PROJECT MANUAL for:

SNELL BUILDING (SNLB)

DEAN'S OFFICE REMODEL

Project # C6335841-1695-00320

WO #M9847

15 March 2024

Construction Documents

BRIGHAM YOUNG UNIVERSITY

WPA architecture
475 N. FREEDOM BLVD. PROVO, UTAH 84601
801-374-0800 info@wpa-architecture.com

SECTION 000101
PROJECT TITLE PAGE

PROJECT MANUAL
FOR
SNELL BUILDING DEAN'S OFFICE REMODEL

OWNER'S PROJECT NUMBER: WO #M9847
OWNER'S WORK ORDER NUMBER: M9847

BRIGHAM YOUNG UNIVERSITY
PROVO, UTAH 84602

DATE: BIDDING – 2 APRIL 2024
PREPARED BY: WPA ARCHITECTURE

END OF SECTION

I, Bruce T. Fallon, AIA the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers.

Signature & Date: 03.15.2024

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Signature & Date: 03.15.2024

SECTION 000103

PROJECT DIRECTORY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Identification of project team members and their contact information.

1.02 OWNER:

A. Name: Brigham Young University.
   1. Address Line 1: 234H BRWB
   2. City: Provo.
   3. State: Utah.
   4. Zip Code: 84602.
   5. Telephone: (801) 422-5406.

B. Primary Contact: All correspondence from the Contractor to the Architect will be through this party, unless alternate arrangements are mutually agreed upon at preconstruction meeting.
   1. Title: BYU Construction Project Manager.
   2. Name: Tony Burdette.
   3. Email: anthony_burdette@byu.edu

1.03 CONSULTANTS:

A. Architect: Design Professional of Record. All correspondence from the Contractor regarding construction documents authored by Architect's consultants will be through this party, unless alternate arrangements are mutually agreed upon at preconstruction meeting.
   1. Company Name: WPA Architecture
      a. Address Line 1: 1535 N. Freedom Blvd.
      b. City: Provo
      c. State: Utah
      d. Zip Code: 84602
      e. Telephone: 801.374.0800
   2. Primary Contact:
      a. Title: President | Principal
      b. Name: Bruce T. Fallon, AIA
      c. Email: bfallon@wpa-architecture.com

B. Mechanical Engineering Consultant - Plumbing:
   1. Company Name: DBI Engineering
      a. Address Line 1: 467 N. Main Street
      b. City: Payson
      c. State: Utah
      d. Zip Code: 84651
      e. Telephone: 801.465.4607
   2. Primary Contact:
      a. Title: Mechanical Engineer.
      b. Name: Tom Degraw, PE
      c. Email: tomdegraw@dbieng.com

H. Mechanical Engineering Consultant - HVAC:
   1. Company Name: DBI Engineering
      a. Address Line 1: 467 N. Main Street
      b. City: Payson
      c. State: Utah

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Signature & Date: 03.15.2024

d. Zip Code: 84651
e. Telephone: 801.465.4607

2. Primary Contact:
a. Title: Mechanical Engineer.
b. Name: Tom Degraw, PE
c. Email: tomdegraw@dbieng.com

I. Electrical Engineering Consultant:

1. Company Name: BNA Consulting
a. Address Line 1: 4225 Lake Park Blvd. Suite 275
b. City: West Valley City
c. State: Utah
d. Zip Code: 84120
e. Telephone: 801.532.2196

2. Primary Contact: .
a. Title: Associate
b. Name: Robert Kaldahl
c. Email: rkaldahl@bnaconsulting.com

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

I, Bruce T. Fallon, AIA the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers.

Signature & Date: 03.15.2024

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I, Bruce T. Fallon, AIA the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers.

Signature & Date: 03.15.2024

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I, Bruce T. Fallon, AIA the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers.

Signature & Date: 03.15.2024

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Signature & Date: 03.15.2024

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I, Bruce T. Fallon, AIA the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers.

Signature & Date: 03.15.2024

END OF SECTION

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SECTION 011000

SUMMARY

PART 1 GENERAL

1.01 PROJECT

A. Project Name: BYU Snell Building (SNLB) Dean's Office Remodel

B. Owner's Name: Brigham Young University.

C. Additional Project contact information is specified in Section - 000103 - Project Directory.

D. The Project consists of the construction of remodel of existing Snell Building (SNLB) including but not limited to the following:

1. Remove metal stud walls, doors and frames.
2. Remove and replace existing 2 x 2 grid ceilings
3. Remove and replace lighting and controls where ceilings are replaced.
4. Remove and replace existing mechanical grilles, ducts and VAV boxes where ceilings are replaced.
5. Remove and replace interior finishes, including flooring and wall finishes.
6. Remove existing millwork

1.02 DESCRIPTION OF ALTERATIONS WORK

A. Scope of demolition and removal work is indicated on drawings and specified in Section 024100.

B. Owner will remove the following items before start of work:

1. Network Equipment
2. A/V Equipment

C. Contractor shall remove and deliver the following to Owner prior to start of work:

1. None

D. Contractor shall remove and store the following prior to start of work, for later reinstallation by Contractor:

1. None

1.03 WORK BY OWNER

A. Refer to the drawings for a list of NIC (Not in Contract) work by owner.

1.04 OWNER OCCUPANCY

A. Owner intends to occupy the Project upon Substantial Completion.

B. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.

C. Schedule the Work to accommodate Owner occupancy.

1.05 CONTRACTOR USE OF SITE AND PREMISES

A. Construction Operations: Limited to areas noted on Drawings.

B. Arrange use of site and premises to allow:

1. Owner occupancy.
2. Work by Others.
3. Work by Owner.
4. Use of site and premises by the public.

C. Provide access to and from site as required by law and by Owner:

I, Bruce T. Fallon, AIA the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers.

Signature & Date: 03.15.2024

1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
2. Do not obstruct roadways, sidewalks, or other public ways without permit.

D. Existing building spaces may not be used for storage.

E. Utility Outages and Shutdown:
1. Limit disruption of utility services to hours the building is unoccupied unless approved by owner.
2. Do not disrupt or shut down life safety systems, including but not limited to fire sprinklers and fire alarm system, without 7 days notice to Owner and authorities having jurisdiction.
3. Prevent accidental disruption of utility services to other facilities.

1.06 WORK SEQUENCE

A. Coordinate construction schedule and operations with Owner.

END OF SECTION

I, Bruce T. Fallon, AIA the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers.

Signature & Date: 03.15.2024

BRIGHAM YOUNG UNIVERSITY

STANDARD CONTRACT REQUIREMENTS

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BRIGHAM YOUNG UNIVERSITY

STANDARD CONTRACT REQUIREMENTS

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VIII. REQUEST FOR PAYMENT

- A. SCHEDULE OF VALUES

12 March 2024

(Attached is a list of bidders invited to bid.)

Re: Invitation to Bid – SNELL Building Renovation
W.O. M9847

To Whom It May Concern:

You are invited to bid on the above-referenced project. This project consists of demolishing and remodeling the 2nd floor office suite, approximately 3,800 square feet. The completion date for this project is August 16th, 2024.

Plans will be available at the mandatory pre-bid which has been scheduled for March 19th at 9:30 am in Room 113 BRWB. Bids will be opened and read aloud on April 3rd at 2:00 pm in Room 113 of the Brewster Physical Facilities Building at Brigham Young University. A performance bond and a labor and materials payment bond for 100% of the contract will be required for this project and must be included in your bid.

We hope that you will be able to bid this project.

