform to the study (examples of minor modifications are trip sizes within the same frame, the time curve characteristics of induction relays, and C.T. ranges).

- B. After developing the coordination curves, highlight areas lacking coordination on the Normal Power equipment. Present a technical evaluation with a discussion of the logical compromises for best coordination.
- C. Demonstrate that 100% selective coordination has been achieved as required by NEC Articles 517, 620, 700, 701, 708, and other applicable codes.

3.3 FIELD SETTINGS

- A. The Contractor shall perform field adjustments of the protective devices as required to place the equipment in final operating condition. The settings shall be in accordance with the approved short circuit study, protective device evaluation study, and protective device coordination study and be implemented by trained service technicians under the employ of the electrical equipment manufacturer. A written certification of the setting of protective devices shall be provided within one week after the actual work occurs.
- B. Necessary field settings of devices and adjustments and modifications to equipment to accomplish conformance with the approved short circuit and protective device coordination study shall be carried out by the Contractor at no additional cost to the Owner.

3.4 IDENTIFICATION

- A. The Contractor shall install the arc-flash labels and identify boundaries. Boundaries shall be painted in a color per NFPA 70, and shall include Level 0.
- B. Arc-Flash Labels shall be field installed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion. All panels and equipment shall be provided with a label including Level 0.

3.5 ARC FLASH TRAINING

- A. The equipment vendor shall train personnel of the potential arc flash hazards associated with working on energized equipment (minimum of 4 hours). Maintenance procedures in accordance with the requirements of NFPA 70E, "Standard For Electrical Safety Requirements For Employee Workplaces, shall be provided in the equipment manuals. The training shall be certified for continuing education units (CEUs) by the International Association for Continuing Education Training (IACET).

END OF SECTION 260573

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

- A. This Section includes photoelectric relays, and multipole lighting relays, contactors, and occupancy sensors

1.3 SUBMITTALS

- A. Product Data: Include dimensions and data on features, components, and ratings for lighting control devices.
- B. Shop Drawings: Show installation details for occupancy and light-level sensors.
 - 1. Lighting plan showing location, orientation, and coverage area of each sensor.
 - 2. Interconnection diagrams showing field-installed wiring.
- C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- D. Operation and Maintenance Data: For each type of lighting control device to include emergency, operation, and in maintenance manuals specified in Division 1.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, for their indicated use and installation conditions by a testing agency acceptable to authorities having jurisdiction.
- B. Comply with 47 CFR 15, Subparts A and B, for Class A digital devices.
- C. Comply with NFPA 70.

1.5 COORDINATION

- A. Coordinate features of devices specified in this Section with systems and components specified in other Sections to form an integrated system of compatible components. Match components and interconnections for optimum performance of specified functions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Contactors and Relays:
 - a. Automatic Switch Co.
 - b. Lutron.
 - c. Watt Stopper (The).
 2. Occupancy and Daylight Sensors:
 - a. Sensor Switch, Inc.
 - b. Watt Stopper (The).
 - c. Leviton.
 - d. Hubbell.
 3. Emergency Lighting Transfer Device:
 - a. The Bodine Company.
 - b. Watt Stopper.
 - c. Lutron

2.2 MULTIPOLE CONTACTORS AND RELAYS

- A. Description: Electrically operated and mechanically held, and complying with UL 508 and NEMA ICS 2.
1. Current Rating for Switching: UL listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballasts with 15 percent or less total harmonic distortion of normal load current).
 2. Control Coil Voltage: Match control power source.
- B. Relays shall be heavy-duty, rated at 20 amperes to 600 volts AC. Number of poles and voltage shall be as noted on the drawings.
- C. Relays shall be single coil, electrically operated, mechanically held electrically operated type, and shall be the Automatic Switch Company Series 917 within a NEMA Type 1 enclosure or equivalent.
- D. Each relay shall be labeled with a micarta or equivalent nameplate.
- E. Magnetic contactors indicated on the drawings shall be actuated by a time switch or a local control stations.

F. Magnetic contactors to be actuated by local control stations shall be as follows:

1. Relays shall be arranged to disconnect all equipment by the operation of the "ON-OFF" key-operated control station to be located within the Instructor's Desk Area or on wall as shown within the area controlled.
2. Control Station shall be 2 position cylinder lock type selector switch, momentary contact, locked in both positions, legend plate marking - Off-On, with 1 N.O. and 1 N.C. contact in each position. Pushbutton shall be Allen-Bradley Bulletin No. 800H for flush mounting, or equivalent.

2.3 INDOOR OCCUPANCY SENSORS (VACANCY SENSORS)

A. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor units with a separate relay unit and a separate power pack. All units shall be dual technology type unless noted otherwise on the drawings.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Operation: Unless otherwise indicated, lights shall be manually turned on and automatically turn off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the power pack unit.
4. Power Pack: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
5. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
6. Indicator: Digital display, to show when motion is being detected during testing and normal operation of the sensor.
7. Bypass Switch: Override the on function in case of sensor failure.
8. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; keeps lighting off when selected lighting level is present.
9. PIR Sensor of the Dual Technology Device: Detect occupancy by sensing a combination of heat and movement in area of coverage.
 - a. Detector Sensitivity: Detect occurrences of 6-inch minimum movement of any portion of a human body that presents a target of at least 36 sq. in.
 - b. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.
 - c. Detection Coverage (Corridor): Detect occupancy within 90 feet when mounted on a 10-foot- high ceiling.

10. Ultrasonic Sensor of the Dual Technology Device: detect occupancy by sensing a change in pattern of reflected ultrasonic energy in area of coverage.
 - a. Detector Sensitivity: Detect a person of average size and weight moving at least 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
 - b. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. when mounted on a 96-inch- high ceiling.
 - c. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on an 8-foot- high ceiling.
 - d. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. when mounted on a 96-inch- high ceiling.
 - e. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet when mounted on a 10-foot- high ceiling in a corridor not wider than 14 feet.
- B. Dual-Technology Type Ceiling Mounted Sensors: Ceiling mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on and off functions shall be selectable in the field by operating controls on unit. All sensors on project shall be dual technology.
 1. Sensitivity Adjustment: Separate for each sensing technology.
 2. Detector Sensitivity: Detect occurrences of 6-inch minimum movement of any portion of a human body that presents a target of at least 36 sq. in., and detect a person of average size and weight moving at least 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.
- C. Dual-Technology Type Wall-Switch Sensors: Wall mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on and off functions shall be selectable in the field by operating controls on unit. All sensors on project shall be dual technology.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; AT120 for 120 V.
 - b. Leviton; ODS 15-ID.
 - c. Sensor Switch WSD-PDT.
 - d. Watt Stopper (The); DW-100
 2. Automatic-wall-switch occupancy sensor, suitable for mounting in a single gang switchbox.
 3. Sensing Technology: Dual technology – PIR and ultrasonic.
 4. Switch Type: Single pole, unless otherwise noted, that is field selectable automatic "on," or manual "on" automatic "off."
 5. Description: Adaptive-technology type, dual voltage, adjustable time delay up to 20 minutes, 180-degree field of view, field adjustable from 180 to 40 degrees, with a minimum coverage area of 900 sq. ft.

6. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.

D. High-Bay Occupancy Sensors.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Hubbell Building Automation, Inc.
2. General Description: Solid-state unit. The unit is designed to operate with the lamp and ballasts indicated.
 - a. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - b. Operation: Turn lights on when coverage area is occupied, and to half-power when unoccupied; with a time delay for turning lights to half-power that is adjustable over a minimum range of 1 to 16 minutes.
 - c. Continuous Lamp Monitoring: When lamps are dimmed continuously for 24 hours, automatically turn lamps on to full power for 15 minutes for every 24 hours of continuous dimming.
 - d. Operating Ambient Conditions: 32 to 149 deg F.
 - e. Mounting: Threaded pipe.
 - f. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
 - g. Detector Technology: Dual Technology-PIR and ultrasonic.
 - h. Power and dimming control from the lighting fixture ballast that has been modified to include the dimming capacitor and MyzerPORT option.
3. Detector Coverage: User selectable by interchangeable PIR lenses, suitable for mounting heights from 12 to 50 feet.
4. Accessories: Obtain manufacturer's installation and maintenance kit with laser alignment tool for sensor positioning and power port connectors.

2.4 POWER PACKS

- A. Power Packs shall accept 120 or 277 VAC, be plenum rated, and provide class 2 power for up to 14 remote sensors.
- B. Power Pack shall securely mount to junction location through a threaded ½ inch chase nipple. Plastic clips into junction box shall not be accepted. All class 1 wiring shall pass through chase nipple into adjacent junction box without any exposure of wire leads.
- C. UL Listing under Energy Management or Industrial Control Equipment automatically meets this requirement, whereas Appliance Control Listing does not meet this safety requirement.
- D. When required by local code, Power Pack must install inside standard electrical enclosure and provide UL recognized support to junction box. All class 1 wiring is to

pass through chase nipple into adjacent junction box without any exposure of wire leads.

- E. Power Pack shall incorporate a class 1 relay and an A/C electronic switching device. The A/C electronic switching device shall make and break the load, while the relay shall carry the current in the On condition. This system shall provide full 20 amp switching of all load types, and be rated for 400,000 cycles.
- F. Power Packs shall be single circuit.
- G. Power Packs shall be the following Sensor Switch model numbers.
 - 1. PP-20 (Single Pole) or approved equal.

2.5 EMERGENCY LIGHTING TRANSFER DEVICE

- A. ELTD's shall accept 120 through 277 volts and be rated to 20A for all lighting type loads.
- B. ELTD's shall be UL Listed for field installation in indoor locations, UL 924 Listed as "Emergency Lighting Equipment", and UL 2043 as plenum rated.
- C. ELTD's shall be warranted for a full five (5) years, not pro-rata.
- D. Provide with fire alarm interface.

2.6 DAYLIGHT SENSORS (PHOTOCELLS)

- A. Photocell shall accept 12 to 24 VAC or VDC and provide a SPDT relay for interface with remote switching system. Sensor shall interface with occupancy sensors, directly with power pack, or other system as shown.
- B. Photocell shall provide for an On/Off setpoint, and a dead band to prevent the artificial light from cycling. Delay shall be incorporated into the photocell to prevent rapid response to passing clouds.
- C. Photocell setpoint and dead band shall be automatically calibrated through the sensor's micro-controller by initiating the "Automatic Setpoint Programming" subroutine. Further adjustment may be made manually if needed. Dead band setting shall be verified and modified by the sensor automatically every time the lights cycle to accommodate physical change in the space (i.e., furniture layouts, lamp depreciation, or lamp outages).
- D. For multi-output switching, manufacturers may require multiple daylight sensors to achieve desired results.
 - 1. When using stepped dimming ballast, the daylight sensor shall have multiple outputs or multiple sensors.
 - a. Step 1: 50-60 footcandle sensor reading - reduce lighting output by 33%.

- b. Step 2: 60-70 footcandle sensor reading - reduce lighting output by 66%.
 - c. Step 3: 70+ footcandle sensor reading - reduce lighting output by 100%.
- E. Combination Photocell/Dimming Sensors shall accept 12 to 24 VAC or VDC (from power pack or other low voltage source) and control the On/Off function as well as the dimming function of 0 to 10 VDC dimmable ballasts.
- F. Dual zone option shall be available for photocell, dimming sensors, or combination units. The second zone shall be controlled as an "offset" from the primary zone and shall be the zone farthest from the natural light source.
- G. Stand alone ambient light sensors shall interface directly with the 0 to 10 VDC, without any other power source connection, and control dimmable ballasts by sinking up to 20 milliamps of class 2 current. Sensor shall incorporate a photodiode viewing out of a ceiling enclosure at a 30 degree angle from horizontal to detect diffused light from the ambient and artificial sources. Sensor shall allow for removal of response delays for adjustment, however provide dampening delay for normal operation. Settings shall be made manually.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install equipment level and plumb and according to manufacturer's written instructions.
- B. Mount lighting control devices according to manufacturer's written instructions and requirements in Division 26 Section "Common Work Results for Electrical."
- C. Mounting heights indicated are to bottom of unit for suspended devices and to center of unit for wall-mounting devices.

3.2 CONTROL WIRING INSTALLATION

- A. Install wiring between sensing and control devices according to manufacturer's written instructions and as specified in Division 26 Section "Low-Voltage Power Conductors and Cables" for low-voltage connections.
- B. Wiring Method: Install all wiring in raceway as specified in Division 26 Section "Raceways and Boxes for Electrical Systems."
- C. Bundle, train, and support wiring in enclosures.
- D. Ground equipment.
- E. Connections: 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.

3.3 SENSOR INSTALLATION

- A. All occupancy sensors, wall and ceiling units, shall be mounted in a backbox.
- B. Install and aim sensors in locations to achieve at least 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.
- C. Sensor Wiring Installation:
 - 1. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
 - 2. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
 - 3. Install field-mounting transient voltage suppressors for lighting control devices in Category A locations that do not have integral line-voltage surge protection.
 - 4. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
 - 5. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.
 - 6. 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.

3.4 IDENTIFICATION

- A. Identify components and power and control wiring according to Division 26 Section "Common Work Results for Electrical."

3.5 FIELD QUALITY CONTROL

- A. Schedule visual and mechanical inspections and electrical tests with at least seven days' advance notice.
- B. Inspect control components for defects and physical damage, testing laboratory labeling, and nameplate compliance with the Contract Documents.
- C. Check tightness of electrical connections with torque wrench calibrated within previous six months. Use manufacturer's recommended torque values.
- D. Verify settings of photoelectric devices with photometer calibrated within previous six months.
- E. Electrical Tests: Use particular caution when testing devices containing solid-state components. Perform the following according to manufacturer's written instructions:
 - 1. Continuity tests of circuits.

2. Operational Tests: Set and operate devices to demonstrate their functions and capabilities in a methodical sequence that cues and reproduces actual operating functions.
 - a. Include testing of devices under conditions that simulate actual operational conditions. Record control settings, operations, cues, and functional observations.
- F. Correct deficiencies, make necessary adjustments, and retest. Verify that specified requirements are met.
- G. Test Labeling: After satisfactory completion of tests and inspections, apply a label to tested components indicating test results, date, and responsible agency and representative.
- H. Reports: Written reports of tests and observations. Record defective materials and workmanship and unsatisfactory test results. Record repairs and adjustments.

3.6 CLEANING

- A. Cleaning: Clean equipment and devices internally and externally using methods and materials recommended by manufacturers, and repair damaged finishes.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel as specified below:
 1. Train Owner's maintenance personnel on troubleshooting, servicing, adjusting, and preventive maintenance. Provide a minimum of two hours' training.
 2. Training Aid: Use the approved final version of maintenance manuals as a training aid.
 3. Schedule training with Owner, through Architect, with at least seven days' advance notice.

3.8 ON-SITE ASSISTANCE

- A. Occupancy Adjustments: Within two months of date of final payment, provide up to two Project site visits, to make program changes, and adjust controls to suit actual conditions.

END OF SECTION 260923

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Distribution panelboards.
 - 2. Lighting and appliance branch-circuit panelboards.

1.3 DEFINITIONS

- A. TVSS: Transient voltage surge suppressor.

1.4 SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Include evidence of NRTL listing for series rating of installed devices.
 - 6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 7. Include wiring diagrams for power, signal, and control wiring.
 - 8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.
- 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. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.
- E. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA PB 1.
- D. Comply with NFPA 70.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations:
 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.7 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. Siemens Energy & Automation, Inc.
 - 3. General Electric
 - 4. Square D; a brand of Schneider Electric.
- B. Enclosures: Flush- and surface-mounted cabinets.
 - 1. Rated for environmental conditions at installed location.
 - 2. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
 - 3. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
 - 4. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
 - 5. Finishes:
 - a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Galvanized steel.
 - 6. Directory Card: Inside panelboard door, mounted in transparent card holder. At the end of the project all directory cards shall be up to date and typed to reflect panel loads.
 - 7. All panelboards shall have a common keyed lock.
- C. Incoming Mains Location: Top and bottom.
- D. Phase, Neutral, and Ground Buses:
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - a. Each section of multiple compartment panelboard shall be provided with full size buses, or each section shall be protected by an individual circuit breaker where panelboard bus sizes are reduced. Separate section circuit breakers are not necessarily shown in the panelboard schedules and are the responsibility of the panelboard manufacturer and the electrical contractor.
 - 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.

- E. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - 2. Main and Neutral Lugs: Compression type.
 - a. Main and neutral lugs shall be oversized when ordered if the specified feeder conductors are oversized due to voltage drop or other design considerations.
 - 3. Ground Lugs and Bus-Configured Terminators: Mechanical or compression type.
- F. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- G. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 DISTRIBUTION PANELBOARDS

- A. Panelboards: NEMA PB 1, power and feeder distribution type.
- B. Doors: Door-in-door construction with hinged front panels and hinged doors; secured with flush latch with tumbler lock; keyed alike.
 - 1. For doors more than 36 inches high, provide two latches, keyed alike.
- C. Mains: Refer to panel schedules.
- D. Branch Overcurrent Protective Devices for all Circuit-Breaker Frame Sizes: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- B. Mains: Refer to panel schedules.
- C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- D. Doors: Door-in-door construction with hinged front panels and hinged doors; secured with flush latch with tumbler lock; keyed alike.