Sincerely,

Anthony Burdette

ARB/mh
Attachment

NOTICE TO BIDDERS

SECTION l--PROJECT: SNELL Building Renovation

WORK ORDER NUMBER: M9847

SECTION 2--LOCATION: Brigham Young University

SECTION 3--OWNER: Brigham Young University

SECTION 4--DESIGNER: Brigham Young University

SECTION 5--STANDARD CONTRACT REQUIREMENTS:

The Bidder is directed to the Brigham Young University Standard Contract Requirements (revised October 2017). This volume is an integral part of the contract documents and is hereby made a part of the contract.

SECTION 6--DATES:

A. Start Date: 29th April 2024

B. Completion Date: 16 August 2024

SECTION 7--PREBID CONFERENCE

A. Prebid Conference will be:

Date: 19 March 2024

Time: 9:30 AM

Place: Room 111, Brewster Building

SECTION 8--RECEIPT AND OPENING OF BIDS:

A. Bids will be received:

Date: 3 April 2024

Time: 2PM

Place: Room 111, Brewster Building

By: Ole M. Smith

B. The Owner reserves the exclusive right to release all publicity relating to the proposals and the project.

SECTION 9--DEPOSIT FOR CONTRACT DOCUMENTS:

A. A deposit of $0.00 will be required for each set of contract documents (plans and specifications) taken.

SECTION 10--GENERAL CONTRACTORS

A. Bidding by General Contractors will be by invitation only.

BRIGHAM YOUNG UNIVERSITY

FORM OF PROPOSAL

NAME OF PROJECT SNELL Building Renovation

WORK ORDER NUMBER M9847

NAME OF CONTRACTOR _____

DATE OF PROPOSAL _____

The undersigned, hereinafter referred to as the Bidder, certifies that the following facts and/or circumstances have occurred or exist relating to the proposed work: SNELL Building Renovation prepared by _____.

1. That Bidder has received the contract documents for the above entitled project.

2. That Bidder has received Brigham Young University General Conditions Requirements, revised October 26, 2017.

3. That Bidder is familiar with such documents, has examined the site of the proposed work, including availability of access, utilities, and other similar items relating to performance of the work and is thoroughly familiar with all general and local conditions which could in any way affect this work.

4. That no verbal agreements or representations with or by any officer, agent, or employee of the Owner exist or have been made to the Bidder and the Bidder in submitting this proposal is in no way relying thereon.

5. That if this proposal is accepted, Bidder will enter into a contract with the Owner in substantially the form contained in the contract documents, and will provide the bonds, insurance coverage and all other items required by the contract documents.

6. The term "base bid" shall be understood to include all work contained in the contract documents excluding any substitutes or alternates. The Owner will have the right to accept Alternates in any order or combination, and to determine the low Bidder on the basis of the sum of the Base Bid and Alternates accepted.

Bidder hereby proposes to furnish all materials, labor, equipment, tools, transportation, services, licenses and permits necessary for the completion of all the work set forth in the contract documents for the sum of:

Base Bid* ($)

*Base bid to include the cost of a Performance Bond and a Labor/Materials Payment Bond and Builder's Risk. See General and Supplementary Conditions.

1. The bidder agrees to complete the work on or before 16 August 2024

2. The bidder acknowledges receipt of addenda No.(s)_____

3. The Bidder's Utah contractor's license number is_____

4. Is your bonding capacity adequate for this job? Yes No

5. For verification call_____

6. Telephone number_____

PROPOSED SUBSTITUTE MATERIALS

The total sum of the Bidder's proposal shall include the furnishing and installing of all materials, equipment, and labor as called for in the contract documents as a base bid.

Hereafter give the total amount to be added or deducted for a complete installation of equipment or materials other than those specified and those approved by addendum are submitted for the Owner's consideration. All materials and equipment proposed for substitution shall be listed below and must meet the requirements of the contract documents. During the time of consideration of the proposals, complete information shall be submitted immediately to the Architect and Owner's Representative. The Contractor is referred to Page 3 of the Instructions to Bidders, Section 9, prior approvals and substitutions for requirements relative to proposed substitutions.

Proposed Substitute	Manufacturer and Catalog Numbers	$ Add	$ Deduct

TYPE OF BIDDER'S ORGANIZATION:

Official Name of Organization

Corporation, Co-partnership, Individual, or Other

Address

Name of individual Members of Firm:

Name of President of Corporation:

Name of Secretary of Corporation:

Corporation is organized under the laws of the State of:

Signature

( )
)Seal(
( )

Title or Office

Legal Address

BIDDER'S LIST OF SUBCONTRACT BIDS USED IN PROPOSAL

(LIST OF SUBCONTRACTORS)

PROJECT NAME SNELL Building Renovation

WORK ORDER NUMBER M9847

OWNER'S NAME Brigham Young University

DIVISION	SUBCONTRACT CLASSIFICATIONS	SUBCONTRACTOR USED	AMOUNT

INSTRUCTIONS TO BIDDERS

SECTION 1 -- BIDDING BY INVITATION

A. Bidding shall be by written invitation only. Those wanting to be considered for such invitation shall apply to:

Assistant Administration Vice President
Physical Facilities
202 Brewster Building
Provo, UT 84602

B. The Owner reserves the right to accept or reject any or all bids.

SECTION 2 -- CONTRACT DOCUMENTS

A. The Contract documents may be obtained by contractors from:

Construction Department
Physical Plant
240 Brewster Building
Provo, UT 84602

B. Subcontractors and suppliers who want to obtain Contract documents (plans and specifications) may do so by requesting the documents and paying the printing costs.

C. All Contract documents must be returned within ten (10) days after the bid opening, or the deposit will be forfeited. Those documents purchased outright by the Bidders are exempted.

D. The Contract documents (plans and specifications) may be deposited with local Bid Depositories. Bidders may contact the Invited General Contractors for locations. The Contract documents may be examined free at:

Construction Department
Physical Plant
240 Brewster Building
Provo, UT 84602

SECTION 3 -- CONTRACT METHOD

A. All work specified is to be done under one general contract. Bids will be accepted by the Owner from prime contractors only.

SECTION 4 -- INTERPRETATION OF CONTRACT DOCUMENTS

A. If any Bidder doubts the true meaning of any of the Contract documents, or finds errors, discrepancies or omissions, he shall request a clarification from the Architect in writing. Any interpretations or corrections will be made only by written addenda duly issued by the Owner. All addenda will be mailed, faxed or otherwise delivered to each person receiving a set of the Contract documents. Requests for clarifications must be submitted to the Architect at least five (5) days before bid opening. Unwritten instructions or interpretations will have no validity.

B. Should discrepancies appear in the Contract documents that are not resolved by an addendum, it is expressly understood that the Contractor has used the most expensive method and/or material in the bid.

SECTION 5 -- REQUIREMENTS BEFORE SUBMITTING BIDS

A. The Contractor shall become thoroughly familiar with the site and structures located there (if any). The Contractor shall thoroughly examine all Contract documents in relation to all conditions that might directly or indirectly affect the contract work. The bid amount shall reflect all such conditions.

SECTION 6 -- PREPARING AND SUBMITTING BIDS

A. To receive consideration, a bid must be made according to the following instructions:

1. Bids shall be prepared on BYU bid forms.
2. Bids shall have all items or blanks filled. Numbers shall be stated both in writing and in figures. If there is a discrepancy between the two, the written number shall govern.
3. Bids shall be without interlineations, alterations or erasures.
4. Signatures shall be by those authorized to execute the Contract.
5. The Bidder's legal name, business address and telephone number shall be stated.
6. Neither oral bids nor modifications shall be considered.
7. You may email your bid to the Construction Department Secretary, but it is not official until it is printed, inserted into an envelope, and delivered to the designated person opening the bids prior to the appointed bid opening time. It is suggested that the bidder call in advance to make these arrangements. We do not accept responsibility for email, printing, delivery, or other problems.
8. It is the Bidder's sole responsibility to see that the bid is received at the proper time. Any bid received after the scheduled bid opening time will be returned unopened to the Bidder.
9. Bidders shall accept proposals from only those subcontractors who are approved by the Owner or those who have shown to the Bidder's satisfaction that they are financially capable of handling the work. Furthermore, subcontractors must have the technical ability, personnel, plant, experience and reputation to carry out their portions of the work. It will be assumed that the question of bonding subcontractors, where considered desirable or necessary by the Contractor, including the cost of such bonds, has been resolved before bids have been submitted.
10. In order for the bid to be considered valid, two or more Bidders bidding as a "joint venture" must have the written approval of the Owner before submitting a bid. All members of a joint venture shall sign the bid and an official representative of the joint venture shall be designated in the proposal.
11. The term "base bid" shall be understood to include all work contained in the Contract, excluding any alternates or substitutes. The Owner shall have the right to accept alternates in any order or combination, and to determine the low Bidder based on the sum of the base bid and alternates accepted.
12. Substitutes or alternates accepted by the Owner may be included in the Contract or added by Change Order. In determining the low Bidder, the Owner will not consider substitutes.
13. Bids may be withdrawn by the Bidder, either in person or by a written request before bid opening. Once opened, the Bidders will have 24 hours to review and withdraw their bids. After the 24-hour period, the bids may not be withdrawn and must remain fixed as submitted for 45 days after opening. Envelopes must contain nothing but the proposal and bid breakdown forms if required. Envelopes shall be opaque, sealed and bear the Bidder's name.

SECTION 7 -- APPROVAL OF CONTRACTORS AND SUBCONTRACTORS

A. As soon after the bid opening as is practicable, the Owner will interview the apparent low Bidder and if deemed advisable, the second or third low Bidders. Within two hours of the bid opening, the low Bidder and the second or third low Bidders will provide to the Owner a list of subcontractors and their dollar amounts that were used in formulating their bid. The list of subcontractors will be examined by the Owner as soon as possible. The Owner reserves the right to accept or reject any subcontract proposal.

B. Provide Unit Prices within 24 hours of Bid Opening if requested in Form of Proposal.

C. If a Bidder doubts the correctness or acceptability of any subcontract proposal, the Bidder may submit the names and amount of other competing subcontractors for consideration, making sure that he clearly states which one he has used in formulating his proposal.

SECTION 8 -- FACTORS AFFECTING AWARD OR REJECTION OF BID

A. The Bidder's and subcontractor's past performance, organization, equipment and ability to perform and complete their contract as specified will be vital elements, as well as the amount of their bids, in the award of the Contract.

B. The Owner reserves the right to reject any or all bids, or to waive any irregularities or informalities in bids received. The

Owner reserves the right to accept the bid that will, in the Owner's opinion, best serve the interests of the Owner.

C. If a schedule is requested on form of proposal - The Owner reserves the right to reject a bid that provides a date that is past the requested substantial completion. Further, the Owner reserves the right to award the project based on proposed substantial completion regardless of whether such bid is the lowest.

SECTION 9 -- PRIOR APPROVALS AND SUBSTITUTIONS

A. Several acceptable brands of equipment, manufactured articles or methods of construction may have been identified in the Contract. It is not intended to close the Contract against other brands, articles, or methods that may warrant consideration. However, unspecified materials must have prior approval by the Owner to be considered.

B. Prior Approvals: Requests for approval of unspecified materials must be made to the Architect at least five days before bid opening. The requests for prior approval shall be considered by the Architect if time permits and if properly documented. The Architect is not bound to consider these items despite their apparent validity.

C. Fully detailed technical data, references and other information shall be furnished simultaneously with the requests for prior approval items.

D. Such requests shall be reviewed by the Architect and the Owner. If accepted, the approved requests will be included in an addendum.

E. The Contractor's "base bid" shall include the furnishing of only those items that are explicitly specified or which have received prior approval by addendum.

F. Substitutions: Besides the "base bid," any equipment or material supplier and any contractor or subcontractor may, at his option, submit a substitute price and product for any item specified which he feels warrants consideration by the Owner. This proposed substitution is to be listed where indicated on the bid form.

G. Any proposed substitute submitted by a Bidder shall include the amount by which the "base bid" would be increased or decreased.

H. The Owner may accept or reject any substitute proposed. In determining the low Bidder, the Owner will not consider substitutes.

I. If requested, the Contractor shall furnish information or data concerning the substitute. The Owner may request the Contractor, at his own expense, to have the substitute tested by an approved testing laboratory.

SECTION 10 -- FORM OF CONTRACT

A. Copies of the form of the Contract that the successful Bidder will be required to execute are included in this specification.

SECTION 11 -- ADDENDA

A. All addenda issued before bid opening shall be included in the bid and shall be a part of the Contract.

SECTION 12 -- REQUIREMENTS IMMEDIATELY AFTER SIGNING THE CONTRACT

A. Immediately after signing the Contract, the Contractor shall furnish the following to the Owner:
   1. Executed performance, labor and material payment bonds, each in an amount equal to 100 percent of the contract sum as specified in the General Conditions.
   2. Insurance certificates as specified in the General Conditions.
   3. A cost breakdown of the work that may, as approved by the Owner, serve as a basis for making monthly payments to the Contractor.
   4. A project schedule as to how he intends to construct the project. This must be, in the opinion of the Owner, a realistic method of analyzing and scheduling each component of the work. It must show when all trades or crafts start and finish their work. This schedule must be reviewed weekly in the OAC meeting and updated as

required. A critical path method of scheduling is preferred. If the Contractor cannot produce and maintain such a schedule, this service must be obtained from an outside consultant. The schedule must be approved by the Owner's Representative before the Contractor submits the first payment request.

B. The Contractor shall issue subcontracts as mutually agreed between the Owner and the Contractor. A complete list of subcontractors and major suppliers including names, addresses and telephone numbers are required within fourteen (14) days of the Owner=s subcontractorreview.

SECTION 13 -- DISQUALIFICATION

A. If the above requirements are not satisfied, the bid may be disqualified at the discretion of the Owner.

CONTRACT

Project Name

AT

BRIGHAM YOUNG UNIVERSITY

LONG FORM CONTRACT NO.
Project No.:
(Work Order No.:)

THIS CONTRACT, made and executed as of the day day of month, year, by and between BRIGHAM YOUNG UNIVERSITY, a non-profit Utah corporation of Provo, Utah (hereinafter referred to as "Owner"), and Contractor Name (hereinafter referred to as "Contractor").

WITNESSETH:

That for and in consideration of the payments hereinafter specified to be paid by the Owner to the Contractor and the covenants and agreement herein contained to be kept and performed by the parties hereto, the Contractor agrees to build and construct the proposed Project Name at Brigham Young University in Provo, Utah (hereinafter referred to as the "Project") and to furnish and deliver all materials, and perform and supervise all services (hereinafter, the “Work”) as required herein and by the contract documents hereinafter identified, all of which shall collectively constitute the contract, and shall hereinafter be referred to collectively as the "Contract".

ARTICLE I. THE IDENTIFICATION OF CONTRACT DOCUMENTS

A. The Plans entitled "Name on plans" were prepared by Brigham Young University, reviewed by Richard or Ray or whomever, Title of Reviewer, and approved by Ole Smith, Assistant Administration Vice-President of Brigham Young University, on date.

B. The Specifications entitled "Name on Specs" were prepared by Brigham Young University, reviewed by Richard or Ray or whomever, Title of Reviewer, and approved by Ole Smith, Assistant Administration Vice-President of Brigham Young University, on date.