2.4 COMPUTER PANELBOARDS

- A. Refer to Section 262416-2.3 and Section 262417 "Electronic Distribution Panelboards."

- B. In addition to the sections mentioned above all computer panelboards shall meet the requirements of ANSI/IEEE C62.41 Category "B" TVSS.

2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 - 3. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
 - 4. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
 - 5. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits; Type HACR for feeding heating, air conditioning and refrigeration loads.
 - d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - e. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
 - f. The circuit breakers shall be 1-pole, 2-pole, or 3-pole, with trip elements calibrated in capacities as shown on the drawings. Circuit breakers shall be suitable for operation at the indicated voltage. Circuit breakers shall be "ambient compensated for enclosures" and shall be capable of carrying their full nameplate rating in a surrounding temperature of 40 degrees C. All circuit breakers shall be of the "bolt-on" type. Bolt-on shall be defined as a direct electrical connection bolted to the panelboard bus bars. The use of a mechanical bolted connection or bolting the circuit breakers to a module which utilizes a spring loaded latching type connection will not be permitted. All circuit breakers shall be of the same manufacturer.
 - g. Main circuit breakers shall be unit type with permanent, non-interchangeable, trip elements.
 - h. Branch circuit breakers of 150 ampere frame capacity or less shall be unit type with permanent trip elements. Branch circuit breakers of over 150 ampere capacity shall have removable trip elements for ready interchangeability. In lieu of interchangeable trip elements, the Contractor may provide electronic trip type circuit breakers, as approved by the Architect. Circuit breakers having an ampacity rating of 250 amperes up to 400 amperes shall have an instantaneous trip adjustable from 3x to 10x of

- the full load current rating. Circuit breakers having an ampacity rating of 400 amperes and greater shall be electronic trip type.
- i. Automatic tripping of all breakers shall be secured by means of a bimetallic thermal element of each pole engaging a common trip, supplemented by an instantaneous trip on current values ten times normal and above. The trip elements shall insure constant calibration and be capable of withstanding excessive short circuit conditions without injury. Tie handles will not be permitted for multiple pole breakers, except the breakers are of the common trip type.
 - j. The individual tripping elements shall be enclosed and sealed in units of molded composition to eliminate tampering or unauthorized changes in calibration. The ampere rating of each circuit breaker shall be clearly and permanently designated on its operating handle.
 - k. The circuit breakers shall have inverse-time-element characteristics so that tripping will be prevented on momentary overloads, but will occur before dangerous values are reached.
 - l. The breakers shall be operable in any position and removable from the front of the panelboard without disturbing adjacent units.
 - m. Each branch circuit shall be distinctly numbered.
 - n. The mechanism shall trip free from the handle so that contacts cannot be held closed against short circuit or abnormal overloads.
 - o. Breakers shall have a quick-make and quick-break toggle mechanism insuring full contact pressure to the time of opening, whether actuated automatically or manually. Contacts shall be nonwelding silver alloy type. The principle of arc dividing and cooling shall be incorporated in the breakers.
 - p. Automatic tripping shall be clearly indicated by trip indicators and the handle automatically assuming a position between the manual "ON" and "OFF" position. Each individual circuit breaker shall have a single operating handle and shall be of the single circuit type.
 - q. Circuit breakers shall have NEMA and UL listed symmetrical interrupting ratings of not less than the interrupting rating indicated on the circuit breaker schedules. All circuit breakers shall have the interrupting ratings indicated. The use of series rated circuit breakers to obtain the required interrupting ratings will not be permitted. Circuit breakers shall comply with, but not be limited to, Underwriters' Laboratories Standard No. 489 and the National Electrical Manufacturers Association Standard Publication No. AB-1.
 - r. Circuit breakers for exhaust fans, power roof ventilators, and all circuit breakers in "Emergency" and "Normal/Emergency" panelboards shall be provided with set screw type locking devices. Circuit breakers shall be normally locked in the "On" position but shall be capable of tripping on overloads. Circuit breakers in emergency panels and breakers for are protection shall be furnished with locking devices as herein specified.
 - s. Circuit breakers for circuits with exterior receptacles, and at other locations indicated on the drawings shall be of the ground fault interruption type. Ground fault interrupter circuit breakers shall be of ratings shown, minimum of 10,000 RMS symmetrical amperes, trip indicating handle for immediate identification of faulty circuits, push-to-test button, solid state ground fault sensing and signaling circuitry, overload and short circuit protection, and

arranged to provide 5 milliamp maximum ground fault protection and tripping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to NECA 407.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install panelboards and accessories according to NECA 407.
- B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- C. Mount top of trim 78 inches above finished floor unless otherwise indicated.
- D. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- E. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
- F. Install filler plates in unused spaces.
- G. Provisions for Future Circuits: Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.
- H. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
- I. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."

- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.4 CONNECTIONS

- A. Install equipment grounding connections for panelboards with ground continuity to main electrical ground bus.
- 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.
- C. Conductors shall be attached to all wiring device ground terminals with approved crimp-on, insulated fork terminal connectors.

3.5 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- B. Testing: After installing panelboards and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
 - 1. Procedures: Perform each visual and mechanical inspection and electrical test indicated in NETA ATS, Section 7.6 for molded-case circuit breakers. 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. Balancing Loads: After final payment, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes as follows:
 - 1. Measure as directed during period of normal system loading.
 - 2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data-processing, computing, transmitting, and receiving equipment.

3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
 4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.
- D. Infrared Scanning: After final payment, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove panel fronts so joints and connections are accessible to portable scanner.
1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of final payment.
 2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 3. Record of Infrared Scanning: Prepare a certified report that identifies panelboards checked and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges as indicated in the selective coordination study.

3.7 CLEANING

- A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
 - 2. Twist-locking receptacles.
 - 3. Receptacles with integral surge suppression units.
 - 4. Isolated-ground receptacles.
 - 5. Snap switches and wall-box dimmers.
 - 6. Pendant cord-connector devices.
 - 7. Cord and plug sets.
 - 8. Floor service outlets, poke-through assemblies, service poles, and multioutlet assemblies.

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.
- E. TVSS: Transient voltage surge suppressor.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
- C. Samples: One for each type of device and wall plate specified, in each color specified.
- D. Field quality-control test reports.

- E. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.
- C. All wiring devices shall be provided by a single source.

1.6 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
 - 1. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
 - 1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
 - 2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
 - 3. Leviton Mfg. Company Inc. (Leviton).
 - 4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 STRAIGHT BLADE RECEPTACLES

- A. Convenience Receptacles, light industrial specification grade 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, UL 498 and FS W-C-596.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; AH5361 (single), AH5362 (duplex).
 - b. Hubbell; HBL5361 (single), 5362 (duplex).
 - c. Leviton; 5891 (single), 5362 (duplex).
 - d. Pass & Seymour; 5361 (single), 5362 (duplex).
- B. Isolated-Ground, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, UL 498 and FS W-C-596.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; IG5362RN.
 - b. Hubbell; CR5352IG.
 - c. Leviton; 5362-IG.
 - d. Pass & Seymour; IG5362.
 2. Description: Straight blade; equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.
- C. Tamper-Resistant Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement SD, and FS W-C-596.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; TR8300.
 - b. Hubbell; HBL8300SGA.
 - c. Leviton; 8300-SGG.
 - d. Pass & Seymour; TR63H.

2.3 GFCI RECEPTACLES

- A. General Description: Straight blade, feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A. Where required by the National Electrical Code Receptacle shall be stamped with a 'WR' on the face of the receptacle:
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; VGF20A.
 - b. Hubbell; GF20LA.
 - c. Leviton; 7899.
 - d. Pass & Seymour; 2095HG.

2.4 TWIST-LOCKING RECEPTACLES

- A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498.
 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; L520R.
 - b. Hubbell; HBL2310.

- c. Leviton; 2310.
- d. Pass & Seymour; L520-R.

2.5 PENDANT CORD-CONNECTOR DEVICES

- A. Description: Matching, locking-type plug and receptacle body connector; Refer to drawings for NEMA configurations of plugs and receptacles.
 - 1. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.
 - 2. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.6 CORD AND PLUG SETS

- A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.
 - 1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
 - 2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.7 SNAP SWITCHES

- A. Comply with NEMA WD 1 and UL 20.
- B. Switches, 120/277 V, 20 A:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; AH2221 (single pole), AH2222 (two pole), AH2223 (three way), AH2224 (four way).
 - b. Hubbell; 1221 (single pole), 1222 (two pole), 1223 (three way), 1224 (four way).
 - c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
 - d. Pass & Seymour; PS20AC1 (single pole), PS20AC2 (two pole), PS20AC3 (three way), PS20AC4 (four way).
- C. Key-Operated Switches, 120/277 V, 20 A:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; AH2221L.

- b. Hubbell; HBL1221L.
 - c. Leviton; 1221-2L.
 - d. Pass & Seymour; PS20AC1-L.
- 3. Description: Single pole, with factory-supplied key in lieu of switch handle.

2.8 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
 - 1. Plate-Securing Screws: Metal with head color to match plate finish.
 - 2. Material for Finished Spaces: 0.035-inch- thick, satin-finished stainless steel.
 - 3. Material for Wood Wall Finished Spaces: 0.04-inch thick. Brushed bronze; laquered to prevent corrosion.
 - 4. Material for Unfinished Spaces: Galvanized steel RS Cover.
 - 5. Material for Wet and Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations." NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable cover. Cover shall be weatherproof 'While-in -Use' type. Bronze or Gray in color as selected by the architect.

2.9 FLOOR SERVICE FITTINGS

- A. Type: Modular, flush-type, dual-service units suitable for wiring method used.
- B. Compartments: Barrier separates power from voice and data communication cabling.
- C. Service Plate: Rectangular, solid brass with satin finish.
- D. Power Receptacle: NEMA WD 6 configuration 5-20R, gray finish, unless otherwise indicated.
- E. Voice and Data Communication Outlet: Refer to detail on drawings for voice and data communication outlet layout in floor boxes.

2.10 RETRACTABLE REEL CORD AND PLUG (DROP-CORD DEVICES)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Hubbell Incorporated; Wiring Device-Kellems.
 - 2. Pass & Seymour/Legrand; Wiring Devices & Accessories.
 - 3. Thomas & Betts Corporation.
 - 4. Wiremold, Legrand.
- B. Description: Industrial Retractable Reel Cord – Durable corrosion resistant steel construction, Multi-position guide arm. Positive-latch mechanism automatically maintains desired cord length, 12 AWG cord. Factory-fabricated and pre-wired

assembly with 45 feet of cord, 125V A/C, 20 Amps. Factory attached double duplex plug and cord. (Hubbell HBL45123R20WM1)

2.11 MULTIOUTLET ASSEMBLIES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Hubbell Incorporated; Wiring Device-Kellems.
 - 2. Wiremold Company (The).
- C. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.
- D. Raceway Material: Metal, with manufacturer's standard finish.
- E. Wire: No. 12 AWG THHN/THWN.

2.12 FINISHES

- A. Color: Wiring device catalog numbers in Section Text do not designate device color.
 - 1. Wiring Devices Connected to Normal Power System: As selected by Architect, unless otherwise indicated or required by NFPA 70 or device listing.
 - 2. Wiring Devices Connected to Emergency Power System: Red.
 - 3. TVSS Devices: Blue.
 - 4. Isolated-Ground Receptacles: Orange.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Coordination with Other Trades:
 - 1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
 - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.

3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
 - a. Existing Conductors shall not be reused. Remove existing and re-pull new in existing conduits.

D. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. Stranded wire shall be terminated to all wiring devices with approved fork terminals on side mounted terminating screws.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

- H. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings. It is the electrical contractors responsibility to coordinate with all trades the location and installation of service poles to not interfere with lighting, ductwork, cable tray, furniture, etc.
- I. Any outlet installed by the Contractor in such a location as to be out of proper relation to beams, walls, or other details of the building, shall be corrected by and at the expense of the Contractor.
- J. Unless otherwise indicated, outlet boxes in walls shall be located with centerline at the following elevations above finished floor:
 - 1. Wall Switch Outlets 4'-0", except as hereinafter specified.
 - 2. Convenience Outlets 1'-6", or 6" above back splash of countertops.
 - 3. Distribution Cabinets 6'-6" to top.
 - 4. Fire Alarm Stations 3'-8", and Labor and Industry requirements.
 - 5. Fire Alarm Indicating Devices 6'-8", or 6" below ceiling height, whichever is lower.
 - 6. Miscellaneous Equipment Outlets Manufacturer's Recommendations.
- K. Where outlets are designated with centerline at 8'-0" and ceiling heights are 8'-6" or lower, outlets shall be located with centerline 1'-0" below ceiling. Thermostat and other outlet locations shall vary from above heights where applicable State or Local Codes differ from the above.
- L. These heights may be changed to meet building conditions, in which case the Contractor shall use new dimensions given him by the Architect. All fire alarm stations and sounding devices shall be installed on same vertical centerline. Outlets shall be located in a symmetrical manner. The Electrical Contractor shall cooperate with the General Contractor in locating ceiling fixtures in rooms and other locations where acoustical tile ceilings are installed. Fixtures shall be located symmetrically on centers of tile blocks where possible.
- M. New switches shall be located in accordance with physically handicapped regulations and in accordance with ANSI A117.1-1980 Standards and the Americans With Disabilities Act (ADA). Switches shall be located with centerline 3'-10" above floor. Switches at counters and where required for a high forward reach shall be mounted with centerline at 3'-10" maximum. Where new switches are located adjacent to existing switches, and they are side reach accessible, the switches may be mounted at the same height, except in no case shall the switches be located more than 4'-6" above floor to the centerline.
- N. Where the Architectural Drawings indicate the exact locations of various items the Electrical Contractor shall follow the Architectural Drawings provided the locations do not conflict with applicable codes and regulations.

3.2 IDENTIFICATION

- A. Comply with Division 26 Section "Identification for Electrical Systems."

1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.
2. Test Instruments: Use instruments that comply with UL 1436.
3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 5 percent or higher is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

END OF SECTION 262726

SECTION 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, apply to this Section.

1.2 SUMMARY

- A. This Section includes individually mounted enclosed switches and circuit breakers used for the following:
 - 1. Feeder and branch-circuit protection.
 - 2. Motor and equipment disconnecting means.
 - 3. Elevator Shunt-Trip Fused Disconnect Switches.

1.3 SUBMITTALS

- A. Product Data: For each type of switch, circuit breaker, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each switch and circuit breaker.
 - 1. 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. Enclosure types and details for types other than NEMA 250, Type 1.
 - b. Current and voltage ratings.
 - c. Short-circuit current rating.
 - d. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 2. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
- C. Field Test Reports: Submit written test reports and include the following:
 - 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.

- E. Maintenance Data: For enclosed switches and circuit breakers and for components to include in maintenance manuals specified in Division 1. In addition to requirements specified in Division 1 Section "Closeout Procedures," include the following:
 - 1. Routine maintenance requirements for components.
 - 2. Manufacturer's written instructions for testing and adjusting switches and circuit breakers.
 - 3. Time-current curves, including selectable ranges for each type of circuit breaker.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NEMA AB 1, NEMA FU1 and NEMA KS 1.
- C. Comply with NFPA 70 and NFPA 72.
- D. Comply with UL 98, UL 248 and UL 508A.
- E. Comply with ANSI/ASME 17.1.
- F. 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.

1.5 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Fusible Switches and Molded-Case Circuit Breakers:
 - a. Eaton Corp.; Cutler-Hammer Products.
 - b. Square D Co.
 - c. Siemens.

2.2 ENCLOSED SWITCHES

- A. Enclosed, Nonfusible Switch: NEMA KS 1, Type HD, with lockable handle.
- B. Enclosed, Fusible Switch, 800 A and Smaller: NEMA KS 1, Type HD, with Class "R" or "L" clips to accommodate specified fuses, lockable handle with two padlocks, and interlocked with cover in closed position.

2.3 ENCLOSED CIRCUIT BREAKERS

- A. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.
 - 1. Comply with molded-case circuit breaker specifications in the Division 26 section, "Panelboards."

2.4 ENCLOSURES

- A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.
 - 1. Outdoor Locations: NEMA 250, Type 3R.
 - 2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
 - 3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

2.5 FACTORY FINISHES

- A. Finish: Manufacturer's standard color paint applied to factory-assembled and -tested enclosures before shipping.

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.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with mounting and anchoring requirements specified in Division 26 "Common Work Results for Electrical."

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Common Work Results for Electrical."
- B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.4 CONNECTIONS

- A. Install equipment grounding connections for switches and circuit breakers with ground continuity to main electrical ground bus.
- B. Install power wiring. Install wiring between switches and circuit breakers, and control and indication devices.
- C. 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.

3.5 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 - 1. Test insulation resistance for each enclosed switch, circuit breaker, component, and control circuit.
 - 2. Test continuity of each line- and load-side circuit.
- B. Testing: After installing enclosed switches and circuit breakers and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
 - 1. Procedures: Perform each visual and mechanical inspection and electrical test indicated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. 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.

3.6 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges as indicated on the selective coordination study to be provided by this Contractor.