C. Addendum Number One, dated Month Day, Year.

D. Addendum Number Two, dated .

E. The Brigham Young University General Conditions are a part of this Contract.

ARTICLE II. THE CONTRACT SUM

The Owner agrees to pay to the Contractor, in accordance with the terms hereof, the following:

Base Bid	$
Total	**$**

The Contractor agrees to accept a total of written dollar amount (check instructions for guidelines) Dollars ($) as full compensation for performing his obligation under the contract.

ARTICLE III. DATE OF COMPLETION

The Contractor agrees to complete the work required by the Contract on or before midnight, date (Month Day, Year). Time is hereby expressly declared to be of the essence of the Contract.

ARTICLE IV. THE CONTRACTOR'S REPRESENTATIVE

The Contractor's Representative is Name of the Contractor.

ARTICLE V. THE OWNER'S REPRESENTATIVE

The Owner's Representative is Ole M. Smith.

IN WITNESS WHEREOF, the Owner has caused this instrument to be signed by its President, attested by its Secretary, and its corporate seal to be hereunto affixed, and the Contractor has hereunto affixed his signature as of the day and year above written.

ACKNOWLEDGED: BRIGHAM YOUNG UNIVERSITY	CONTRACTOR
Ole M. Smith Assistant Administration Vice President	contractor rep contractor company
Steve Hafen Administration Vice President	Date
Shane Reese President	

BRIGHAM YOUNG UNIVERSITY

(Tax Exempt No. 11691946-003-STC)

SALES TAX EXEMPTION CERTIFICATE

In Lieu of Form TC-721

TO: contractor name _____

Pursuant to Utah State Tax Commission Rule R865-19S-58, Brigham Young University is exempt from sales/use tax on purchases of all Construction Materials (as defined by the above Rule). You and your subcontractors are hereby authorized to purchase Construction Materials free of Utah sales tax for the Project listed below pursuant to the agreement between you and Brigham Young University dated _____.

PROJECT: _____

OWNER'S REPRESENTATIVE: _____

Assistant Administration Vice-President Date
202 BRWB, Provo, UT 84602-8100
(801) 422-5500

CONTRACTOR'S (OR SUB'S) AFFIDAVIT

TO (Name of Vendor): _____

I certify that the purchases of Construction Materials from the Vendor above are made in behalf of Brigham Young University for the above referenced Project *only*. I further certify that the Construction Materials purchased will be installed or converted into real property owned by Brigham Young University.

NAME OF CONTRACTOR/SUB: _____

Street Address: _____ **Phone:** _____
Address City State/Zip

By: _____ **Title:** _____ _____
Authorized Representative Position or Job Title Date

NOTE: Vendor must keep this certificate on file for audit review. Contractor or Sub must keep a copy of this certificate on file and must notify vendors of cancellation, modification, or limitation of the exemption claimed. Contractor or Sub is liable for sales tax on any Construction Materials purchased which are not used on the Project above or which do not otherwise qualify for exemption.

GENERAL CONDITIONS

SECTION 1 - DEFINITIONS

A. OWNER - Brigham Young University, Provo, UT, referred to as the "Owner."

B. OWNER'S REPRESENTATIVE - The Assistant Administration Vice President - Physical Facilities, 202 Brewster Building, Brigham Young University, Provo, UT 84602.

C. ARCHITECT - The Architect is a licensed architect, engineer, or organization so designated in the Contract. The term "Architect" means the Architect or his authorized representative.

D. CONTRACTOR - The Contractor is the person or organization identified as such in the Contract and referred to throughout the Contract as if singular in number and masculine in gender. The term "Contractor" means General Contractor or his authorized representative.

E. SUBCONTRACTOR - The person, firm or corporation supplying direct or indirect labor and/or materials at the site of the Project and under separate contract or agreement with the Contractor.

F. PROJECT MANAGER - The BYU personnel who acts as liaison between the Owner and the Contractor for the Project. [CITY INSPECTOR ISSUE]

G. THE WORK - The work includes all labor necessary to produce the construction, demolition, or other delivery of goods and services required by the Contract and all materials and equipment incorporated or to be incorporated in such work.

H. THE PROJECT - The Project is the total construction designed by the Architect. The Work performed under the Contract may be the whole or a part of the work required to be performed under the Project.

I. WRITTEN NOTICE - Written notice shall have been duly served if delivered in person to the Project Manager or the Contractor's designated representative. Written notice is also served by a registered or certified mailing to the last known address of the corporation, if delivered to the direction of the Project Manager or the Contractor's designated representative.

J. CONTRACT - The Contract consists of the Brigham Young University short or long form contract; the Instructions to Bidders; the Supplementary Conditions; the General Conditions; the Drawings; the Specifications; Addenda; and Change Orders describing the Work and signed or acknowledged between the Owner and Contractor.

SECTION 2 - THE CONTRACT DOCUMENTS

A. The Contract represents the entire agreement between the parties and supersedes all prior negotiations, representations or agreements, either written or oral, including the bidding documents. After written execution of the Contract, the Contract shall be amended or modified only by a Change Order.

B. Words that have well-known technical or trade meanings are used herein by such recognized meanings.

C. Within the Contract there shall be the following order of precedence, (1) being the highest precedent:
   1. The BYU Short Form or Long Form Contract takes precedence over all other documents.
   2. Supplementary General Conditions take precedence over General Conditions.
   3. General Conditions take precedence over Drawings and Specifications.
   4. Addenda or modifications of any nature, to the Drawings and Specifications, take precedence over the original.

5. Specifications take precedence over Drawings.
6. Within the Working Drawings, the larger scale takes precedence over smaller, figured dimensions over scaled and noted materials over graphic indications.

SECTION 3 - DISCREPANCIES IN THE CONTRACT

A. Should any question arise regarding the Contract, the Contractor shall request written interpretation and clarification from the Architect before proceeding. Without such request and written authorization, the Contractor proceeds at his own risk.

SECTION 4 - ADDITIONAL DRAWINGS & INSTRUCTIONS

A. The Architect shall promptly furnish any additional instructions or clarification necessary for proper execution of the Work specified in the Contract.

SECTION 5 - OWNERSHIP AND MAINTENANCE OF DRAWINGS

A. All drawings and specifications furnished to the Contractor, including electronic file versions, are the property of the Owner. They are not to be used on other work and must be returned to the Owner if so requested. One copy may be retained by the Contractor, but may not be used for any third-party work without the express written consent of the Owner.

B. The Owner shall furnish, free of charge to the Contractor, all copies of drawings and specifications reasonably necessary for the execution of the Work. The Contractor shall maintain in good order on the Project one copy of drawings, addenda and specifications that shall be readily available to the Architect and the Project Manager.

SECTION 6 - PROGRESS MEETINGS

A. Contractor shall be required to attend weekly Owner, Architect, and Contractor (OAC) meetings. The agenda and meeting minutes will be prepared by the Architect. The Architect shall distribute meeting minutes within seven days of the meeting. The Contractor shall attend such meetings and shall require subcontractors to attend as necessary. These meetings are to:
    1. Insure that all activities are being coordinated properly on the Project.
    2. Review the schedule.
    3. Check the status of:
        a. Submittals, including shop drawings and samples.
        b. Change Orders and Proposal Requests.
        c. Payment requests.
        d. Any other matters that may need to be reviewed.

SECTION 7 - PROJECT SCHEDULE

A. Before the first payment request, the Contractor shall prepare and submit for review an estimated Project schedule for the Work. The Project schedule shall be in sufficient detail to include, but not be limited to:
    1. Significant elements of the Work.
    2. Period for each element of Work with a beginning and ending date.
    3. Percentage of progress of Work completed or to be completed in a monthly period.
    4. Early start anticipated schedule of all Owner Provided/Contractor Installed (OP/CI) mechanical controls.

B. The Project schedule shall be updated monthly and submitted with each payment request and shall show the original Project schedule or revised Project schedule, one entry for each item of work, as follows:
    1. All Work already completed and paid for by Owner.

2. Work during current period for which payment is being requested.
3. Remaining Work to be done, itemized in the Schedule of Values.

SECTION 8 - EMERGENCIES

A. In case of an emergency endangering life or threatening the safety of the structure or of adjoining property, the Contractor may, without waiting for specific authorization from the Architect or Owner, act at his own discretion to safeguard life or property. Compensation and time shall be allowed the Contractor for such emergency work. The amount of both shall be decided between the Contractor, the Architect, and the Owner.

B. The Contractor shall notify the Project Manager immediately and shall make a full written report of such emergency action to the Project Coordinator within seven days of the event.

SECTION 9 - SUBMITTALS, SHOP DRAWINGS, AND SAMPLES

A. General:

1. The Contractor shall deliver submittals, shop drawings or samples to the Owner and Architect as indicated below. Furthermore, the Contractor shall accompany each submittal with a transmittal letter indicating the title of the Project, the name of the Contractor, the title of the submittal and the specification section number.

B. Submittal Schedule:

1. The Contractor shall, within twenty-one (21) calendar days after receipt of the signed contract, furnish a submittal schedule listing all items that the Contract requires for review. This schedule shall include shop drawings, manufacturers' literature, certificates of compliance, material samples, material colors, guarantees, etc.
2. The schedule shall show the type of item, the Contract requirement reference, the Contractor's scheduled dates for submitting the items and the projected need dates for review by the Architect. The schedule shall show a minimum of fourteen (14) calendar days for review by the Architect. If resubmittal is required, an additional seven (7) days will be allowed. The Contractor shall revise and update this schedule as appropriate and submit it with each payment request until all items have been submitted and reviewed.
3. The Contractor shall coordinate the submittal schedule with the Project schedule for all the work. The Contractor shall revise and update the submittal schedule to insure consistency with the Project schedule. The Contractor shall promptly provide such revised submittal schedules to the Owner.
4. Furnishing of the submittal schedule or subsequent revisions shall not be interpreted as relieving the Contractor of the obligation to comply with all Contract requirements for items on the schedule.

C. Definitions:

1. Shop drawings are drawings, diagrams, illustrations, electronic files, schedules, performance charts, brochures and other data prepared by the Contractor or subcontractor, manufacturer, supplier, or distributor. Shop drawings illustrate some portion of the work and confirm dimensions and conformance to the Contract.
2. Samples are physical examples furnished by the Contractor to illustrate materials, equipment, color, or construction and to help establish standards by which the work will be judged.

D. Procedure:

1. The Contractor shall review and stamp his certification that the products and methods meet the requirements specified in the Contract. The Contractor shall submit one (1) electronic copy of shop drawings to the Architect and one (1) electronic copy to the Owner, with reasonable promptness and in orderly sequence. Shop drawings and samples not required by the Contract

but requested by the Contractor, or supplied by those under contract to him, need not be submitted to the Architect and Owner for approval. These shop drawings shall meet all specified shop drawing requirements, except those relating to submission to the Architect and Owner.

2. The Contractor shall reject shop drawings not in conformance with the Contract.
3. Shop drawings shall be complete and detailed. If reviewed by the Architect, each copy of the shop drawings shall be stamped and dated by the Architect. If review "with exception" or "as noted" by the Architect is so identified, stamped and dated, the Contractor shall comply with notations shown. If the Architect requires resubmission of submittals, the Contractor shall make any corrections at the Contractor's expense. The Contractor shall not copy Project drawings and use those drawings as submittals.
    a. Any shop drawing which does not conform to the Contract shall be explicitly noted on the drawings and in the transmittal letter. This shall not be construed as approval to proceed with performing or providing the changed work until specifically approved by the Owner and a Change Order accordingly issued. If shop drawings show variations from Contract requirements because of standard shop practice, or for any other reason, such variations shall be explicitly noted in the transmittal letter. Shop drawing review shall be general. It shall not relieve the Contractor of responsibility for accuracy of such shop drawings, nor for proper fitting, construction of work, furnishing of materials or work required by Contract and not shown on shop drawings.
    b. All transmittal of shop drawings may be by email or other electronic means.

E. By approving shop drawings and samples, the Contractor determines and certifies that all field measurements, field construction criteria, materials, catalog numbers and similar data conform to the Contract. The Contractor determines and certifies that he has checked and coordinated each shop drawing and sample with requirements of the Contract.

F. No work requiring a shop drawing or sample submission shall be commenced until submission has been approved in writing by the Architect.

G. Samples:
1. Where specified or required, the Contractor shall submit samples to the Architect with specification material, affidavits, and other documentation as required by the Architect or the Owner.
2. It is the Contractor's specific responsibility to ascertain that samples have been checked and approved before being submitted.
3. Cost of samples, including transportation, delivery and any other costs, shall be paid by the Contractor. Unless specified otherwise, samples shall be submitted in triplicate for the Architect, the Owner and the Contractor. The Contractor shall keep his samples on the jobsite. Where samples are specifically required to be submitted for approval, no work involving the sampled materials shall proceed until written approval has been obtained from the Architect.

H. Review by the Architect and the Owner:
1. Review of shop drawings by the Architect and the Owner shall not be construed as a complete check, but will show only that the general method of construction and detailing is satisfactory. Review of such drawings will not relieve the Contractor of responsibility for any error that may exist in the submittals.

SECTION 10 - ROYALTIES & PATENTS

A. The Contractor shall pay all royalties and license fees. The Contractor shall defend and hold the Owner harmless from all suits or claims for infringement of any patent rights.

SECTION 11 - CONTRACTOR'S LIABILITY INSURANCE AND BONDS

A. Insurance:

1. The Contractor shall not commence work under this Contract until he has obtained the insurance required and evidence of such insurance has been submitted to and approved by the Owner. The submittal of said evidence to the Owner shall not relieve or decrease the liability of the contractor.
    a. Workers' Compensation & Employers' Liability Insurance as required by statute.
    b. Commercial General Liability Insurance – the current version of ISO Form CG 00 01 or equivalent, Occurrence Policy, with -
        (1) Limits of not less than -

(a)	General Aggregate	$ 2,000,000.00
(b)	Products - Comp/OPS Aggregate	$ 2,000,000.00
(c)	Personal and Advertising Injury	$ 1,000,000.00
(d)	Each Occurrence	$ 1,000,000.00
(e)	Fire Damage (any one fire)	$ 50,000.00
(f)	Medical Expense (any one person)	$ 5,000.00

        (2) Endorsements attached thereto including the following or their equivalent -
            (a) The current version of ISO Form CG 25 03, Amendment of Limits of Insurance (Designated Project or Premises), describing the subject Contract and specifying the limits as shown above.
            (b) The current version of ISO Form CG 20 10, Additional Insured -- Owners, Lessees, or Contractors (Form B), naming the Owner as an additional insured and containing the following statement - "This endorsement also constitutes primary coverage in the event of any occurrence, claim, or suit."
    c. Automobile Liability Insurance, with -
        (1) Limits of not less than $1,000,000.00 Combined Single Limit per accident.
        (2) Coverage applying to any auto.

B. Certificate of Insurance, on the current version of ACORD 25-S Form, or equivalent, filed with the Owner identifying:
    1. Owner, as defined in the Construction Contract, as Certificate Holder and Additional Insured.
    2. Endorsements, as listed above. (Note: If forms other than ISO forms are used, copies of the non-ISO forms are to be attached to this certificate).
    3. Project as defined in the Construction Contract.
    4. Cancellation clause of the certificate amended to read, "Should any of the above described policies be canceled before the expiration thereof, the issuing company will mail a notice within thirty (30) days to the certificate holder named."
    5. Insurance companies providing coverage - All companies listed must be rated "A-" or better in the Standard and Poor's Solvency Review Guide Property & Casualty (current edition.)
    6. The Name, Address, and Telephone Number of The "Producer" - The certificate is to bear an original signature of the Authorized Representative of the Producer. Facsimile or mechanically reproduced signatures will not be accepted.