3.7 CLEANING

- A. On completion of installation, inspect interior and exterior of enclosures. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION 262816

SECTION 262913 - ENCLOSED CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes motor controllers rated 600 V and less.
- B. Related Section:
 - 1. Division 26 Section "Variable-Frequency Motor Controllers" for general-purpose, ac, adjustable-frequency, pulse-width-modulated controllers for use on variable torque loads in ranges up to 200 hp.
 - 2. Division 26 Section "Common Work Results for Electrical" for general materials and installation methods.
 - 3. Division 26 Section "Fuses" for fuses in fusible switches.

1.3 DEFINITIONS

- A. CPT: Control power transformer.
- B. MCCB: Molded-case circuit breaker.
- C. MCP: Motor circuit protector.
- D. N.C.: Normally closed.
- E. N.O.: Normally open.
- F. OCPD: Overcurrent protective device.
- G. SCR: Silicon-controlled rectifier.

1.4 SUBMITTALS

- A. Product Data: For each type of enclosed controller. Include manufacturer's technical data on features, performance, electrical characteristics, ratings, and enclosure types and finishes.

- B. Shop Drawings: For each enclosed controller. Include dimensioned plans, elevations, sections, details, and required clearances and service spaces around controller enclosures.
 - 1. Show tabulations of the following:
 - a. Each installed unit's type and details.
 - b. Factory-installed devices.
 - c. Nameplate legends.
 - d. Short-circuit current rating of integrated unit.
 - e. Features, characteristics, ratings, and factory settings of individual OCPDs in combination controllers.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
- C. Qualification Data: For qualified testing agency.
- D. Field quality-control reports.
- E. Operation and Maintenance Data: For enclosed controllers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Routine maintenance requirements for enclosed controllers and installed components.
 - 2. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.
 - 3. Manufacturer's written instructions for testing, adjusting, and reprogramming reduced-voltage solid-state controllers.
- F. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
 - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NFPA 70.
- D. IEEE Compliance: Fabricate and test enclosed controllers according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store enclosed controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

1.7 COORDINATION

- A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Specification Section 033000.5.
- C. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

1.8 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. Fuses: Refer to Division 26 Section "Fuses"
 - 2. Indicating Lights: Two of each type and color installed.
 - 3. Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.
 - 4. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

PART 2 - PRODUCTS

2.1 Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- A. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
- B. Siemens Energy & Automation, Inc.
- C. Square D; a brand of Schneider Electric.

2.2 MANUAL MOTOR CONTROLLERS

- A. Description: NEMA ICS 2, general purpose, Class A with toggle action, pilot light and overload element. Switches shall be complete with Type 302 (18-8) stainless steel wall plates.

2.3 FULL-VOLTAGE CONTROLLERS

- A. General Requirements for Full-Voltage Controllers: Comply with NEMA ICS 2, general purpose, Class A.
- B. Combination Magnetic Controller: Factory-assembled combination of magnetic controller, OCPD, and disconnecting means.
 - 1. MCP Disconnecting Means for motors 10-40 HP:
 - a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
 - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
 - c. Auxiliary contacts "a" and "b" arranged to activate with MCP handle.
 - d. N.O. alarm contact that operates only when MCP has tripped.
 - e. Current-limiting module to increase controller short-circuit current (withstand) rating to 100 kA.
 - 2. MCCB Disconnecting Means for motors ¼ up to 10 HP:
 - a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents; thermal-magnetic MCCB, with inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.
 - b. Front-mounted, adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - c. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
 - d. Auxiliary contacts "a" and "b" arranged to activate with MCCB handle.
 - e. N.O. alarm contact that operates only when MCCB has tripped.

2.4 REDUCED-VOLTAGE MAGNETIC CONTROLLERS

- A. General Requirements for Reduced-Voltage Magnetic Controllers: Comply with NEMA ICS 2, general purpose, Class A; closed-transition; adjustable time delay on transition.
- B. Combination Reduced-Voltage Magnetic Controller: Factory-assembled combination of reduced-voltage magnetic controller, OCPD, and disconnecting means.
 - 1. Used for motors over 40 HP
 - 2. MCP Disconnecting Means:
 - a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.

- b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
- c. Auxiliary contacts "a" and "b" arranged to activate with MCP handle.
- d. N.O. alarm contact that operates only when MCP has tripped.
- e. Current-limiting module to increase controller short-circuit current (withstand) rating to 100 kA.

2.5 ENCLOSURES

- A. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.
 - 1. Dry and Clean Indoor Locations: Type 1.
 - 2. Outdoor Locations: Type 3R.
 - 3. Kitchen Wash-Down Areas: Type 4X.
 - 4. Other Wet or Damp Indoor Locations: Type 4.
 - 5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.

2.6 ACCESSORIES

- A. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.
 - 1. Push Buttons, Pilot Lights, and Selector Switches: Heavy-duty, type.
 - a. Pilot Lights: LED types; colors as indicated; push to test.
 - b. Selector Switches: Hand/Off/Auto.
- B. N.O. auxiliary contact(s).
- C. Control Relays: Auxiliary and adjustable solid-state time-delay relays.
- D. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.
- E. Sun shields installed on fronts, sides, and tops of enclosures installed outdoors and subject to direct and extended sun exposure.
- F. Cover gaskets for Type 1 enclosures.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and surfaces to receive enclosed controllers, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

- B. Examine enclosed controllers before installation. Reject enclosed controllers that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."
- B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- C. Install fuses in each fusible-switch enclosed controller.
- D. Install fuses in control circuits if not factory installed. Comply with requirements in Division 26 Section "Fuses."
- E. Install heaters in thermal overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.
- F. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.
- G. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved nameplate.
 - 3. Label each enclosure-mounted control and pilot device.

3.4 CONTROL WIRING INSTALLATION

- A. Install wiring between enclosed controllers and remote devices and facility's central control system. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- B. Bundle, train, and support wiring in enclosures.

- C. Connect selector switches and other automatic-control selection devices where applicable.
 - 1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.
 - 2. Connect selector switches with enclosed-controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- D. Tests and Inspections:
 - 1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
 - 2. Test insulation resistance for each enclosed-controller element, component, connecting motor supply, feeder, and control circuits.
 - 3. Test continuity of each circuit.
 - 4. Verify that voltages at controller locations are within plus or minus 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Owner before starting the motor(s).
 - 5. Test each motor for proper phase rotation.
 - 6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 8. Perform the following infrared (thermographic) scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After final payment, but not more than 60 days after Final Acceptance, perform an infrared scan of each multi-pole enclosed controller. 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 multi-pole enclosed controller 11 months after date of Final payment.
 - 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.
- 9. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Enclosed controllers will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports including a certified report that identifies enclosed controllers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

- A. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.
- B. Adjust overload-relay heaters or settings if power factor correction capacitors are connected to the load side of the overload relays.
- C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable instantaneous trip elements. Initially adjust to six times the motor nameplate full-load ampere ratings and attempt to start motors several times, allowing for motor cooldown between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Architect before increasing settings.
- D. Set the taps on reduced-voltage autotransformer controllers at 65 percent.
- E. Set field-adjustable switches and program microprocessors for required start and stop sequences in reduced-voltage solid-state controllers.
- F. Set field-adjustable circuit-breaker trip ranges as specified.

3.7 PROTECTION

- A. Replace controllers whose interiors have been exposed to water or other liquids prior to final payment.

3.8 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers.

END OF SECTION 262913

SECTION 265100 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Interior and Exterior lighting fixtures, light emitting diodes, and drivers.
 - 2. Exit signs.
 - 3. Lighting fixture supports.
- B. Related Sections include the following:
 - 1. Division 26 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
 - 2. Division 26 Section "Wiring Devices" for manual wall-box dimmers for incandescent lamps.

1.3 DEFINITIONS

- A. CRI: Color-rendering index.
- B. CU: Coefficient of utilization.
- C. LED: Light emitting diode.
- D. LER: Luminaire efficacy rating.
- E. Luminaire: Complete lighting fixture, including lamps, driver, and housing.
- F. RCR: Room cavity ratio.

1.4 SUBMITTALS

- A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
 - 1. Physical description of lighting fixture including dimensions.
 - 2. Driver.

3. Energy-efficiency data.
 4. Life, output, and energy-efficiency data for lamps or LEDs.
 5. Samples for verification purposes of specific individual fixtures when requested by the Architect.
- B. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
1. Lighting fixtures.
 2. Suspended ceiling components.
 3. Structural members to which suspension systems for lighting fixtures will be attached.
 4. Other items in finished ceiling including the following:
 - a. Air outlets and inlets.
 - b. Speakers.
 - c. Sprinklers.
 - d. Smoke and fire detectors.
 - e. Occupancy sensors.
 - f. Access panels.
 - g. Fire alarm notification devices
 - h. Power Poles
 5. Perimeter moldings.
- C. Qualification Data: For agencies providing photometric data for lighting fixtures.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.
- F. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.
- D. Mockups: Provide interior lighting fixtures for room or module mockups, complete with power and control connections.

1. Obtain Architect's approval of fixtures for mockups before starting installations.
2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
3. Approved fixtures in mockups may become part of the completed Work if undisturbed at time of final payment.

1.6 COORDINATION

- A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.7 WARRANTY

- A. Special Warranty for LED Lamps and Drivers: Manufacturer's standard form in which the manufacturer agrees to repair or replace the lamps and/drivers that fail in materials or workmanship within specified warranty period.
 1. Warranty Period for LED Lamps and Drivers: Five years from date of final payment.
- B. Special Warranty for Exterior Lighting Fixtures and Supports: Manufacturer's standard form in which the manufacturer agrees to repair or replace the components that fail in structural support, faulty operation of the luminaires and accessories, deterioration of metal, metal finishes, or colors beyond normal weathering, materials or workmanship within specified warranty period.
 1. Warranty Period for Exterior Fixtures and accessories: Five years from date of final payment.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Lamps: 10% of each type and rating installed. Furnish at least one of each type.
 2. Plastic Diffusers and Lenses: 1% of each type and rating installed. Furnish at least one of each type.
 3. Battery and Charger Data: One for each emergency lighting unit.
 4. Drivers: 5% of each type and rating installed. Furnish at least one of each type.
 5. Globes and Guards: 5% of each type and rating installed. Furnish at least one of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the products indicated for each designation in the Lighting Fixture Schedule indicated on the drawings.

2.2 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

- A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- B. Metal Parts: Free of burrs and sharp corners and edges.
- C. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging, painted after fabrication.
- D. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- E. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
 - 4. Laminated Silver Metallized Film: 90 percent.
- F. Plastic Diffusers, Covers, and Globes:
 - 1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - a. Lens Thickness: At least 0.125 inch minimum unless different thickness is indicated.
 - b. UV stabilized.
 - 2. Glass: Annealed crystal glass, unless otherwise indicated.

2.3 LED FIXTURES (other than Exit Signs)

- A. Fixtures shall be manufactured and assembled in the United States and meets the buy American requirements within the American Recovery and Reinvestment Act and be UL Listed.

- B. Light Emitting Diodes shall be manufactured by Cree, Lumiled, or Nachia; no approved equal.
- C. Drivers shall be manufactured by Osram/Sylvania, Phillips/Advance, or ADL Technology and be capable of accepting the voltage indicated on the drawings and capable of dimming if required. The driver shall meet the following requirements:
 - 1. Class A Sound Rating
 - 2. Total Harmonic Distortion of less than 20 percent.
 - 3. Operating temperature between -40 degree Celsius and 40 degrees Celsius.
 - 4. Driver shall not contain any Polychlorinated Biphenyl (PCB).
- D. All LED fixtures shall be tested to IESNA LM-79-2008 and LM-80-2008 and meet the following:
 - 1. Fixture Efficacy (Lumens per watt): 60 or greater.
 - 2. Color Accuracy: Color Rendering Index (CRI): 70 or greater.
 - 3. Light Color: As indicated on lighting fixture schedule.
 - 4. Outdoor fixtures shall be IP65 Rated.
 - 5. LEDs, driver and all components shall have a system lifetime of 50,000 hours or more at 25 degrees Celsius.
 - 6. Fixture shall have a minimum of a five year warranty on all components and finishes.

2.4 EXIT SIGNS

- A. Description: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
 - 1. Lamps for AC Operation: LEDs, 70,000 hours minimum rated lamp life.

2.5 LIGHTING FIXTURE SUPPORT COMPONENTS

- A. Comply with Division 26 Section "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
- C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage.
- E. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- F. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.
- B. Support for Lighting Fixtures in or on Grid-Type Suspended Ceilings: Use grid as a support element.
 - 1. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than 6 inches from lighting fixture corners.
 - 2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
 - 3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
- C. Suspended Lighting Fixture Support:
 - 1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
 - 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
 - 3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- E. Install lighting fixtures at locations and heights as indicated, in accordance with fixture manufacturer's written instructions, applicable requirements of NEC, NECA's "Standard of Installation", NEMA standards, and with recognized industry practices to ensure that lighting fixtures fulfill requirements.
- F. Provide fixtures and/or fixture outlet boxes with hangers to properly support fixture weight. Submit design of hangers, method of fastening, other than indicated or specified herein, for review by Architect.
- G. Install flush mounted fixtures to eliminate light leakage between fixture frame and finished surface.
- H. Fasten fixtures securely to indicated structural supports; and ensure that pendant fixtures are plumb and level. Provide individually mounted pendant fixtures longer than 2 feet with twin stem hangers. Provide stem hanger with ball aligners and provisions for minimum 1" vertical adjustment. Mount continuous rows of fixtures with an additional stem hanger greater than number of fixtures in the row.
- I. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten

connectors and terminals to comply with tightening torques specified in UL Std 486A and B, and the National Electrical Code.

- J. Support surface mounted fixtures greater than 2 feet in length at a point in addition to the outlet box fixture stud.
- K. Suitable plaster rings or frames shall be provided for all recessed fixtures. Where sloping ceilings occur, all suspended fixtures shall be mounted at the same height above the floor, except where directed otherwise by the Architect. Where fixtures or boxes are recessed in special construction, the Contractor shall do all cutting required at each location. The Contractor shall reinforce openings with suitable structural members as required by the Architect.
- L. The Electrical Contractor shall be responsible for notifying the General Contractor of exact locations where recessed fixtures and boxes will be installed. It will be necessary to coordinate the exact locations of structural members to provide clearance for the recessed electrical equipment.
- M. Recessed fluorescent fixtures shall be supported independently of T-bars furnished as a part of the General Contractor's ceiling construction. Fixtures shall be fastened to the T-bars in accordance with the requirements of the National Electrical Code. The approximate locations and arrangement of fixtures shall be as shown on the drawings. All work shall be properly coordinated with the General Contractor. Locations, dimensions, weights, etc., shall be given to the General Contractor prior to the installation. The Electrical Contractor shall be responsible for furnishing fixtures with accessories compatible for installation in the ceilings being installed. The exact type of ceiling to be installed and details of construction shall be obtained from the General Contractor. The fixture installation shall also be coordinated with piping, diffusers, grilles and ductwork which will be installed under other Contracts. Although fixtures are specified with Type G or F trim and accessories, special trim and mounting accessories shall be used where necessary to obtain the closest coordination and compatibility with the ceilings furnished.
- N. All lighting fixtures shall be rigidly supported from main building construction slabs or structural members. The arrangement and type of supports shall be subject to the approval of the Architect. Supports shall be made up of steel members, steel rods or steel straps.
- O. The Electrical Contractor shall space all lighting fixtures evenly on centers or joints of ceiling tiles or other construction. Fixtures shall be located at center of ceiling tiles where possible. All lighting fixtures and associated boxes shall also be coordinated with ductwork, diffusers and grilles installed under the Heating Contract.
- P. Fixtures shall be designed, arranged and furnished and installed complete with all accessories for mounting in or on plaster, acoustical tile construction, T-bar type construction, and other types of ceilings shown on the Architectural Drawings. The Contractor shall check carefully with final ceiling finish schedule of rooms before ordering fixtures for he will be held responsible for the installation complete in every detail. All work shall be coordinated with the General Contractor.

- Q. It is the Electrical Contractor's responsibility to scale the drawings and count the actual number of fixtures which must be furnished and installed under this Contract. Refer to architectural drawings for exact dimensions of fixture location.
- R. Where the building insulation is penetrated by boxes, fixtures, conduits, etc., under this Contract, the Contractor shall repair the insulation and vapor barrier jacket on the insulation, and shall seal all edges to assure a moisture-tight installation.
- S. Where smoke walls, fire barriers and fire rated ceilings, and floors are penetrated by boxes, fixtures, conduits, etc., under this Contract, the Contractor shall seal all openings and shall provide all noncombustible materials and coverings as required to conform to the requirements of the National Fire Protection Association.
- T. Boxes on prewired fixtures shall not be used for through-circuit wiring, except where the fixtures are specifically UL approved for that purpose.
- U. All inoperable lamps shall be replaced with new lamps during the course of construction, up to and including the date of final acceptance of the building by the Architect.

3.2 CONNECTIONS

- A. Ground equipment.
 - 1. 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.

3.3 FIELD QUALITY CONTROL

- A. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.
- B. At date of final acceptance by the Owner, replace lamps in lighting fixtures which are observed to be noticeably dimmed after Contractor's use and testing, as judged by Architect.

3.4 CLEANING AND ADJUSTING

- A. Clean fixtures internally and externally after installation. Use methods and materials recommended by manufacturer.
- B. Adjust aimable fixtures to provide required light intensities.
- C. Clean lighting fixtures of dirt and construction debris upon completion of installation. Clean fingerprints and smudges from lenses.
- D. Protect installed fixtures from damage during remainder of construction period.