C. Performance Bond and Labor & Material Payment Bond:
    1. The Contractor shall furnish the Owner a performance bond, and a labor and a material payment bond each in an amount equal to 100 percent of the Contract amount as security for all obligations arising under the Contract. Such bonds shall –
        a. Be written on Form AIA Document A312. Where the laws of the state in which the project is located mandate a statutory payment bond form, such mandated payment bond form shall be used but is to be accompanied by the AIA Document A312 Performance Bond.
        b. Be issued by a surety company or companies licensed in the state in which the Project is located and holding valid certificates of authority under applicable federal insurance law as acceptable sureties or reinsurance companies on federal bonds. The penal sum

obligation assumed by each surety, shall not exceed the maximum amount permitted by law.

c. Be accompanied by a certified copy of the Power of Attorney stating the authority of the Attorney-in-fact executing the bonds on behalf of the Surety.

D. The Owner reserves the right to reject any insurance company, policy, endorsement, certificate of insurance, surety company, performance bond, or labor and material payment bond with or without cause.

E. The cost of such insurance and such bonds as required above shall be the obligation of the Contractor.

SECTION 12 - HOLD HARMLESS AGREEMENT

A. Besides obtaining insurance coverage as required above, the Contractor shall indemnify and save the Owner, the Architect, and their agents and employees harmless from and against any liability, demands, causes of action or claims thereof, whether well founded or otherwise, including the cost of defending the same, for bodily injury to any person whosoever (including the employees of the Owner or the Architect) or damage to property of any person during construction because of the negligence of the Contractor, their subcontractors or material suppliers, their agents or employees.

B. The Contractor shall defend the Owner and Architect in any lawsuit filed by any of their subcontractors or material suppliers. Where liens have been filed against the Owner's property, this shall require the Contractor or his bonding company to obtain lien releases and record them in the appropriate county or local jurisdiction so as to unencumber and provide the Owner with a title free and clear from any liens.

C. No subcontract shall relieve the Contractor of any of his liability or obligation under the Contract. The Contractor agrees that he is fully responsible to the Owner for acts or omissions of his subcontractors and their material suppliers and of persons either directly or indirectly employed by them.

SECTION 13 - BUILDERS RISK LOSSES

A. The Owner will provide Builder's Risk Insurance or reimburse the Contractor for losses to the Project, described herein, to the extent to which such losses are or would be covered by the Owner's Policy Form of F.M. Global's "All Risk" insurance policy covering Builders Risk Insurance. 1. Deductible Clause - All claims for loss or expense arising out of one occurrence shall be adjusted as one claim, and from the amount of such adjusted claim, there shall be deducted the sum of:

a. $2,500.00 on all Projects. The deductible amount is the responsibility of the Contractor or Subcontractor.

2. Loss Reporting Procedure - All losses requiring reimbursement under this Section shall be reported to the Project Coordinator as soon as practical and always before the beginning of repairs so that details of the loss can be obtained and verified to simplify a prompt loss adjustment.

B. Copies of the insurance forms are available from the Owner at the Brigham Young University Physical Facilities, Construction Section offices.

SECTION 14 - PERMITS, INSPECTIONS, CERTIFICATES, AND REGULATIONS

A. Permits:

1. The Contractor shall obtain, and the Owner shall pay cost of, permits necessary for completion of this work. "Permits," as used in this paragraph includes any permits necessary for the Contractor to complete the Work, including but not limited to: excavation, footing, and foundation permits; building permits; hot work permits; elevator permits; fire sprinkler permits; boiler permits; demolition permits; specialty permits from the State of Utah or other federal or state

governmental entities, such as Health Department permits; etc. The responsibility for obtaining, and any resulting liability for failing to obtain, such permits shall rest with the Contractor.

2. The Contractor shall schedule and coordinate all necessary inspections and shall notify the Project Manager and the Authority Having Jurisdiction of all inspections. The Contractor shall be responsible for securing a certificate of occupancy that may be required by Authorities Having Jurisdiction over the Work. The Contractor shall deliver these certificates to the Project Manager before execution of the Certificate of Substantial Completion.
3. The Contractor will be required to notify the Utah Division of Air Quality of any demolition projects and obtain all permits required by the State, County, and/or Provo City. The Contractor shall include all demolition permit fees in his bid.
4. The Contractor shall hold harmless, defend, and indemnify Owner from and against any and all claims, demands, allegations, fines, and damages associated with or arising from the Contractor's failure to obtain required permits.

B. Regulations:

1. The Contractor and others working under his jurisdiction, supervision, or control shall do all work according to laws, regulations, and ordinances required by governmental authority or other agencies having jurisdiction over this work.
2. If the Contractor observes that the Contract is in variance with any laws, regulations or ordinances, he shall notify the Project Manager and shall not proceed unless necessary changes required for compliance with said laws, regulations and ordinances have been made as provided in the General Conditions, Section 24. The Contractor shall be fully responsible for any work knowingly done contrary to laws, regulations and ordinances. The Contractor shall fully indemnify the Owner against loss and bear all costs and penalties arising from those violations.
3. The Contractor shall hold harmless, defend, and indemnify Owner from and against any and all claims, demands, allegations, fines, and damages associated with or arising from the Contractor's failure to follow applicable regulations.

SECTION 15 - MEASUREMENTS, SURVEYS, BUILDING LAYOUT & SITE EXAMINATION

A. The Contractor shall be responsible for:

1. Establishing lot lines and bench marks.
2. Laying out the work on the building site.
3. The proper observance of property lines and set back requirements.
4. The location and layout of buildings as noted in the drawings with respect to the position on the property and elevation in relation to the grade.

B. If existing conditions shown in the Contract documents differ materially from those the Contractor encounters in the performance of the work, the Contractor shall immediately notify the Architect and the Owner in writing.

C. The Architect and the Owner shall promptly investigate the reported conditions. If they find that such conditions do materially differ and cause an increase or decrease in the Contractor's cost or the time required for performance of any part of the work, the Owner shall make an equitable adjustment by Change Order.

D. As the work progresses, the Contractor shall lay out on the forms, or floors, the exact locations of all partitions as a guide to all trades. Subcontractors providing work that is to be placed in connection with walls and/or partitions shall check such locations and immediately notify the Contractor of any conflicts in structure or changes necessary to adapt services, utility lines or equipment required by the Contract. Subcontractors and others failing to make such checks and give notice as outlined above shall be required to assume any costs resulting from their failure to do so.

E. Before ordering materials or doing work, the Contractor shall verify all measurements to properly size or fit

the work. No extra charge or compensation will be allowed by the Owner resulting from the Contractor's failure to comply with this requirement.

SECTION 16 - INSPECTION OF WORK

A. The Architect, Owner, and other inspectors or government officials as appropriate shall always have full access to all phases of the work. The Contractor shall provide adequate means to simplify inspection.

1. The Contractor shall notify the Project Manager and local authorities twenty-four (24) hours before doing work that covers or otherwise makes it difficult to inspect structural, plumbing, mechanical, electrical, or other work.
2. Should any of the work be covered before it is inspected by Project Manager and local authorities, the Contractor shall uncover that work for inspection at his own expense.
3. The Contractor shall schedule the work so an inspection team may inspect the mechanical, electrical, and plumbing work before it is covered up. This inspection team will furnish a list of items that must be completed before the work is concealed.

SECTION 17 - SUPERVISION & CONSTRUCTION PROCEDURES

A. The Contractor shall be solely responsible for all construction means, methods, techniques, sequences, and procedures and for coordinating all portions of the work under the Contract. The Contractor shall not change project managers or superintendents without the written consent of the Owner.

SECTION 18 - ARCHITECT'S STATUS AND DECISIONS

A. The Architect shall assist the Project Manager during the construction period.

1. The Architect will make frequent visits to the site to familiarize himself with the progress and quality of the work and to determine if the work is proceeding according to the Contract and schedule. During periodic visits the Architect may condemn work that fails to conform to the Contract.
2. The Architect shall interpret the conditions of the Contract and be the judge of its performance. He shall use his powers under the Contract to enforce its faithful performance by the Contractor. The Architect will review shop drawings and prepare Proposal Requests. The Architect will conduct inspections with the Project Manager to determine the dates of substantial completion and final completion.
3. In general, the Architect shall work with and coordinate with the Project Manager and the Contractor for the accomplishment of the Work. However, in the event that the Architect and Project Manager disagree on how a work should be accomplished, the Contractor shall take final direction from the Project Manager.
4. Neither the Owner nor the Architect will be responsible for construction means, methods, techniques, sequences or procedures, or for safety precautions and programs concerning the Work. Neither the Owner nor the Architect will be responsible for failure of the Contractor, subcontractor, material supplier or their employees to carry out the Work according to the Contract.

SECTION 19 - MATERIAL & EQUIPMENT

A. DELIVERY, STORAGE, & HANDLING

1. Materials shall be delivered to the site in original packaging with labels and trademarks intact, and such labels and trademarks shall remain intact until used. Structural steel, piping and fittings shall be manufactured in the United States of America.
2. The Contractor shall confine his apparatus, storage of materials, and operations of his workers to limits indicated by law, ordinances and permits. The Contractor shall arrange and maintain storage of materials within contract limit lines in an orderly manner leaving all walks, driveways, roads and entrances unencumbered. The Contractor and the Contractor’s employees shall park

only in the areas designated by Owner.

3. All new and existing equipment on the site shall be protected from physical damage and from the elements by measures satisfactory to the Architect and the Project Coordinator. All rotating equipment shall be rotated four turns weekly during construction.
4. If any material is found not conforming to the Contract, the Contractor shall remove such nonconforming materials at his expense.

B. PRODUCT OPTIONS & SUBSTITUTIONS

1. When several materials are specified in the Contract by name for one use, the Contractor may select any one of those so specified. The mixing of different products specified by name for one use is prohibited.
2. Items and material not specified in the Contract shall be removed and replaced by specified items and material at no additional cost to the Owner. No additional time will be added to the Contract for removal or replacement.
3. Wherever words "approved by," "satisfactory to," "submitted to," "inspected by," or similar phrases are used in this specification, they shall be understood to mean that the material or item referred to shall be approved by, be satisfactory to, submitted to, or inspected by the Architect and the Project Manager.

SECTION 20 - TEMPORARY CONSTRUCTION FACILITIES

A. TEMPORARY ELECTRICITY

1. The Contractor shall arrange with the proper authority (State, County, City, Owner, etc.) for all power required by the Contractor during the construction period until the Certificate of Substantial Completion is issued. If the power is coming from a BYU owned source, it will be paid for by BYU with the exception of the installation cost of equipment, conduit, wire, etc. BYU may provide transformer(s) and meter(s) at their discretion. Contractor to coordinate with BYU Construction Project Manager prior to bid. If no coordination takes place prior to bid, contractor is to provide transformer and meter at no additional cost to the owner after bid. Contractor shall bare the cost of any damages to owner provided equipment due to contractor's negligence. The method of metering, connections, etc., must have the written approval of the authority furnishing the utility to the Contractor. The Contractor shall be responsible for all utilities needed for his use during the entire construction period.
2. The Contractor shall provide all temporary wiring, outlets, metering (if the source of power is other than a BYU source), and associated materials. The temporary electrical system shall comply with local codes and the current, adopted version of the National Electrical Code.
3. The Contractor shall provide electrical power to distribution centers only.
4. If utility service is available from the Owner's permanent utilities, the Contractor may, by arranging with the Owner, use these permanent utilities. The Owner assumes no responsibility for damage caused by the Contractor using any of the Owner's utilities due to interruption of services by the Owner, whatever the cause.

5 The contractor may not use BYU provided power for welding equipment or other major equipment without written approval of BYU. Anything needing power other than for small tools, temporary lighting and project start up and function of permanent equipment (for example: elevator and mechanical equipment) shall be approved in writing by the BYU project Manager.

B. TEMPORARY LIGHTING

1. The Contractor shall provide wiring, outlets and fixtures for temporary lighting.
2. The Contractor shall provide pigtails and other lights for all areas within and around the building, sufficient to meet OSHA regulations, or to provide the following intensities, whichever is greater:

a. All working areas	3 foot candles
b. Stairs, landings, ramps	5 foot candles
c. Outdoor floodlighting within contract limit lines	3 foot candles
d. All areas involving finish work	30 foot candles

C. TEMPORARY HEATING, COOLING & VENTILATING

1. All temporary heating and cooling shall be arranged and paid for by the Contractor. Heating and cooling from the central plant will be charged at $12.00 per million BTUs, if available and payable monthly to the Owner. BYU will provide the meter and contractor will install.
2. New Additions and New Buildings:
    a. The Contractor shall be responsible for installation and operation of temporary heating, cooling, and ventilating units including fuel, temporary piping, fittings, wiring, and connections in new additions and new buildings as necessary.
    b. The Contractor shall be responsible for damage to building and contents caused by cold, heat, and dampness.
    c. The Contractor shall maintain safe conditions for use of temporary heating, cooling, and ventilating systems including, but not limited to, the following:
        (1) Operate equipment following the manufacturer's instructions.
        (2) Provide fresh air ventilation required by the equipment manufacturer.
        (3) Keep temperature of fuel containers stabilized.
        (4) Secure fuel containers from overturning.
        (5) Operate equipment away from combustible materials.
        (6) Provide adequate fire extinguishers.
3. Existing Building:
    a. Where practicable and unless otherwise specified, existing facilities may be used, at the Owner's expense, to maintain minimum heating and cooling requirements. Normal setback temperature patterns shall not be interfered with except as specifically required to meet construction requirements. The existing system shall be protected by the Contractor from contamination, construction dust and debris. Filters shall be maintained in a clean condition and replaced with new filters at the completion of construction.
4. Specific heating requirements, unless otherwise specified by industry or manufacturer specifications, include but are not limited to:
    a. Gypsum Plaster – Uniform minimum temperature of 55 deg F for a week before application of plaster, during plastering operations, and until plaster is dry.
    b. Gypsum Board - 55 degrees F minimum day and night during entire joint treatment operation and until execution of Certificate of Substantial Completion.
    c. Ceramic Tile - 50 deg F minimum during preparation of mortar bed, laying of the tile, and for 72 hours after completion of the tile work.
    d. Acoustical Tile - 70 deg F minimum during setting of the tile.
    e. Resilient Flooring - 70 deg F minimum during application.
    f. Painting - 55 deg F minimum during painting operations and until dry.
5. When temporary heating, cooling, or ventilating is no longer required, the Contractor shall dismantle the temporary system and remove it at his own expense. The Contractor shall return permanent mechanical equipment to 'like-new' condition for the Substantial Completion Inspection. All warranties will begin at substantial completion regardless of when the equipment was started.

D. TEMPORARY WATER

1. The Owner will allow the Contractor usage of existing water facilities required for construction, at the Contractor’s expense. If additional water is needed which cannot be supplied by existing facilities, the Contractor is to pay for installation of all valves, piping and metering, and arrange with the proper authority for connection of the additional water. BYU will provide the meter and contractor will install.