3.5 DEMONSTRATION

- A. Upon completion of installation of lighting fixtures, and after building circuitry has been energized, apply electrical energy to demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.

3.6 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- B. Steel Conduits: Comply with Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch-thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.7 LIGHTING FIXTURE SCHEDULE

- A. The lighting fixture schedule is indicated on the drawings.

END OF SECTION 265100

SECTION 270500 - COMMON WORK RESULTS FOR COMMUNICATIONS

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. Communications equipment coordination and installation.
 - 2. Sleeves for pathways and cables.
 - 3. Sleeve seals.
 - 4. Grout.
 - 5. Common communications installation requirements.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For sleeve seals.

1.5 COORDINATION

- A. Coordinate arrangement, mounting, and support of communications equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right of way for piping and conduit installed at required slope.
 - 4. So connecting pathways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

- C. Coordinate location of access panels and doors for communications items that are behind finished surfaces or otherwise concealed.
- D. The actual runs and locations of all cabling and cable tray systems shall be determined on the site and shall be installed to meet the various conditions at the building, and any changes necessary to conceal pipes or clear pipes or equipment of other trades shall be made without additional compensation. Where the location of pipe lines installed under the HVAC Contract or Sprinkler Contract conflict with telecommunication pathways, the HVAC Contract piping and ductwork and Sprinkler Contract piping shall have precedence as to the preferred location.
- E. Where this Contractor elects to substitute materials or equipment approved for those specified, this Contractor will be held responsible for all structural, mechanical, and electrical changes required for the installation of substituted materials at no additional compensation. When the Contractor proposes to use an item or equipment other than that specified or detailed on the drawings, that is approved by the Architect and that requires re-design of the structure, partitions, foundations, piping, wiring or any other part of the mechanical, electrical or architectural layout, then such re-design, new drawings, and detailing required for it shall be prepared by the Contractor without additional compensation.
- F. Lay out work from dimensions of Architectural Drawings and Structural Drawings and actual dimensions of equipment being installed. Layouts in congested areas shall not be scaled from the Mechanical, Electrical and Telecommunications Drawings. Clearances shall be provided on all sides of equipment for proper maintenance purposes as required by the equipment manufacturer and as required by the Department of Labor and Industry. All equipment, apparatus, and accessories requiring normal servicing, operation, or maintenance shall be made easily accessible.
- G. All equipment shall operate without objectionable noise or vibration and within Noise Criteria or Vibration Tables as determined by authorized representatives of the Architect from Sound and Vibration Control listed in the latest Edition of the ASHRAE Handbook of Fundamentals. If such objectionable noise or vibration shall be produced and transmitted to occupied portions of the building by apparatus, piping, or other parts of this work, any necessary changes, as approved, shall be made by the Contractor without cost to the owner.
- H. The Contractor shall be responsible for providing all necessary fire-resistant materials and covers where fire-rated construction is penetrated under this Contract. Materials shall be furnished by the Contractor as required to maintain the fire rating of the walls, partitions, ceilings, and floors in accordance with the requirements of NFPA, *the Pennsylvania Department of Labor and Industry*, International Building Code (IBC) 2006, and all other applicable codes.
- I. This Contractor shall disconnect and remove all telecommunications cabling and other associated telecommunications equipment in conjunction with removed HVAC, electrical, and other miscellaneous equipment. Relocated equipment shall be reconnected to telecommunication systems at their new locations.

- J. Where present piping or equipment is removed and unused openings remain in walls, floors, ceilings, partitions, and similar locations, the openings shall be properly patched by this Contractor in a manner satisfactory to the Architect.
- K. Cutting of the construction excessively or carelessly done shall be repaired to match the original work by this Contractor and to the satisfaction of the Architect who will make the final decision with respect to excessive or careless cutting work.
- L. The submissions are the Contractor's documents and the Architect's and Engineer's approval constitutes an acknowledgment that the documents have been submitted and nothing more. It is the Contractor's responsibility to check his own submissions for compliance with the Contract Documents and job conditions.

1.6 GENERAL PROJECT REQUIREMENTS

- A. This Contractor shall include all inspection fees as required by the local municipality, along with coordinating inspector visits in a timely manner.
- B. Provide protection of all existing structures, flooring, equipment, finishes, landscaping, insulation, etc from damage resulting from the work of this Contract. Repair any damage promptly to the satisfaction of the Architect and Owner.
- C. Provide painting for "touch up" that will be required to restore "factory finished" equipment and material to its original condition in the event of damage.
- D. Provide any housekeeping and equipment pads required for equipment (interior or exterior) that are required for the work of this Contract.
- E. Perform the necessary on-site discovery process in order to understand all existing systems currently in use.
- F. Assist in resolving and scheduling any power outages. A two (2) week notice shall be given in the event an outage must occur. All outages shall be kept to a minimum and shall be approved by the Owner.

PART 2 - PRODUCTS

2.1 SLEEVES FOR PATHWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel.

1. Minimum Metal Thickness:

- a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
- b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Calpico, Inc.
 - b. Metraflex Co.
 - c. Pipeline Seal and Insulator, Inc.
 - d. Thunder Line/Link-Seal.
2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of pathway or cable.
3. Pressure Plates: Stainless steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR COMMUNICATIONS INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both communications equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR COMMUNICATIONS PENETRATIONS

- A. Communications penetrations occur when pathways, cables, wireways, or cable trays penetrate concrete slabs, concrete or masonry walls, or other wall assemblies.
- B. Concrete Slabs and All Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and pathway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint.
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pathway and cable penetrations. Install sleeves and seal pathway and cable penetration sleeves with firestop materials.
- K. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.

- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between pathway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for communications installations to restore original fire-resistance rating of assembly.

END OF SECTION 270500

SECTION 271300 - TELECOMMUNICATIONS SYSTEM (TELEPHONE AND DATA
NETWORK)

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 WORK INCLUDED

- A. The Work of this Section shall consist of the labor, materials, and equipment required for furnishing and installing cable and equipment for complete and operating telecommunications system.

1.3 DESCRIPTION OF WORK

- A. The work generally consists of furnishing and installing inside Technology and equipment as indicated on the drawings.
- B. All items shall be furnished and installed to provide complete and operating systems extended from the existing infrastructure.
- C. Contractor shall furnish and install the following:
 - 1. Unless noted, conduits, raceways, cable tray, sleeves, pull boxes, and outlet boxes.
 - 2. Power supply to telecommunications rooms and equipment.
 - 3. Grounding busbars, ground wires and ground clamps
 - 4. A #14 fish wire or Jet Line No. 232 pull rope in each spare run of conduit.
 - 5. Outlet boxes.
 - 6. Conduits from outlet boxes to above accessible ceilings (or to accessible location if ceilings are not accessible). Refer to Electrical Drawings for locations of conduit stub-outs
 - 7. Copper cables, including patch cords
 - 8. Fiber optic cables, including patch cords
 - 9. Jacks, wallplates and connectors, both copper and fiber.
 - 10. Building entrance terminal and protectors
 - 11. Fiber optic termination panels
 - 12. Fiber optic cable management ring.
 - 13. Racks including patch panels and wire management panels.
 - 14. "J" hooks for supporting cables.
 - 15. Testing of all cable, copper and fiber optic
 - 16. Surge protection devices

17. Splice closures
18. Innerduct
19. Fire stops in sleeves
20. Backboards

D. The following items will be the responsibility of the Owner:

1. Telephone and fax machines.
2. PCs, printers, video display terminals, etc.

1.4 SUBMITTALS

A. Submit for approval in accordance with specified submittal procedures:

1. Cable, Fiber Optic
2. Cable, Copper
3. Category 6 Jacks
4. Wall Plates
5. Blank Inserts
6. Category 6 Patch Panels
7. Category 6 Patch Cords
8. Fiber Optic Termination Panels
9. Fiber Optic Patch Cords
10. Fiber Optic Connectors
11. Innerduct
12. Racks and Horizontal Cable Management Devices
13. Fiber Optic Cable Management
14. Building Entrance Terminal and Protectors and Punchdown Blocks, 110 Type
15. Adhesive Port Label Icons
16. Splice Closures
17. Grounding System Components
18. Surge Protectors Devices
19. Uninterruptible Power Supply
20. Network Equipment
21. Remote Access Points
22. Mounting Brackets, All Types
23. Termination Blocks, All Types
24. Test results as specified herein.
25. System labeling schedule as specified and submitted in the forms indicated herein.
26. Wiring diagrams to show typical wiring schematics, including the following:
 - a. Cross Connects
 - b. Patch Panels
 - c. Patch cords
27. Software and Firmware Operational Documentation:
 - a. Software operating and upgrade manuals.

- b. Program software backup: On magnetic media or compact disk, complete with data files.
- c. Device address list.
- d. Printout of software application and graphic screens.

1.5 COORDINATION – GENERAL

- A. All cables shall be terminated and labeled prior to final inspection and acceptance by Owner.
- B. All telephone and data service outage times and durations shall be coordinated with and approved by Owner a minimum of one week prior to said outages.
- C. System shall be completely installed, labeled and tested prior to turnover to Owner.

1.6 DATA NETWORKING EQUIPMENT/TECHNOLOGY CONTRACTOR'S QUALIFICATIONS

- A. Contractor shall be recognized by the manufacturer providing the data system performance warranty as an approved/certified installer of their products. Furnish a certificate from the manufacturer with the shop drawings.
- B. Contractor must have at least 5 years experience in providing certified communication Technology Programs.
- C. Contractor Program team which includes, as a minimum, the Program manager, and foreman. Note on the list the personnel that have been trained and certified by the data system manufacturer along with a brief description of their experience and training.
- D. Contractor must have at least one full time employee with a current RCDD status that is part of the Program team. Furnish a copy of the employee's RCDD certificate with the shop drawings.
- E. Contractor must have personnel trained and certified in both Cat 6 cable installation and testing and fiber optic Technology, splicing, termination and testing techniques. Personnel must have experience using a Cat 6 cable tester, a light meter, and OTDR. Include personnel that will be assigned to this Program on the Program team list along with a brief description of their experience and training.
- F. Contractor and service organization shall be no greater than 100 miles from the Program site.
- G. Installation shall be under the direct supervision of a Level 2 installer, who shall be present at all times when work of this section is performed at the project site.

1.7 VARIATIONS TO SPECIFIED MATERIALS AND EQUIPMENT

- A. Any variations of materials and equipment specified shall be completely described listing all variances from that specified. This information shall be submitted with shop drawings of equipment.

1.8 INSPECTIONS

- A. Work shall be regularly inspected by the contractor and periodically by the Architect/Engineer. At any time, if work is observed to be incorrect or fails inspection it shall be corrected by the contractor at no additional charge. Upon completion of any corrections, the contractor shall notify the Architect/Engineer that such corrections are complete and available for re-inspection.
- B. Scheduled observations by the Owner and Architect/ Engineer shall occur at the following phases of work:
 - 1. Completion of all conduit and box rough-in
 - 2. Following the installation of cables but prior to the commencement of terminations and/or splicing.
 - 3. During the initial commencement of terminations and/or splicing.
 - 4. During initial testing of conductors or equipment.
- C. Proper notification to the Owner and/or Engineer shall be given by the Contractor of the readiness for inspection of any of the above mentioned work at a minimum of 48 hours prior to desired inspection. At such time, the Contractor shall advise the inspecting party of any observed deficiencies or incomplete work.
- D. At the time of final inspection, the Contractor shall have available the copies of the field as-built drawings and copies of all test reports.

1.9 SYSTEM ARCHITECTURE

- A. The Technology system shall be a standards based, standards compliant system. The backbone Technology subsystem consists of single mode fiber optic cable and twisted pair copper cable. The interior horizontal Technology subsystem consists of four pair, 24 or 23 AWG, 100Ω unshielded twisted pair, (UTP) copper cable.
- B. Horizontal Technology shall consist of Category 6 for Data and Voice.
- C. All horizontal cables are to be plenum rated.
- D. The Contractor is responsible to provide complete system documentation, as described in the "Submittals" section.
- E. All manufacturer part numbers, product performance information, warranty information, testing procedures required to maintain the system during routine maintenance and

serious trouble conditions shall be provided. All installation, operation, and maintenance manuals for OEM equipment must be provided. All documentation must pertain to the specific equipment and revision level of the installed system.

PART 2 - PRODUCTS

2.1 COPPER CABLE

A. Category 6 Cable (Voice and Data)

1. Acceptable Manufacturer: COMScope Gigaspeed XL 2071, no approved equal.
2. All category 6 cable for data throughout shall have blue color jacket and all category 6 cable for voice throughout shall have blue color jacket.
3. Marking and labeling systems for cable shall comply with UL969 standard for legibility, defacement, and adhesive characteristics. Cable Marking and Identification
 - a. The cable jacket shall be legibly marked at least every 24 in. by surface printing. The following information shall be provided:
 - 1) Manufacturer's Identification
 - 2) Type of Cable Construction
 - 3) UL or ETL Verification
 - 4) CMP Identification Code
 - 5) Cable Footage Marker
4. All Cat 6 cable for data and voice shall be of the same manufacturer.
5. 4 twisted pair, 23 AWG solid copper, Plenum rated jacket with rip cord.
6. Rated to EIA/TIA 568B.2-1 Category 6 standards for both 250 MHZ and 550 MHZ. (550 MHZ ratings in parentheses)
 - a. Attenuation (dB/100m) – 30.8 (47.3)
 - b. Near end cross talk (NEXT) (dBmin)– 44.3 (39.2).
 - c. Power sum near end cross tack (PS NEXT) (dBmin) – 42.3 (37.2).
 - d. Characteristic Impedance – 100 OHMS \pm 15% (1 to 100 MHz).
 - e. DC resistance/unbalanced – 6.66 OHMS 100M max/2.5% max.
 - f. Dielectric breakdown – 2500 volts DC conductor to conductor.
 - g. Propagation delay – 5.7 n sec/m max @ 10 MHz.
 - h. Propagation delay skew – 25 n sec/100m max. @ 10 MHz.
 - i. Nominal velocity of propagation - BL/wh = 0.71
OR/wh = 0.71
GR/wh = 0.71
Br/wh = 0.71
 - j. ACR (dB@100) – 13.5
 - k. PS-ACR (dBmin) – 11.5
 - l. ELFEXT (dBmin) – 25.8 (19.0)
 - m. PS-ELFEXT (dBmin) – 22.8 (16)
 - n. Return Loss (dBmin) – 18.3 (15.9)

2.2 8.3/125 MICRON SINGLE-MODE OPTICAL FIBER CABLE (INSIDE PLANT)

- A. Provide four-(4) strand fiber from MDF to all IDF closets within the building. Contractor responsible for terminating and testing of both ends of cable.
- B. Optical fiber requiring the use of mode conditioning patch cords when using a laser transmitter shall not be acceptable.
- C. Optical Parameters
 - 1. Attenuation
 - a. The attenuation, of the cabled fiber, shall not exceed 0.5 dB/km at 1310 nm and 0.4 db/km at 1550 nm.
 - b. Attenuation measurements shall be made in accordance with ANSI/EIA/TIA-455-61, Measurement of Fiber or Cable Attenuation Using an OTDR.
 - 2. Attenuation Variation
 - a. The attenuation variation shall be less than 0.05 dB/km for wavelengths between 1285 nm and 1330 nm compared to the attenuation at 1310 nm. The attenuation variation shall be less than 0.05 dB/km for wavelengths between 1525 nm and 1575 nm compared to the attenuation at 1550 nm.
 - b. Attenuation variation measurements shall be made in accordance with ANSI/EIA/TIA-455-61, Measurement of Fiber or Cable Attenuation Using an OTDR.
 - 3. Attenuation at Water Peak
 - a. The attenuation shall not exceed 2.1 dB/Km at 1383 nm \pm 3 nm.
 - 4. Attenuation Uniformity
 - a. The attenuation discontinuity shall not exceed 0.1 dB at 1310 nm or 1550 nm throughout the cable length.
 - b. Attenuation Uniformity measurements shall be made in accordance with EIA-455-59, Generic Description of Optical Time Domain Reflectometry.
 - 5. Macrobending Attenuation
 - a. The maximum induced attenuation shall be less than or equal to 0.05 dB at 1310 and 0.10 dB at 1550 nm when wound 100 turns on a 75 mm diameter mandrel.
 - 6. Index of Refraction
 - a. The effective group index of refraction will be 1.4675 at 1310 nm and 1.4681 at 1550 nm.

7. Chromatic Dispersion

- a. The zero dispersion wavelength shall be between 1300 to 1322 nm, and the nominal zero dispersion wavelength should be 1310 nm.
- b. The maximum value of the dispersion slope shall not be greater than 0.092 psec/(nm-2 km) at the zero dispersion wavelength.
- c. The dispersion measurements shall be made in accordance with EIA-455-168, Chromatic Dispersion Measurement of Multimode Graded-Index and Single-Mode Optical Fibers by Phase-Shift Method, or EIA-455-175, Chromatic Dispersion Measurement of Optical Fibers by the Differential Phase Shift Method.

8. Cut-off Wavelength

- a. The cut-off wavelength shall be $<1250 \pm 100$ nm for matched clad fiber.
- b. Measurement shall be made on a routine basis according to EIA-455-170, Cut-off Wavelength of Single-Mode Fiber Cable by Transmitted Power, or EIA-455-80, Cut-off Wavelength of Uncabled Single-Mode Fiber by Transmitted Power.

9. Mode Field Diameter

- a. The nominal mode field diameter, for matched clad fiber, shall be 9.3 ± 0.5 μm using a measurement wavelength of 1310 nm. At 1550 nm, the nominal mode field diameter shall be 10.50 ± 1.0 μm .

D. Geometrical Parameters

1. Cladding Diameter

- a. The cladding outside diameter shall be 125.0 ± 1.0 μm .
- b. The cladding diameter shall be measured in accordance with ANSI/TIA/EIA-455-176, Method for Measurement of Geometry by Automated Grey-Scale Analysis.

2. Cladding Noncircularity

- a. The cladding noncircularity shall not be greater than 1%.
- b. The cladding non-circularity shall be measured in accordance with ANSI/TIA/EIA-455-176 (Method for Measurement of Geometry by Automated Grey-Scale Analysis).

3. Core/Cladding Concentricity Error

- a. The offset between the center of the core and the center of the cladding shall not be greater than 0.6 μm .

4. Coating

- a. The coating shall be a U.V. curable acrylate and shall be 245.0 ± 10 microns in diameter. The coating shall be readily removable with commercially available stripping tools.
- b. Measurements shall be in accordance with either EIA-455-55A, Methods for Measuring the Coating Geometry of Optical Fibers or EIA-455-48A, On-Line Diameter Measurement of Optical Waveguides.

E. Cable Jacket

1. Non plenum rated cables shall have a (CMR) rated PVC jacket.
2. Plenum rated cables shall have a (CMP) rated jacket.
3. The cable jacket shall be yellow and printed with the following information: Manufacturer, Manufacturer's part number, cable type, number of strands, UL type, and sequential footage markings.

2.3 CATEGORY 6 JACKS

- A. Acceptable Manufacturer: COMScope Gigaspeed XL MGS400-270, no approved equal.
- B. Non-keyed, 8-position, 4-pair, RJ45, unshielded, pinned to T568B.
- C. Color to be gray for data and gray for voice.
- D. Center balanced to Category 6 plug specifications.
- E. 4+Gbs capacity within the Bandwidth of 1-250MHz (channel).
- F. Compatible with standard 110 termination tools.
- G. Construction Materials:
 1. Housing: High impact thermoplastic (UL 94 V-0)
 2. Stuffer cap: Lexan (UL 94 V-0)
 3. Hinged dust cover: Polypropylene. Furnished and installed for each data and voice jack.
- H. Nose Contacts:
 1. Material: Beryllium copper with a minimum of 50 micro-inch gold plating over nickel under plating.
 2. 2,000+ mating cycles with FCC compliant 8-position plug.
 3. Confirmed contact performance over full range of (FCC Spec) deflection limits.
 4. Min. contact force 100 grams with FCC compliant 8-position plug.
 5. Accepts FCC compliant 6-position plugs.

I. IDC 110 Contacts

1. Material: Phosphor bronze with 100 micro-inch tin lead 60/40 plating over nickel under plating.
2. 20+ IDC terminations for same size AWG wire.
3. Accommodates 22 to 26 AWG/Solid wire.

J. Adhesive Port Label Icons

1. Acceptable Manufacturer: COMScope, no approved equal.
2. Clear adhesive port ICON labels.
3. Furnish and install for each voice, data, and CATV jack.
4. Furnish and install second clear adhesive port ICON label blank, to be placed on top of labeled port ICON.

2.4 WALL PLATES

A. Data Wall Plate

1. For mounting on device boxes as required.
 - a. Acceptable Manufacturer: COMScope "1-2111011-3" series, no approved equal.
 - b. Color shall be 430 stainless steel.
 - c. UL 94 V-O rated flames retardant material.
 - d. Consists of plate frame and unloaded modules.
 - e. For use with labeling system in compliance with EIA/TIA 606, and as specified herein.
 - f. Face plate labels, type as directed by Owner.
 - g. Furnish and install frame blanks as required.

B. Wireless Access Point Outlet

1. Outlet shall consist of a COMScope terminated CAT6 cable.
2. Wall mounted access point cables shall emerge from the wall at the left edge of the wall bracket.
3. Ceiling mounted access point cables shall emerge from the ceiling at the left edge of the mounting bracket. Provide 15' of slack cable above the ceiling for flexibility.

2.5 BLANK INSERTS

- A. Acceptable Manufacturer: COMScope "1116412-1" series, no approved equal.
- B. Materials: ABS molding compound.
- C. To be installed in unused wall plate openings.

- D. Color shall be Office White or as approved by the Owner.

2.6 PATCH PANELS – (DATA – 10GbE)

- A. Acceptable Manufacturer: COMScope "CPP-UDDM-M-1U-24/48" series, or approved equal.
- B. Component Performance shall exceed ANSI/TIA/EIA-568-B.2-1 Category 6 component requirements.
- C. Panel shall be constructed of 14 gauge steel, rolled edge construction with black powder coat finish. Panel shall be capable of standard 19" rack mounting.
- D. ANSI/TIA/EIA-568-B.2-1 Category 6 component complaint.
- E. Appropriate cable management for Category 6 cables at the front and rear of the patch panels shall be provided by Contractor. Provide horizontal cable managers above and below each patch panel and provide cable management bars one per patch panel at back of panels.
 - 1. Provide "COMScope" Combo front/rear manager, 19.0 inches wide, 3.5 inches high. Furnish and install Velcro type wraps only for cable(s) tie-offs.
 - 2. Provide sufficient number of Velcro wraps. NO PLASTIC TIE-WRAPS ARE ALLOWED FOR USE ON ANY Category 6 CABLE, ONLY VELCRO TIE-WRAPS.
 - 3. Provide 2 inches wide Velcro, minimum 8 inches in length; provide by Panduit or HellermanTyton.
 - 4. Strain relief brackets shall be provided for each patch panel. Cables shall be attached to strain relief brackets with sufficient slack to allow removal of patch panel from rack for service.

2.7 INNERDUCT

- A. Acceptable Manufacturer: Endot Industries Endocor or as approved.
- B. 1 inch and 1 ¼ inch as indicated.
- C. Innerduct shall be smooth with integral pull line when installed in conduits, approved for use in PVC conduit underground. Orange color.
- D. All fiber optic cables shall be installed in innerducts.
- E. A minimum one spare innerduct shall be run where each active innerduct is located. Where innerduct is run in conduit, four innerducts shall be installed inside the conduit.

2.8 DUCT PLUGS

- A. Acceptable Manufacturer: Jack Moon, or as approved.

- B. Blank duct plugs, fiber optic simplex plugs, biphase seal-in system, triplex duct plugs, quadplex duct plugs, custom duct plugs, as required.
- C. Shall be furnished and installed in all existing conduits, innerduct, etc., in all existing manholes where contractor will be working in to perform the work of this contract. Refer to detail on drawings for layout.

2.9 BACKBOARDS

- A. Plywood backboards shall be installed in all MDF/IDF rooms on all four walls. Back boards shall be 8' in height and 4' in width, and 3/4" thick, type A/C or better; "C" side towards wall.
- B. Backboards shall be painted with two coats of white fire retardant paint on both sides
- C. Furnish and install on backboard "D" rings, spools, etc, as required to install all wiring on the backboard neat and orderly.

2.10 VOICE CABLE TERMINATIONS - INCOMING

- A. Building Entrance Terminal (Incoming Copper Voice Cables)
 - 1. Acceptable Manufacturer: Porta Systems Series 24 Building Entrance Terminal, 100 Port (#24100-110-F110P), or approved equal.
 - 2. Furnish and install Building Entrance terminals as required to accommodate all incoming copper pairs.
 - 3. Equip entrance terminal with Solid State Heat Coil protector modules, rated for 240V, , sufficient for all incoming pairs, plus 20 spares. Protectors shall be solid state, clamping time less than 5 nanoseconds, Five pin, tin/lead alloy plated contact over spring tempered phosphor base metal. (Porta Systems 15 SCN-240V)
 - 4. Constructed of 18 gauge steel, epoxy powder coated.
 - 5. Terminations shall be 110/110 type, input output.
 - 6. Enclosure shall have an internal splice chamber and cover for cable splicing and/or cable pass through.
 - 7. Protector module shall be UL Listed.
- B. IDF voice cable 110 punch blocks.
 - 1. Acceptable Manufacturer: COMScope Type 110, no approved equal.
 - 2. All copper voice cables from house voice jacks shall be terminated on 110 type punch down blocks, CAT6 performance compliance.
 - 3. Furnish and install sufficient blocks to accommodate all voice lines plus cross-connect blocks for output from IDF.
 - 4. Punch down blocks shall be wall mounted on the backboard.
 - 5. Furnish and install Hubbell, Inc., 25-pair 110 Blocks with standoff leg mounting bases.
 - 6. Furnish and install cable management accessories including "D"-rings, spools and clamps.

7. Wire cross connects as directed by Telephone Company.

2.11 FIRE STOPS

- A. Where cables penetrate walls through sleeves, firestop putty shall be installed on both ends of the sleeve.
- B. Putty shall be re-enterable, non-hardening, intumescent capable of forming a cold smoke seal.
- C. Putty shall adhere to both the conductor and the surrounding conduit or sleeve.
- D. Acceptable Manufacturers shall be:
 1. Nelson
 2. STI
 3. 3M, with approval

2.12 GROUNDING SYSTEM

- A. Acceptable Manufacturer: ERICO EGBA14112EE Grounding Bar, or as approved
- B. Contractor shall install a Telecommunications Main Grounding Busbar.
- C. All connections and conductor sizes shall be as indicated on drawings.
- D. All conductors and connectors shall be base copper. Aluminum conductors or connectors will not be accepted.
- E. All connections throughout the grounding system shall be made to insure a 98% conductivity.

2.13 TWISTED PAIR COPPER SPLICE CLOSURE

- A. The splice closure housing shall be non-metallic. It shall be resistant to solvents, stress cracking, and creep. The housing materials shall also be compatible with chemicals and other materials to which they might be exposed in normal applications.
- B. The closure shall be capable of accepting any cable used in interoffice, outside plant, and building entrance facilities.
- C. The closure shall be available in distinct sizes to accommodate a variety of cable entries as specified in the table below:

Table 2-2. Cable Capacity

MAXIMUM CABLE CAPACITY (INCHES)					
Splice Case Dimension	Single Sheath				Maximum Cable Opening
	1 Cable	2 Cables	3 Cables	4 Cables	
4.0 x 25.8	2.2	1.95	1.7	1.45	16.5
6.5 x 22.0	4.1	3.85	3.6	3.35	12
6.5 x 28.4	4.1	3.85	3.6	3.35	19
8.0 x 25.4	5.6	5.35	5.1	4.85	19
9.5 x 28.4	7.1	6.85	6.6	6.35	18
12.5 x 28.4	*	*	*	*	18
6.5 x 38.4	4.1	3.85	3.6	3.35	29
8.0 x 38.4	5.6	5.35	5.1	4.85	29
9.5 x 38.4	7.1	6.85	6.6	6.35	28
12.5 x 38.4	*	*	*	*	28
8.0 x 45.2	5.6	5.35	5.1	4.85	36
9.5 x 45.2	7.1	6.85	6.6	6.35	35
12.5 x 45.2	*	*	*	*	35

* Three Section End Plates

- D. The sealing mechanism shall not utilize heat shrinks nor require electrical power to attain a seal. The sealing mechanism used for the drop ports shall be of a mechanical type incorporating reusable compression fittings. Mastic sealing tape shall be used to install cables along the end cap seam. Encapsulation shall not be required to resist water penetration.
- E. The splice closure shall be re-enterable. The closure end cap shall be capable of accepting additional cables without removal of the sheath retention or strength member clamping hardware on previously installed cables or disturbing existing splices. The splice closure shall provide a clamping mechanism to prevent cable sheath slip or pullout.
- F. The splice closure shall have appropriate hardware and installation procedures to facilitate the bonding and grounding of metal components in the closure and the armored cable sheath. The cable bonding hardware shall be able to accommodate a copper conductor equal to or larger than a #6 AWG.
- G. The installation of the splice closure shall not require specialized tools or equipment, other than those normally carried by installation crews.
- H. Performance Requirements as Follows:
 - 1. A bond clamp shall remain firmly attached to the cable armor sheath while under a tensile load of 20 lbf. Following removal of the load, there shall be no evidence of clamp loosening or damage to the cable sheath, armor, or clamp that would reduce its current carrying capacity as required by the AC fault test.

2. The electrically conductive path used for continuity and grounding of the splice closure metallic components shall be capable of withstanding an AC current of 1000 amperes for 20 seconds.
3. The cable clamping and sealing hardware used to terminate optical fiber cable shall not cause an attenuation change greater than ± 0.05 dB per fiber, when tested with a source operating at 1550 nm ± 20 nm.
4. An axial load of 100 lbf, individually applied to each cable, shall not cause mechanical damage to the cable or clamping hardware.
5. The diameter of the splice closure shall not permanently deform more than 10%, nor temporarily deform more than 20%, when it is compressed by a uniformly distributed load of 300 lbf. Additionally, the compressive load shall cause no mechanical damage to the closure or its contents.
6. The closure shall not exhibit any mechanical damage after being subjected to mechanical impact of 85 lbf at temperatures of 0 ± 3.6 degrees F and 104 ± 3.6 degrees F.
7. The closure shall be capable of being safe and proper assembly at temperatures of 32 ± 3.6 degrees F and 104 ± 3.6 degrees F using materials and procedures specified by the manufacturer.
8. The splice closure shall show no evidence of water penetration following exposure to a 20 ft waterhead for a period of 7 days.
9. A closure shall show no evidence of corrosion following exposure to salt-fog for a period of 90 days.
10. Samples of polymeric closure materials shall not support fungus growth when tested per ASTM G 21. A rating of 0 is required.
11. Subjecting the closure/cable interface to 10 cycles of Torsional loading at ambient temperatures of 0 ± 3.6 degrees F and 104 ± 3.6 degrees F shall not cause any mechanical damage to the cable or clamping hardware.
12. Subjecting the closure/cable interface to 90 degrees flexing for 8 cycles at ambient temperatures of 0 ± 3.6 degrees F and 104 ± 3.6 degrees F shall not cause any mechanical damage to the cable or clamping hardware.
13. Sealing components (gaskets, grommets, O-rings) used in a closure, shall not permit the entry of water into the closure after thermal aging at 194 ± 1.8 degrees F for 720 hours.

2.14 POWER STRIP

- A. Provide a power strip at each rack, Geist RN120-102P20DST5, or approved equal.

PART 3 - EXECUTION

3.1 CABLE AND WIRING INSTALLATION

- A. Unless noted otherwise, all interior wiring shall be concealed within walls.
- B. Installation shall allow for easily replacing cables in the future.
- C. All cable shall be installed in cable tray where available. Refer to Division 26 section for cable tray specification. Where cable tray is not present, cable shall be installed

neatly above accessible ceilings (utilizing "J" hooks) supported from building structure. Do not attach to pipes, ducts, etc. Do not allow cable to rest on pipes, ducts, ceiling tiles, etc. Do not attach to wires used for supporting suspended ceilings. Do not use tie wires or bridle rings.

- D. J-hooks shall be the ERICO CADDY fastener "CableCat Wide Base Cable Support System" specifically designed for Category 6 and Fiber Optic Cables. Provide the 2 inch diameter loop Category Number "CAT32" series. Furnish and install hanger brackets/assemblies/loops as required to support all data and voice cable at no greater than 48 inches with no greater than 12 inches sag between supports. Do not install more than 50 cables per hook. Separation from light fixtures shall be minimum 6 inches and from power conduits minimum 12 inches, minimum 48 inches from fan motors/transformers. All wiring in the J-hook fasteners shall be securely clamped using the plenum rated tie-wrap Erico part number "CATTRC", number as required. J-hooks shall only support data and voice Technology. No other Technology (i.e.; HVAC control, video, sound, power, etc...) shall be supported by these systems.
- E. No plastic tie wraps allowed anywhere except on the J-hooks; VELCRO tie-wraps shall be used on all Cat 6 Technology in all circumstances, including racks, and all wire management in the racks and for all patch cord management. Provide a minimum of 12 (twelve) 1" x 8" long per rack.
- F. All interior cable shall be plenum rated.
- G. All conduits and raceways shall include pull strings (minimum of 2) for ease of future installation. Pull strings shall test at 200 lbs.
- H. Any metallic conduit or raceway stubbed out shall be affixed with plastic bushings to protect cable from damage due to expansion/contraction and vibration.
- I. All wires shall be marked at all junction boxes, pull boxes, cabinets, boxes and terminations. Each cable run between terminating locations shall be one continuous cable (no splices or connections).
- J. Proceed with caution when installing cable to protect cable from stretching, kinking, or sharp bends. Cable damaged during installation or not passing required testing shall be removed and replaced at no additional cost to Owner.
- K. The Contractor shall replace or rework cables showing evidence of improper handling including stretches, kinks, short radius bends, over tightened bindings, loosely twisted and over twisted pairs at terminals, and sheath removed too far over ½ inch.
- L. Cable splices not permitted within the building.
- M. Bending radius of cables shall be greater than 10 times cable diameter. Install cable per manufacturer's instructions. Install any fiber optic cable adhering exactly to manufacturer's specified handling instructions.
- N. Care shall be taken so cables are not placed near power sources or other items where interference or heat damage could develop.

- O. All telephone and data systems wiring, shall be done as directed by and under the supervision of the Architect/Engineer. All cross-connect wiring shall be completed by the contractor.
- P. Telecommunications cables may share conduits, raceways, and sleeves within the scope of the telecommunications work, but not with any conductors outside the scope of this specification.
- Q. A minimum 30' service loop shall be maintained within each manhole or handhole for copper cables less than 200 pair. Where splice points exist within the manhole or handhole, the 30' service loop shall be divided with 15' on either side of the splice point unless indicated otherwise on the construction drawings. For copper cables 200 pair or greater, make one complete loop around the inside of the manhole or handhole. Rack cables in such a manner as not to block existing conduits and maintain space for present or future splicing.

3.2 LABELING

A. Inside Plant Labeling

- 1. Contractor shall utilize labeling plan per contract drawings. Handwritten labels are not acceptable. Labels shall follow the format (IDF Termination Point, followed by a hyphen, followed by the Floor Number, followed by a second hyphen, followed by a Sequential Plate Number for the floor).
- 2. The contractor will label all outlets following the detailed contract drawing design, using permanent/legible typed or machine engraved labels approved by the Owner. All labels shall be machine printed on clear, adhesive labels. The font shall be at least 1/8 inch in height, block characters, and legible. The text shall be of a color contrasting with the label such that it may be easily read.
- 3. If labeling tape is utilized, the width of the tape shall not exceed 3/8 inch, and the font color shall contrast with the background.
- 4. The Contractor shall provide a blank, clear, adhesive label to cover the installed label and to protect the ink.
- 5. Terminals in the demarc shall be labeled by the Contractor using designation strips designed as applicable to terminal hardware.
- 6. The labels on station terminal blocks shall be numerically sequential. Outlets shall be labeled to match the labels on the corresponding terminal block position. Work station numbers shall be comprised of a sequential numbering scheme that meets the labeling scheme per the contract drawings. Each workstation cable shall be labeled, using a machine based net permanent medium, at each end with its respective workstation number. Each binder group shall be tied off with its respective identifying ribbon at each break-out point.
- 7. A floor plan clearly labeled with all outlet jack numbers shall be included in the as-built plans. See section 3.2C below.
- 8. All labels shall correspond to as-built and to final test reports.
- 9. Cable Wiring label system by Panduit, or approved equal to meet EIA/TIA-606 Standards. Contractor shall label horizontal drop cables per contract drawings. Contractor shall label all fiber patch cords; coordinate with Owner for Owner's labeling standards for labeling of all fiber patch cords.

10. All fiber optic termination panels and shall list with labeling information the installer name and the date installed.
11. All existing cabling shall be labeled per the labeling requirements herein.
12. Labeling shall be done in the following manner. Each wall plate shall be labeled with a unique label designation. This should be done using the template A-1-XXX where:

A = Telecom closet designation where cabling from that wall plate will terminate

1 = Floor

XXX = Arbitrary numeral starting with 001 and continuing sequentially.

B. Outside Plant Cable Wiring

1. Each outside copper voice and outside fiber optic cable shall be labeled, per contract drawings detail, within 12" of each manhole entrance/exit and within 12" of each splice case and within 12" of each termination field.
2. Labels shall be embedded characters on cable tags and shall be attached to the cable via plastic cable ties.
3. Cable tags shall be non-indelible, resistant to chemicals, and designed to withstand underground environments.
4. Fiber cable tags shall be orange and shall state "FIBER OPTIC CABLE".
5. Copper cable ties shall be yellow and shall state "CUSTOMER OWNED COPPER CABLE".
6. Cable tags shall allow a minimum of 15 character labeling for the cable ID.
7. Furnish and install Tech Products.

C. Contractor shall provide Telecommunications Program Record Prints for both ends of the outside plant cabling termination locations including the "as-built" outlet labels. Prints shall be tabloid size and shall be mounted under Plexiglas beside each telecommunications equipment rack. Labels shall correspond to the actual outlet label for each data/voice/video drop and the corresponding patch panel/voice termination at the demarcation and on the CATV drops (as they enter the splitter).

D. Contractor shall provide Telecommunications Program Record Prints for the building including the "as-built" outlet labels. Prints shall be ANSI E size and shall be mounted under Plexiglas beside each telecommunications equipment rack. Labels shall correspond to the actual outlet label for each data/voice/video drop and the corresponding patch panel/voice terminations at the demarcation and on the CATV drops (as they enter the splitter).

E. Contractor shall provide a termination schedule showing jack number and corresponding wall plate number. Document shall be provided electronically to Owner, and posted at each rack.

3.3 DATA AND VOICE OUTLET WIRING

A. Contactor foreman shall supervise the installation of all telecommunications cable. Installers shall be trained and familiar with the installation of low voltage Technology systems.

- B. Installer shall not exceed the bend radiuses or pull tensions of the cables to be installed. Velcro cable wraps shall not be installed in an over-tightened manner. Handle with care so as not to change performance criteria.
- C. Pin connections for CAT6 outlets shall conform to EIA/TIA-568-B modular jack recommendation T568B.
- D. Pin connections on both ends of the cables shall match, providing for "straight-through" connection.

3.4 WARNING TAGS

- A. At each point where any fiber optic cable is exposed to human intrusion, it shall be marked with warning tags, black for a background color with orange lettering, bearing the text "CAUTION FIBER OPTIC CABLE".
- B. Tags shall be installed at intervals of no more than 5 feet.
- C. Label text for warning tags shall be minimum 3/16" in height, black in color, and permanently affixed.
- D. Any run of exposed cable less than 5 feet in length shall bear at least one warning label.

3.5 FIBER OPTIC CABLE INSTALLATION GUIDELINES

- A. Installation of fiber optic cables shall be performed according to guidelines established by the product manufacturer and in compliance with industry standards. Special care shall be taken to avoid damage to cable.
 - 1. While under pulling tension, the cable shall not be formed into a curve with a radius less than 20 times the cable diameter to avoid fracture of the fiber member.
 - 2. Pulling tension shall not exceed the manufacturer's recommended maximum tensile load.
 - 3. If a pull winch is used, it shall be equipped with tension control or a break-away link designed to separate at or below the recommended maximum tension.
 - 4. A minimum 25' service loop shall be maintained inside the building. This service loop shall be kept on the fiber cable ring as shown on the drawings.
 - 5. A minimum of 30' service loop shall be maintained within each manhole or handhole. Where splice points exist within the manhole or handhole, the 30' service loop shall be divided with 15' on either side of the splice point.
- B. Notify the Owner 48 hours in advance of fiber optic cable installation into any existing conduit or building facility.
- C. When installation of fiber optic cable involves existing communications equipment, work shall be performed in the presence of the Owner's representatives, unless otherwise directed.

- D. Any damage caused as a result of work performed under this scope shall be corrected within 48 hours.
- E. The innerduct walls shall be completely lubricated when cable is pulled. The lubricant shall be applied immediately before or during the pull. The cable lubricant shall meet the following specification:
 - 1. The lubricant shall be UL listed.
 - 2. The lubricant shall produce no deleterious effects on physical or electrical properties of cable jackets.
 - 3. The lubricant shall produce no stress cracking on LDPE cable jackets when tested per IEEE Standard 1210, Standard Tests for Determining Compatibility of Cable-Pulling Lubricants with Wire and Cable.
 - 4. Cable jacket materials LLDPE, XLPE, CPE, and PVC heat aged in lubricant shall pass tensile and elongation compatibility requirements from IEEE Standard 1210, Standard Tests for Determining Compatibility of Cable-Pulling Lubricants with Wire and Cable.
 - 5. The lubricant shall contain no waxes, greases, silicones, or polyalkylene glycol oils or waxes.
 - 6. The lubricant shall not phase-out after five freeze/thaw cycles or 5-day exposure at 60 degrees C.
 - 7. A 200-gram sample of the lubricant, when placed in a one-foot, split metal conduit and fully dried for 24 hours at 105 degrees C., shall not ignite with a pilot flame and continuously burn for more than one minute at a continued heat flux of 40 kW/m².
- F. Should a cable become kinked, skinned or stretched during installation, it shall be removed and replaced. Splicing at points other than those specified will not be acceptable.
- G. Termination and closure of fiber optic cable shall be performed by installers who are properly trained and have prior experience in the handling and care of fiber optics and the preparation of termination points.
- H. When installing fiber optic connectors and terminal cabinets, work area must be cleaned and free of excessive dust and moisture. Final preparation and installation of fiber equipment shall occur after all work which may produce fine dust or involve moisture such as sheet rock preparation and core drilling.
- I. Bending radius of fiber optic cable shall not exceed manufacturer's specifications.
- J. All interior fiber optic cables shall be installed in innerduct above accessible ceilings.
- K. All exterior fiber optic cables shall be installed in innerduct.
- L. Manufacturer's instruction shall be followed for terminating fiber optic cable. Install dust covers on all unused connector ports.
- M. Perform all work in facilities (e.g. conduits, junction boxes, cabinets and buildings) containing Owner's existing communications equipment only in the presence of Owner's representative, unless otherwise directed.

- N. Use shear pins or other failsafe means to prevent exceeding the maximum cable pulling tension specified by the cable manufacturer.
- O. Replace any fiber optic cable segment not meeting the requirements of the specifications entirety between splice points shown on the plans.

3.6 FIBER OPTIC CABLE PREPARATION

- A. Remove the jacket without damaging buffer tubes.
- B. Carefully expose the fibers by removing the buffer tube with a properly calibrated stripping tool that will not nick the fibers.
- C. Clean the fibers and buffer tubes using a solvent designed to remove all water blocking gel from each exposed fiber.
- D. Solvent requirements:
 - 1. Shall not remove any color from individual fibers or buffer tubes.
 - 2. Not harmful to the cable jacket.
- E. Cleave fiber strands using a high precision cleave tool meeting the following requirements:
 - 1. Ability to cleave the individual fibers as close to a perfect 90 degree angle as possible.
 - 2. With minimum end angle averages that are less than 0.70 degree with no cleaves exceeding 1.5 degrees.
 - 3. This cleave tool shall be used for all splicing and termination of fibers.

3.7 SPLICE ENCLOSURE INSTALLATION

- A. Assemble, seal, and install the fiber optic and copper splice closures per the manufacturer's recommendations.
- B. Use all tools/kits required to assemble and test closures per manufacturer's recommendations.
- C. Pressurize each enclosure to the manufacturer's recommended PSI and check for leaks with soapy water. After the closure passes the pressure test bleed the closure.
- D. Furnish and install all required hardware to mount closures to manhole racks. Furnish and install racks in existing manholes.
- E. Ground copper enclosures as required to existing grounding system in existing manholes.

3.8 ENTRY AND REENTRY OF FIBER OPTIC SPLICE CLOSURES

- A. Perform all work in a suitable environment free from excess dust and moisture. Acceptable environments to work on splice closures include office type environments in buildings, splice trailers, splice vehicles, and splicing tents with floors.
- B. Do not perform fiber splicing, testing, or connecting in freezing temperatures.
- C. Do not expose open splice closures and fiber ends to rain, snow, or wind-blown dust.

3.9 FUSION SPLICING

- A. All fiber splicing: fusion splice method.
- B. Perform fusion splices with the following:
 - 1. Use Equipment with automatic fiber alignment and automatic light injection with detection devices to minimize splice losses.
 - 2. Provide splice closure as a protection for all splices and stripped cable.
 - 3. House all splices in splice trays.
- C. Use glass capillaries, heat shrink tubing, or silicone sealant to provide additional protection and strain relief.
- D. Maximum splice loss allowance is 0.30 dB.
 - 1. Install new splice enclosure end plates at each location where there is a new fusion splice in an existing splice enclosure per manufacturer's recommendations.
- E. Test fiber strands before splicing using OTDR and power meter to assure acceptable cable attenuation and no events. Record testing.

3.10 FIBER OPTIC CABLE TERMINATIONS

- A. Fiber Optic Cable shall be installed in innerduct.
- B. Terminations shall be performed by a manufacturer trained and certified technician for optical fiber connections.
- C. Terminations shall be made in a controlled environment. The Contractor may choose to have the cables assembled off-site, although testing must be completed with the cable in its final installed condition.
- D. The Contractor is responsible for obtaining minimum loss in fiber connections and polishing per manufacturer's specifications.

3.11 COPPER CABLE TESTING – OTHER THAN CAT 6

- A. Copper cable backbone shall be tested for the following. Each wire/pair shall be tested at both ends for the following utilizing Contractor's standard form.
 - 1. Termination order
 - 2. Polarity
 - 3. Continuity
 - 4. Shorts
 - 5. Grounds
 - 6. Cable length record all length.
- B. Existing multiple pair copper cables shall be tested as specified.

3.12 RACK INSTALLATION

- A. Reference manufacturer's proper installation practices for the cable support hardware and define cable dressing and termination procedures.
- B. Racks shall be installed in the following manner:
 - 1. Floor mount racks shall be securely attached to the floor using minimum 3/8 inch (.95 cm) hardware. Racks installed on raised access flooring shall be anchored to the concrete floor slab, through the raised floor with threaded rods.
 - 2. All racks shall be grounded in accordance with this document the NEC and the equipment manufacturers requirements.
 - 3. Rack mount screws (#12-24) not used for installing hardware shall be bagged and left with the rack upon completion of the installation.
 - 4. Inter-bay and end-cap managers shall be installed to the rear mounting rail of the rack using all available mounting holes.
 - 5. Cables shall be securely fastened to the cable managers with velcro ties.
 - 6. Cable feeds shall alternate left and right to minimize congestion at the top of the rack.

3.13 COPPER CABLE TESTING – CAT 6

- A. All cables and termination hardware shall be 100% tested for defects in installation and to verify cable performance under installed conditions. All conductors of each installed cable shall be verified usable by the contractor prior to system acceptance. Any defect in the cable system installation including but not limited to cable, connectors, feed through coupler, patch panels, and connector backs shall be repaired or replaced in order to ensure 100% usable conductors in all cables installed.
- B. General Requirements
 - 1. Every Technology link in the installation shall be tested in accordance with the field test specifications defined in the most recent standard of the Telecommunications Industry Association (TIA)/Electronics Industry Association (EIA).

2. The installed twisted-pair horizontal links shall be tested from the data or telecommunications room to the jack in the wall outlet against the "Permanent Link" performance limits specification as defined by TIA/EIA.
3. 100% of the installed Technology links must be tested and must pass the requirements of the TIA/EIA standards. Any failing link must be diagnosed and corrected. The corrective action shall be followed with a new test to prove that the corrected link meets the performance requirements. The final and passing result of the tests for all links shall be provided in the test results documentation.
4. Trained technicians who have successfully attended an appropriate training program and have obtained a certificate as proof thereof shall execute the tests. Appropriate training programs include but are not limited to installation certification programs provided by BiCSi or the ACP (Associations of Technology Professionals).
5. The test equipment (tester) shall comply with or exceed the accuracy requirements for the field testers as defined by TIA. The tester including the appropriate interface adapter must meet the specified accuracy requirements.
6. The tester shall be within the calibration period recommended by the vendor in order to achieve the vendor-specified measurement accuracy.
7. The tester interface adapters must be of high quality and the cable shall not show any twisting or kinking resulting from coiling and storing of the tester interface adapters. In order to deliver optimum accuracy, preference is given to a permanent link interface adapter for the tester that can be calibrated to extend the reference plane of the Return Loss measurement to the permanent link interface. The contractor shall provide proof that the interface has been calibrated within the period recommended by the vendor. To ensure that normal handling on the job does not cause measurable Return Loss change, the adapter cord cable shall not be of twisted-pair construction.
8. The Pass or Fail condition for the link-under-test is determined by the results of the requirements individual tests. Any Fail or Fail* results yields a Fail for the link-under-test. In order to achieve an overall Pass condition, the results for each individual test parameter must Pass or Pass*.
9. A Pass or Fail result for each parameter is determined by comparing the measured values with the specified test limits for the parameter. The test result of a parameter shall be marked with an asterisk (*) when the result is closer to the test limit than the accuracy of the field tester. The field tester manufacturer must provide documentation as an aid to interpret results marked with asterisks.
10. The Owner's representatives shall be invited to witness field testing. The Owner shall be notified of the start date of the testing phase 5 business days before testing commences.
11. The Owner's representatives will select a random sample of 5% of the installed links. The Owner will test these randomly selected links and the results are to be stored as specified herein. The results obtained shall be compared to the data provided by the installation contractor. If more than 2% of the sample results differ in terms of the pass/fail determination, the installation contractor under supervision of the Owner's representative shall repeat 100% testing and the cost shall be borne by the installation contractor.

C. Performance Test Parameters – Category 6

1. The test parameters of Cat 6 shall be as defined by TIA/EIA. The test of each link shall contain all of the following parameters: In order to pass the test all

measurements (at each frequency in the range from 1 MHz through 250 MHz) must meet or exceed the limit value listed by TIA/EIA.

- a. Wire Map: Wire Map shall report Pass if the wiring of each wire-pair from end to end is determined to be correct. The Wire Map results shall include the continuity of the shield connection if present.
- b. Length: The field tester shall be capable of measuring length of all pairs of a basic link or channel based on the propagation delay measurement and the average value of Nominal Velocity or Propagation (NVP). Nominal Velocity of Propagation (NVP) expresses the speed of the electrical signals along the Technology link in relation to the speed of light in vacuum (3×10^8 m/second). The physical length of the link shall be calculated using the pair with the shortest electrical delay. This length figure shall be reported and shall be used for making the Pass/Fail decision. The Pass/Fail criteria are based on the maximum length allowed for the permanent Link configuration (90 meters – 295 feet) plus 10% to allow for the variation and uncertainty of NVP.
- c. Insertion Loss (Attenuation)
 - 1) Insertion Loss is a measure of signal loss in the permanent link or channel. The term “Attenuation” has been used to designate “Insertion Loss.” Insertion Loss shall be tested from 1 MHz through 250 MHz in maximum step size of 1 MHz. It is preferred to measure insertion loss at the same frequency intervals as NEXT Loss in order to provide a more accurate calculation of the Attenuation –to-Crosstalk ratio (ACR) parameter.
 - 2) Minimum test results documentation (summary results): Identify the worst wire pair (1 of 4 possible). The test results for the worst wire pair must show the highest attenuation value measured (worst case), the frequency at which this worst case value occurs, and the test limit value at this frequency.
- d. NEXT Loss, Pair-to-Pair
 - 1) Pair-to-pair near-end crosstalk loss (NEXT) shall be tested for each wire pair combination from each end of the link (a total of 12 pair combinations). This parameter is to be measured from 1 through 250 MHz. NEXT Loss measures the crosstalk disturbance on a wire pair at the end from which the disturbance signal is transmitted (near-end) on the disturbing pair. The maximum step size for NEXT Loss measurements shall not exceed the maximum step size defined by TIA/EIA.
 - 2) Minimum test results documentation (summary results): Identify the wire pair combination that exhibits the worst case NEXT margin and the wire pair combination that exhibits the worst value of NEXT (worst case). NEXT ‘Margin’ designates the difference between the measured value and the corresponding test limit value. For passing links, ‘worst case margin’ identifies the smallest margin over the entire frequency range; the point at which the measured performance is “closest” to the test limit. NEXT is to be measured from each end of the link-under-test. These wire pair combinations must be

identified for the tests performed from each end. Each report case shall include the frequency at which it occurs as well as the test limit value at this frequency.

e. PSNEXT Loss

- 1) Power Sum NEXT Loss shall be evaluated and reported for each wire pair from both ends of the link-under-test (a total of 8 results). PSNEXT Loss captures the combined near-end crosstalk effect (statistical) on a wire pair when all other pairs actively transmit signals. Like NEXT this test parameter must be evaluated from 1 through 250 MHz and the step size may not exceed the maximum step size defined by TIA/EIA.
- 2) Minimum test results documentation (summary results): Identify the wire pair combination that exhibits the worst case margin and the wire pair combination that exhibits the worst value for PSNEXT. These wire pair combinations must be identified for the tests performed from each end. Each report case shall include the frequency at which it occurs as well as the test limit value at this frequency.

f. ELFEXT Loss, pair-to-pair

- 1) Pair-to-pair FEXT Loss shall be measured for each wire-pair combination from both ends of the link-under-test. FEXT Loss measures the crosstalk disturbance on a wire pair at the opposite end (far-end) from which the transmitter emits the disturbing signal on the disturbing pair. FEXT is measured to compute ELFEXT Loss that must be evaluated and reported in the test results. ELFEXT measures the relative strength of the far-end crosstalk disturbance relative to the attenuated signal that arrives at the end of the link. This test yields 24 wire pair combinations. ELFEXT is to be measured from 1 through 250 MHz and the maximum step size for FEXT Loss measurements shall not exceed the maximum step size defined. By TIA/EIA.
- 2) Minimum test results documentation (summary results): Identify the wire pair combination that exhibits the worst case margin and the wire pair combination that exhibits the worst value for ELFEXT. These wire pair combinations must be identified for the tests performed from each end. Each report case shall include the frequency at which it occurs as well as the test limit value at this frequency.

g. PSELFEXT Loss

- 1) Power Sum ELFEXT is a calculated parameter that combines the effect of the FEXT disturbance from three wire pairs on the fourth one. This test yields 8 wire-pair combinations. Each wire-pair is evaluated from 1 through 250 MHz in frequency increments that do not exceed the maximum step size defined by TIA/EIA.

- 2) Minimum test results documentation (summary results): Identify the wire pair combination that exhibits the worst case margin and the wire pair combination that exhibits the worst value for PSELFEXT. These wire pair combinations must be identified for the tests performed from each end. Each report case shall include the frequency at which it occurs as well as the test limit value at this frequency.
- h. Return Loss
- 1) Return Loss (RL) measures the total energy reflected on each wire pair. Return loss is to be measured from both ends of the link-under-test for each wire pair. This parameter is also to be measured from 1 through 250 MHz in frequency increments that do not exceed the maximum step size defined by TIA/EIA.
 - 2) Minimum test results documentation (summary results): Identify the wire pair combination that exhibits the worst case margin and the wire pair combination that exhibits the worst value for Return Loss. These wire pair combinations must be identified for the tests performed from each end. Each report case shall include the frequency at which it occurs as well as the test limit value at this frequency.
- i. ACR
- 1) Attenuation to Crosstalk Ratio (ACR) provides an indication of bandwidth for the two wire-pair network applications. ACR is a computed parameter that is analogous to ELFEXT and expresses the signal to noise ratio for a two wire-pair system. This calculation yields 12 combinations – six from each end of the link.
 - 2) Minimum test results documentation (summary results): Identify the wire pair combination that exhibits the worst case margin and the wire pair combination that exhibits the worst value for ARC. These wire pair combinations must be identified for the tests performed from each end. Each report case shall include the frequency at which it occurs as well as the test limit value at this frequency.
- j. PSACR
- 1) The Power Sum version of ACR is based on PSNEXT and takes into account the combined NEXT disturbance of all adjacent wire pairs on each individual pair. This calculation yields 8 combinations – one for each wire pair from both ends of the link.
 - 2) Minimum test results documentation (summary results): Identify the wire pair combination that exhibits the worst case margin and the wire pair combination that exhibits the worst value for PSACR. These wire pair combinations must be identified for the tests performed from each end. Each report case shall include the frequency at which it occurs as well as the test limit value at this frequency.

k. Propagation Delay

- 1) Propagation delay is the time required for the signal to travel from one end of the link to the other. This measurement is to be performed for each of the four wire pairs.
- 2) Minimum test results documentation (summary results): Identify the wire pair with the worst case propagation delay. The report shall include the propagation delay value measured as well as the test limit value.

l. Delay Skew

- 1) This parameter shows the difference in propagation delay between the four wire pairs. The pair with the shortest propagation delay is the reference pair with a delay skew value of zero.
- 2) Minimum test results documentation (summary results): Identify the wire pair with the worst case propagation delay (the longest propagation delay). The report shall include the delay skew value measured as well as the test limit value.

D. Test Results Documentation

1. The test results information for each link shall be recorded in the memory of the field tester upon completion of the test.
2. The test results records saved by the tester shall be transferred into a WindowsTM-based database utility that allows for the maintenance, inspection and archiving of these test records. A guarantee must be made that the measurement results are transferred to the PC unaltered, i.e., "as saved in the tester" at the end of each test and that these results cannot be modified at a later time. Superior protection in this regard is offered by testers that transfer the numeric measurement data from the tester to the PC in a non-printable format.
3. The database for the completed job shall be stored and delivered on CD-ROM including the software tools required to view, inspect, and print any selection of test reports.
4. General Information to be provided in the electronic data base with the test results information for each link:
 - a. The identification of the customer site as specified by the end-user.
 - b. The identification of the link in accordance with the naming convention defined in the overall system documentation.
 - c. The overall Pass/Fail evaluation of the link-under-test.
 - d. The name of the standard selected to execute the stored test results.
 - e. The cable type and the value of NVP used for length calculations.
 - f. The date and time the test results were saved in the memory of the tester.
 - g. The brand name, model, and serial number of the tester.
 - h. The identification of the tester interface.
 - i. The revision of the tester software and the revision of the test standards database in the tester.
 - j. The test results information must contain information on each of the previously specified test parameters.

5. The detailed test results data to be provided in the electronic database for each tested link shall contain the following information.
 - a. For each of the frequency-dependent test parameters, the minimum test results documentation shall be stored for each wire-pair or wire-pair combination as observed from each end of the link. The minimum test results documentation for each test parameter shall be in compliance with the information described under Performance Test Parameters, herein.
 - 1) Length: Identify the wire-pair with the shortest electrical length, the value of the length rounded to the nearest foot and the test limit value.
 - 2) Propagation delay: Identify the pair with the shortest propagation delay, the value measured in nanoseconds (ns) and the test limit value.
 - 3) Delay Skew: Identify the pair with the largest value for delay skew, the value calculated in nanoseconds (ns) and test limit value.
 - 4) Insertion Loss (Attenuation): Minimum test results documentation for the wire pair with the worst insertion loss.
 - 5) Return Loss: Minimum test results documentation. Identify as detected from each end of the link, the wire pair that exhibits the worst case margin and the wire pair with the worst RL. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.
 - 6) NEXT, ELFEXT, ACR: Minimum test results documentation. Identify as measured from each end of the link, the wire pair combination that exhibits the worst case margin and the wire pair with the worst value. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.
 - 7) PSNEXT, PSELFEXT, and PSACR: Minimum test results documentation. Identify as detected from each end of the link, the wire pair combination that exhibits the worst case margin and the wire pair with the worst value. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.
 - 8) Link length, propagation delay, and delay skew shall be reported for each wire pair as well as the test limit for each of these parameters.

3.14 CABLE SYSTEM TESTING – FIBER OPTIC

- A. All fiber terminations shall be visually inspected with a minimum 100 X microscope to ensure that no surface imperfections exist after final polishing. All 100x inspection views shall be saved as digital images. Terminated fiber strands shall be tested for attenuation with an optical power meter and light source and OTDR. All OTDR records and 100x images shall be delivered to the engineer at the conclusion of the project, appropriately labeled by cable, strand and termination location.

B. General Requirements

1. Every fiber optic Technology link in the installation shall be bi-directionally tested in accordance with the field test specifications defined in the most recent standard of the Telecommunications Industry Association (TIA)/Electronics Industry Association (EIA).
2. Test cables upon receipt at project site. Test optical fiber cables to determine the continuity of the strand end to end. Use optical loss test set. Test optical fiber cables while on reels.
3. ANSI/TIA/EIA Standards, define the passive Technology network, to include cable, and connectors, between two optical fiber patch panels (connecting hardware). A typical horizontal link segment is from the telecommunications outlet/connector to the horizontal cross-connect. The standards describe three typical backbone link segments: (1) main cross-connect to intermediate cross-connect, (2) main cross-connect to horizontal cross-connect, or (3) intermediate cross-connect to horizontal cross-connect.
 - a. The test shall include the representative connector performance at the connecting hardware associated with the mating of patch cords. The test shall not, however, include the performance of the connector at the interface with the test equipment.
4. 100% of the installed Technology links shall be tested and shall pass the requirements of the TIA/EIA standards. Any failing link must be diagnosed and corrected. The corrective action shall be followed with a new test to prove that the corrected link meets the performance requirements. The final and passing result of the tests for all links shall be provided in the test results documentation.
5. Trained technicians who have successfully attended an appropriate training program and have obtained a certificate as proof thereof shall execute the tests. These certificates may have been issued by any of the following organizations or an equivalent organization:
 - a. The manufacturer of the fiber optic cable and/or the fiber optic connectors
 - b. The manufacturer of the test equipment used for the field certification
 - c. Training organizations authorized by BiCSi (Building Industry Consulting Services International with headquarters in Tampa, Florida) or by the ACP (Association of Technology Professionals™) Technology Business Institute located in Dallas, Texas.
6. Field test instruments for multimode fiber Technology shall meet the requirements of the latest standard of ANSI/TIA/EIA. The light source shall meet the launch requirements of ANSI/EIA/TIA. Field test instruments for single mode fiber Technology shall also meet the requirements of ANSI/EIA/TIA.
7. The tester shall be within the calibration period recommended by the vendor in order to achieve the vendor-specified measurement accuracy.
8. The fiber optic launch cables and adapters shall be of high quality and the cables shall not show excessive wear resulting from repetitive coiling and storing of the tester interface adapters.
9. The Pass or Fail condition for the link-under-test is determined by the results of the required individual tests specified herein.

10. A Pass or Fail result for each parameter is determined by comparing the measured values with the specified test limits for that parameter.
11. The Owner shall be invited to witness field testing. The Owner shall be notified of the start date of the testing phase 5 business days before testing commences.
12. The Owner's representatives will select a random sample of 5% of the installed links. The representative (or his authorized delegate) will test these randomly selected links and the results are to be stored as specified herein. The results obtained shall be compared to the data provided by the installation contractor. If more than 2% of the sample results differ in terms of the pass/fail determination, the installation contractor under supervision of the Owner shall repeat 100% testing and the cost shall be borne by the installation contractor.

C. Pre-installation tests of inter-plant fiber-pre-test each reel:

1. Test each strand of each reel of fiber for continuity with an OTDR. If continuity is not achieved test to determine the nature and location of the defect: Measure end-to-end attenuation and the distance to a high attenuation point.
2. If it is determined that the fiber is defective, contact the manufacturer and provide a completely new fiber reel.

D. Performance Test Parameters –Fiber Optic Cable

1. ANSI/TIA/EIA standards prescribe that the single performance parameter for field testing of fiber optic links is link attenuation (alternative and equivalent term: insertion loss), when installing components compliant with this standard.
2. The link attenuation shall be calculated by the following formulas specified in ANSI/TIA/EIA:

Link Attenuation = Cable_Attn + Connector_Attn + Splice_Attn

3. Cable_Attn (dB) = Attenuation_Coefficient (dB/km) * Length (Km)
4. The values for the Attenuation_Coefficient are listed in the table below:

Type of Optical Fiber	Wavelength (nm)	Attenuation_Coefficient (dB/km)
Multimode 62.5/125 µm	850	3.5
	1300	1.5

5. Connector_Attn (dB) = number_of_connector_pairs*connector_loss (dB)
6. Maximum allowable connector_loss = 0.75 dB
7. Splice_Attn (dB) = Number of splices * splice_loss (dB).
8. Maximum allowable splice_loss = 0.3 dB.
9. Link attenuation does not include any active devices or passive devices other than cable, connectors, and splices, i.e. link attenuation does not include such devices as optical bypass switches, couplers, repeaters, or optical amplifiers.
10. Test equipment that measures the link length and automatically calculates the link loss based on the above formulas is required.
11. The previous link test limits attenuation are based on the use of the One Reference Jumper Method specified by ANSI/TIA/EIA. The user shall follow the procedures established by these standards or application notes to accurately conduct performance testing.

12. The horizontal link (multimode): acceptable link attenuation for a multimode horizontal optical fiber Technology system is based on the maximum 90 m (295 ft) distance. The horizontal optical fiber Technology link segments need to be tested at only one (1) wavelength. Because of the short length of Technology [90 m (295 ft) or less], attenuation deltas due to wavelength are insignificant. The horizontal link should be tested at 850 nm or 1300 nm in both directions in accordance with ANSI/EIA/TIA-526-14A, Method B, One Reference Jumper.
 - a. The horizontal link may be tested using a fixed upper limit for attenuation of 2.0 dB. This value is based on the loss of two (2) connector pairs, one (1) pair at the telecommunications outlet/connector and one (1) pair at the horizontal cross-connect, plus 90 m (295 ft) of optical fiber cable.
13. The backbone link (multimode) shall be tested in both directions at both operating wavelengths to account for attenuation deltas associated with wavelength.
14. Multimode backbone links shall be tested at 850 nm and 1300 nm in accordance with ANSI/EIA/TIA. The "Link Attenuation Equation", as previously stated, shall be used to determine limit (acceptance) values for multimode backbone cable).
15. Single mode backbone links shall be tested in both directions at 1310 nm and 1550 nm in accordance with ANSI/TIA/EIA, One Reference Jumper. All single mode links shall be certified with test tools using laser light sources at 1310 nm and 1550 nm. Links destined to be used with network applications that use laser light sources (underfilled launch conditions shall be tested with test equipment based on laser light sources. This rule shall be followed for Technology systems to support Gigabit Ethernet. For Gigabit
 - a. Ethernet compliant certification (IEEE std. 802.3z application), test equipment use a VCSEL (Vertical cavity surface emitting laser) at 850 nm (compliant with 1000BASE-SX) and an FP laser at 1310 nm (compliant with 1000BASE-LX).

E. Test Results Documentation

1. The test result information for each link shall be recorded in the memory of the field tester upon completion of the test.
2. The test result records saved by the tester shall be transferred into a Windows™-based database utility that allows for the maintenance, inspection and archiving of these test records. A guarantee must be made that these results are transferred to the PC unaltered, i.e., "as saved in the tester" at the end of each test and that these results cannot be modified at a later time. Superior protection in this regard is offered by testers that transfer the numeric measurement data from the tester to the PC in a non-printable format.
 - a. The popular 'csv' format (comma separated value format) does not provide adequate protection and shall not be acceptable.
3. The database for the completed job – including twisted-pair copper Technology links if applicable –shall be stored and delivered on CD-ROM; this CD-ROM shall include the software tools required to view, inspect, and print any selection of test reports.

4. General Information to be provided in the electronic data base containing the test result information for each link:
 - a. The identification of the customer site as specified by the Owner
 - b. The overall Pass/Fail evaluation of the link-under-test
 - c. The name of the standard selected to execute the stored test results
 - d. The cable type and the value of the 'index of refraction' used for length calculations
 - e. The date and time the test results were saved in the memory of the tester
 - f. The brand name, model and serial number of the tester
 - g. The revision of the tester software and the revision of the test standards database in the tester
5. The detailed test results data to be provided in the electronic database for each tested optical fiber must contain the following information.
 - a. The identification of the link/fiber in accordance with the naming convention defined in the overall system documentation and as coordinated with Owner.
 - b. The insertion loss (attenuation) measured at each wavelength, the test limit calculated for the corresponding wavelength and the margin (difference between the measured attenuation and the test limit value).
 - c. The link length shall be reported for each optical fiber for which the test limit was calculated based on the formulas

3.15 CABLE TESTING – PATCH CORDS, COPPER

- A. Patch cords shall be field tested for continuity, wire maps, NEXT, ELFEXT (pair-to-pair), attenuation, return loss, propagation delay and delay skew to ANSI/TIA/EIA standards for category 6 patch cords.
- B. For patch cords 100% tested at the factory, 10 percent (minimum of three) patch cords shall be selected at random by the Owner's representative and field tested in the presence of the Owner's representative. If any cables fail, all patch cords shall be tested, all failed patch cords shall be replaced and the testing process shall start at the beginning and be repeated.
- C. For patch cords not 100% tested at the factory, all patch cords shall be field tested. After field testing, 10 percent (minimum of three) patch cords shall be selected at random by Owner's representative and field tested in the presence of the Owner's representative. If any patch cords fail, all new patch cords shall be provided and the testing process shall start at the beginning and be repeated.

3.16 SYSTEM DOCUMENTATION

- A. All equipment and cable shall be designated in accordance with EIA/TIA 606 for system management and administrative purposes, to include outlet-specific markings (behind faceplate) by manufacturer for wiring scheme, transmission category and

termination position markings and installation-specific markings (on front of faceplate) such as station identifier, type of service, and transmission capability.

- B. Files and record AutoCAD drawings (disks) indicating the as-built condition and showing the physical labeling and color coding of the system shall be turned over to the Engineer for review. Review comments shall be incorporated into the documents and CAD drawings of the installation turned over to the owner.
- C. Refer to Section Division 26 for additional documentation and record drawing requirements.

3.17 MOUNTING HEIGHTS - TELEPHONE OUTLETS

- A. Install system components at the following mounting heights:
 - 1. Telephone Wall Outlets: 18 inches above finished floor.
 - 2. Wall Hung Telephone Outlets: Accessible for handicapped; verify with telephone system installer.
 - 3. Telephone Wall Outlets, above counter: Height to be determined in field.

3.18 MOUNTING HEIGHTS - DATA OUTLETS

- A. Install system components at the following mounting heights:
 - 1. Data Wall Outlets: 18 inches above finished floor, verify location and mounting heights of all data outlets with Owner.
 - 2. Data wall outlets, above counter: Height to be determined in field.
 - 3. Wireless access point outlets, when ceiling mounted, shall be on the ceiling. Where wall mounted, outlets shall be mounted 8" below finished ceiling.

3.19 GROUNDING TESTS

- A. Ground resistance of main system grounding point shall be tested and shall not exceed values required by National Electrical Code. Test shall be made using two auxiliary ground rod (three point) method or other approved method. If resistance is found to be higher than that allowed by National Electric Code, additional ground rods shall be driven until a resistance below allowed value is obtained.
- B. Outside tests shall not be performed during unusually wet conditions. Tests shall be made during dry weather conditions.
- C. Complete test record in triplicated shall be submitted to Owner stating allowable National Electrical Code Value, showing resistance values and calculations and shall indicate method of test.

3.20 WARRANTY

- A. The Contractor shall provide a system warranty covering the installed cable system against defects in workmanship, components, and performance, and follow-up support after final project payment.
- B. Installation Warranty: The Contractor shall warrant the Technology system against defects in workmanship for a period of two years from the date of final payment. The warranty shall cover all labor and materials necessary to correct a failed portion of the system and to demonstrate performance within the original installation specifications after repairs are accomplished. This warranty shall be provided at no additional cost to the Owner.
- C. Cable System Warranty: The Contractor shall facilitate a 25 Year Performance Warranty between the manufacturer and the Owner, in compliance with Hubbell 25 year Mission Critical Certification. The performance warranty shall warrant the installed Category 6 copper and the backbone optical fiber portions of the Technology system. Copper links shall be warranted against the link performance minimum expected results defined in the TIA/EIA 568B, TSB-67, and the manufacturer's Network Technology Contractor Agreement. Fiber optic links shall be warranted against the link and segment performance minimum expected results defined in the latest TIA/EIA standard and the manufacturer's Network Technology Contractor Agreement. All other connectivity components shall be warranted against defects in materials and workmanship for a period of 25 years.

END OF SECTION 271300

APPENDIX A
TELECOMMUNICATIONS CONTRACTOR QUALIFICATIONS

- A. In order to qualify for installation of the data/voice communications systems, the Contractor must have a performance history, experience in the installation, splicing and termination of optical fiber cable systems, experience in the installation and termination of low voltage data/voice cable systems, and proof of time in business. Contractor must be trained and certified for the communications cable and hardware which it installs, and must furnish proof of certification.
- B. PERFORMANCE HISTORY: Contractor must have successfully performed at least three projects of similar scope within three years of the date of this bid. Proof of performance shall be in the form of reference sheets which shall include a brief description of the project, the beginning and ending contract price, the project foreman or superintendent's name, and the name, address, and telephone number of the Owner of the reference.
1. The three network project references shall show having installed multiple Ethernet drops, terminations, connections, wiring closets, and active network devices within the last 36 months.
- C. OPTICAL FIBER EXPERIENCE: Contractor must be able to prove to the satisfaction of the Owner that it has significant experience in the installation of optical fiber cable systems. Installation must include installation of optical fiber cable, fiber splicing, fiber termination, a knowledge of interconnect equipment, and a thorough knowledge of testing procedures. Contractor must provide a minimum of 3 references supporting its claim of experience for similar projects within the 3 years prior to this bid. Documentation must be included with the documents submitted.
- D. TIME IN BUSINESS: Contractor must have been in business and in the business of installing telecommunications systems continuously for a period of at least three years prior to the date of this bid. Contractor must submit at least one project reference for each of the three years prior to the date of this bid. These project references shall contain the same information required in Paragraph A above. Contractor must also provide a list of key installation personnel, their hire dates, and a resume of their experience. Key installation personnel shall include at least one foreman and three journey level installers or technicians. By submitting the names of these personnel, the contractor is committing them to the execution of the project outlined in this specification. The Contractor shall submit certificates of completion for all key installation personnel that show evidence of certification to install enhanced category 5 wiring/terminations and show evidence in certification of testing and installing enhanced category 5 horizontal channels to the EIA/TIA testing standards. "Enhanced" Category 5 installation/testing certifications shall be by BICSI (Building Industry Consulting Services Institute), or a BICSI approved or endorsed training program, or equivalent manufacturer's training. All Sub-contractors must also have been in business for a period of at least three years prior to the date of this bid and submit evidence indicating such.

- E. The Contractor shall provide satisfactory evidence of a fully equipped service organization, capable of furnishing adequate inspection and service to the system, including standard replacement parts, within 100 miles of the project site. The address and phone number of the service organization shall be included in the bid response.
- F. The qualified Contractor shall perform all data/voice and terminations at the outlets and MDF locations.
- G. **HARDWARE CERTIFICATION:** The Contractor and/or Sub-Contractors shall be authorized by the listed/provided Wiring/Terminations Supplier, and to market, support, install, and service all hardware proposed to be furnished. Letters of Supply and Proof of Authorization/Certification shall be included with the bid response.
 - 1. The Contractor, or his-Sub-Contractor, must be "certified" to install the proprietary 'Hubbel" Inside and Outside Plant Cabling (Copper only) system.
 - 2. The Contractor, or his Sub-Contractor, must be "certified" to install the proprietary "Corning" Outside Plant Fiber Optic Cabling and Corning terminations. The EWP Warranty Program listed Contractors (Members) are only acceptable for this project.
- H. The "Telecommunications Contractor's Qualifications Statement" must be completed and submitted to be considered for pre-approval. All evidence of qualifications such as resumes, certificates, references, etc. shall be attached to the filled out statement and submitted. The Owner reserves the right to reject any pre-approval proposal due to any irregularities and/or missing information.

TELECOMMUNICATIONS CONTRACTOR'S QUALIFICATION STATEMENT

Performance History:

1. Projects with Multiple Ethernet Drops:

Performed by:		
Job Name	Contact	Telephone No.
_____	_____	_____
_____	_____	_____
_____	_____	_____

Optical Fiber Experience:

Performed by:		
Job Name	Contact	Telephone No.
_____	_____	_____
_____	_____	_____
_____	_____	_____

2. Time in Business: _____

List of Key Personnel:

Data	Voice
_____	_____
_____	_____
_____	_____

3. Name of RCDD and Registration Number: _____

4. Name of experienced Network Engineer: _____

5. Other _____ Project _____ References: _____

Contractor's Name: _____

Contractor's Address: _____

Contractor's Telephone No.: _____

Contact Person: _____

END OF SECTION 271300

SECTION 283111 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

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. Manual fire-alarm boxes.
 - 2. System smoke detectors.
 - 3. Nonsystem smoke detectors.
 - 4. Heat detectors.
 - 5. Notification appliances.
 - 6. Magnetic door holders.
 - 7. Addressable interface device.

1.3 DEFINITIONS

- A. LED: Light-emitting diode.
- B. NICET: National Institute for Certification in Engineering Technologies.

1.4 SYSTEM DESCRIPTION

- A. Noncoded, UL-certified addressable system, with multiplexed signal transmission, dedicated to fire-alarm service only.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
 - 2. Include voltage drop calculations for notification appliance circuits.
 - 3. Include battery-size calculations.
 - 4. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
 - 5. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them.

Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.

6. Include alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
7. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.

C. General Submittal Requirements:

1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Engineer.
2. Shop Drawings shall be prepared by persons with the following qualifications:
 - a. Trained and certified by manufacturer in fire-alarm system design.
 - b. NICET-certified fire-alarm technician, Level IV minimum.
 - c. Licensed or certified by authorities having jurisdiction.

D. Delegated-Design Submittal: For smoke and heat detectors 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. Drawings showing the location of each smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the detector.
2. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Seismic Qualification Certificates: For fire-alarm control unit, 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.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data," deliver copies to authorities having jurisdiction and include the following:

1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
3. Record copy of site-specific software.
4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:
 - a. Frequency of testing of installed components.
 - b. Frequency of inspection of installed components.
 - c. Requirements and recommendations related to results of maintenance.
 - d. Manufacturer's user training manuals.
5. Manufacturer's required maintenance related to system warranty requirements.
6. Abbreviated operating instructions for mounting at fire-alarm control unit.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
- B. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer. Components shall be compatible with, and operate as, an extension of existing system.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. NFPA Certification: Obtain certification according to NFPA 72

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: All devices, components, etc. shall be compliant with and match the Honeywell fire alarm system manufacturer, or approved equal.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:

1. Manual stations.
2. Heat detectors.
3. Flame detectors.
4. Smoke detectors.
5. Duct smoke detectors.

B. Fire-alarm signal shall initiate the following actions:

1. Continuously operate alarm notification appliances.
2. Identify alarm at fire-alarm control unit.
3. Transmit an alarm signal to the remote alarm receiving station.
4. Unlock electric door locks in designated egress paths.
5. Release fire and smoke doors held open by magnetic door holders.
6. Activate alarm communication system.
7. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
8. Activate smoke-control system (smoke management) at firefighter smoke-control system panel.
9. Close smoke dampers in air ducts of designated air-conditioning duct systems.

C. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of primary power at fire-alarm control unit.
4. Ground or a single break in fire-alarm control unit internal circuits.
5. Abnormal ac voltage at fire-alarm control unit.
6. Break in standby battery circuitry.
7. Failure of battery charging.
8. Abnormal position of any switch at fire-alarm control unit or annunciator.

2.3 FIRE-ALARM CONTROL UNIT

- A. Where shown on the plans, provide and install a new Fire Alarm Control Panel. Construction shall be modular with solid state, microprocessor based electronics. It shall display only those primary controls and displays essential to operation during a fire alarm condition.
- B. The Control Panel shall have an 80-character LCD display and perform all functions listed in this specification. The display shall be backlit for enhanced readability. So as to conserve battery standby power, it shall not be lit during an AC power failure unless an alarm condition occurs or there should be keypad activity.
- C. The Control Panel shall have the capability to monitor a minimum of 500 addressable devices.
- D. Provide cabinets of sufficient size to accommodate the aforementioned equipment. The cabinets shall be equipped with locks and transparent door panels providing freedom from tampering yet allowing full view of the various lights and controls.

E. Smoke-Alarm Verification:

1. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.
2. Activate an NRTL-listed and -approved "alarm-verification" sequence at fire-alarm control unit and detector.
3. Record events by the system printer.
4. Sound general alarm if the alarm is verified.
5. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.

F. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke barrier walls shall be connected to fire-alarm system.

G. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values on system printer.

2.4 MANUAL FIRE-ALARM BOXES

A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

1. Double-action mechanism requiring two actions to initiate an alarm, break glass or pull- lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
2. Station Reset: Key- or wrench-operated switch.
3. Indoor Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery- powered audible horn intended to discourage false-alarm operation.
4. Weatherproof Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.

2.5 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.
2. Detectors shall be two wire type.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to 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.
7. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
 - a. Rate-of-rise temperature characteristic shall be selectable at fire-alarm control unit for 15 or 20 deg F (8 or 11 deg C) per minute.
 - b. Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F (57 or 68 deg C).
 - c. Provide multiple levels of detection sensitivity for each sensor.

B. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).

C. Ionization Smoke Detector:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).

D. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.

- c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).
- 3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.
- 4. Each sensor shall have multiple levels of detection sensitivity.
- 5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
- 6. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

E. Single-Station Duct Smoke Detectors:

- 1. Comply with UL 268A; operating at 120-V ac.
- 2. Sensor: LED or infrared light source with matching silicon-cell receiver.
 - a. Detector Sensitivity: Smoke obscuration between 2.5 and 3.5 percent/foot when tested according to UL 268A.
- 3. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. The fixed base shall be designed for mounting directly to air duct. Provide terminals in the fixed base for connection to building wiring.
 - a. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.
- 4. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
- 5. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

2.6 HEAT DETECTORS

- A. General Requirements for Heat Detectors: Comply with UL 521.
- B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or a rate of rise that exceeds 15 deg F per minute unless otherwise indicated.
 - 1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
 - 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
- C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F.
 - 1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
 - 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.7 NOTIFICATION APPLIANCES

- A. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated and with screw terminals for system connections.
 - 1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections.
- B. Combination Audible/Visible Notification Appliances: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet (3 m) from the horn, using the coded signal prescribed in UL 464 test protocol. Visible notification shall comply with 2.7.C.
- C. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.
 - 1. Rated Light Output:
 - a. 15/30/75/110 cd, selectable in the field.
 - 2. Mounting: Wall mounted unless otherwise indicated.
 - 3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
 - 4. Flashing shall be in a temporal pattern, synchronized with other units.
 - 5. Strobe Leads: Factory connected to screw terminals.
 - 6. Mounting Faceplate: Factory finished, red.

2.8 REMOTE ANNUNCIATOR

- A. Description: Provide remote annunciator panel at location indicated on the plans. Remote annunciator shall comply with the latest NFPA requirements.

2.9 ADDRESSABLE INTERFACE DEVICE

- A. Description: Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating devices for wired applications with normally open contacts.
- B. Integral Relay: Capable of providing a direct to fire alarm control panel.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72 for installation of fire-alarm equipment.

B. Smoke- or Heat-Detector Spacing:

1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
2. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.
3. Smooth ceiling spacing shall not exceed 30 feet.
4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Appendix A in NFPA 72.
5. HVAC: Locate detectors not closer than 3 feet 5 feet from air-supply diffuser or return-air opening.
6. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture.

C. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.

D. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.

E. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.

F. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.

G. Visible Alarm-Indicating Devices: Install adjacent to each alarm horn and at least 6 inches below the ceiling.

H. Device Location-Indicating Lights: Locate in public space near the device they monitor.

3.2 CONNECTIONS

- A. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.

3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- B. Install framed instructions in a location visible from fire-alarm control unit.

3.4 GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3.5 FIELD QUALITY CONTROL

- A. Field tests shall be witnessed by Engineer and authorities having jurisdiction
- B. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
 - 1. Visual Inspection: Conduct visual inspection prior to testing.
 - a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
 - b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
 - 2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
 - 3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
 - 4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
 - 5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
 - 6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
- D. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
- E. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

- G. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.
- H. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 283111