E. TEMPORARY SANITARY FACILITIES

1. The Contractor shall provide and maintain sanitary, temporary toilets.
2. The Contractor shall at all times maintain such facilities clean, neat and sanitary.
3. Temporary outside toilets shall be removed at completion of the job.

F. SCAFFOLDING AND PLATFORMS

1. The Contractor or his subcontractors shall furnish and maintain all equipment such as temporary stairs, ladders, ramps, platforms, scaffolds, hoists, runways, derricks, chutes, elevators, etc., as required for proper execution of the Work.
2. All apparatus, equipment, and construction shall meet all requirements of labor laws, safety regulations and other applicable Federal, State or local laws.
3. Temporary stairs shall be built whenever needed. The Contractor shall provide temporary treads, handrails and shaft protection as needed or as required by governing codes.

H. TREE & PLANT PROTECTION

1. Before commencing site work, the Owner shall build and maintain protective fencing around existing trees and vegetation as identified on the Project drawings.
    a. Individual trees shall have protective fencing built beyond the drip line and to the satisfaction of the Project Manager.
    b. Groups of trees and other vegetation shall have protective fencing built around the entire group to the satisfaction of the Project Manager.
    c. Areas within protective fencing shall remain undisturbed and shall not be used for any purpose.
2. The Contractor shall protect all other trees, shrubs, lawns and all landscape work from damage and shall provide appropriate guards and covering. If normal sprinkling system is disrupted, the Contractor shall coordinate with BYU grounds to make sure the trees are watered by BYU or the Contractor.
3. Vegetation designated on drawings to be protected that has died or has been damaged beyond repair shall be removed and replaced by the Owner and back charged to the Contractor.

I. TEMPORARY ENCLOSURES

1. When walls and roof are in place, the Contractor shall provide temporary, weather tight enclosures for all exterior openings to protect all work. Openings into existing structure shall be made weatherproof.

J. PROTECTION FROM SNOW & ICE

1. The Contractor shall remove all snow and ice as may be required for the proper safety, protection and execution of the Work.

K. BRACING, SHORING, & SHEATHING

1. The Contractor shall design, furnish, install, and maintain all shoring, bracing, and sheathing as required for safety and proper execution of the Work and have the same removed if required when the Work is completed.

L. PROTECTION OF PERSONS

1. The Contractor shall provide, install, and maintain all necessary precautions to protect all persons on the site, including the public. Such measures shall include:
    a. Posting of appropriate warning signs in hazardous areas.
    b. Providing guardrails, fencing and barricades of adequate heights around all openings in floors or roofs, and around all excavations. All guardrails shall meet all applicable codes.
    c. Providing warning lights around obstructions, pits, trenches, or similar areas on-site or in adjacent streets, roads, sidewalks, or in the structure itself.
    d. When use or storage of hazardous materials or equipment is necessary for the execution of the Work, the Contractor shall exercise the utmost care and shall carry on such activities under the supervision of properly qualified personnel, and shall perform the work in accordance with all applicable codes or regulations.

M. PROTECTION FROM WEATHER

1. The Contractor shall provide protection against weather and protect all work, materials, apparatus, and fixtures. At the end of the day all work that might be damaged shall be covered.

2. If low temperatures or other weather conditions make it impossible to continue operations safely in spite of precautions, the Contractor shall cease work and notify the Project Manager.

N. PROTECTION OF EXISTING WORK
1. The Contractor shall protect all streets, private roads, and sidewalks, including overhead protection where required, and shall make all necessary repairs to damaged Work at his own expense.
2. The Contractor shall provide proper protection of all existing Work, furnishings, and fixtures likely to be damaged. When exterior openings are made in existing Work, they shall be covered with weather tight protection at the end of the day.
3. Before commencing work, the Contractor shall survey the site, and shall photograph and note any damage to existing structures including walks, curbs and utilities and shall provide copies of the photographs to the Project Manager before proceeding with work. Any damage not noted by the Contractor will be repaired or replaced by the Contractor.
4. Any Work damaged by failure to provide protection shall be removed and replaced at Contractor's expense.

O. FIRE PROTECTION
1. The Contractor shall provide at least one approved fire extinguisher in plain sight on each floor at each usable stairway prior to introduction of any combustible materials into the building.
2. Fires shall not be built on the premises.
3. In existing buildings with fire alarm/detection devices, the Contractor shall cover all smoke detectors within the work area each morning before work begins and remove dust covers at the end of the day. Fire detection devices must be functioning in the work area when the Contractor is not on the site.

P. PROTECTION OF ADJACENT PROPERTY
1. The Contractor shall provide all necessary protection and support of adjacent property.

Q. CONSTRUCTION CLEANING
1. The Contractor shall keep premises broom clean during progress of the work.
2. The Contractor shall remove waste materials and rubbish left by employees, subcontractors, and material suppliers. Roads inside and outside the Project shall be cleaned daily when hauling.
3. Before and during painting and varnishing, the Contractor shall clear the area of all debris, rubbish, and building materials that may cause dust. Sweep floors as required and take all possible steps to keep area dust free.

R. SURFACE WATER CONTROL
1. The Contractor shall protect the excavation, trenches and building from water damage by:
   a. Providing pumps, equipment and enclosures necessary for such protection.
   b. Constructing and maintaining temporary drainage and pumping as necessary to keep the site free of water.
2. The cost of water control shall be borne by the Contractor. The Owner may, if promptly notified of adverse underground water conditions, negotiate reasonable financial relief for the Contractor where such conditions could not have been learned from the Soils Engineer's Report, the Contract, or by commonly known local conditions.

S. OFFICES
1. The Contractor shall provide and maintain a weather tight office at the construction site. This building is to be located outside of, and detached from the building under construction. Connection of utilities and monthly utility costs shall be paid by the Contractor. This building shall be the property of the Contractor and shall be removed upon completion of the Project.

T. SHEDS AND TRAILERS

The Contractor shall provide and maintain neat, weather-tight storage sheds or trailers for storage of all materials that might be damaged or affected by weather or moisture. These sheds or trailers shall

have wood floors raised above the ground and will be outside of and detached from the building under construction. They shall be property of the Contractor and shall be removed upon completion of the work.

U. CODE OF CONDUCT

Contractor recognizes that BYU is an affiliate of the Church of Jesus Christ of Latter-day Saints, and that students and employees at BYU expect to work and learn in an environment consistent with the principles of the Church. Contractor agrees that all of Contractor's employees will A) Refrain from consuming alcohol, tobacco, or other illegal drugs on BYU campus, except that smoking may be permitted in designated, outdoor, areas; B) Refrain from using profanity; C) Observe modest standards of dress and behavior; D) be courteous and respectful to all members of the BYU campus community. Violations of these expectations may be grounds for terminating the Contractor's engagement or for asking the Contractor to dismiss a particular, offending employee from the Project.

SECTION 21 - TESTING

A. Testing companies will be selected by the Owner.

B. The Owner and/or the Architect reserve the right to have tests taken at any time.

C. Tests not specified as part of a trade section shall be paid by the Owner.

D. Should tests reveal a failure of the Work to meet Contract requirements, subsequent tests related to the failure shall be paid by the Contractor.

E. Tests shall be made according to recognized standards by a competent, independent testing laboratory.

F. Materials found defective or not in conformance with the Contract shall be promptly replaced or repaired at the expense of the Contractor.

G. Samples required for testing shall be furnished by the Contractor and selected as directed by the Architect or Project Manager.

SECTION 22 - EXISTING UTILITIES

A. Prior to execution of the Work the Contractor is to locate all existing vaults, manholes, valves, meters, etc. Contractor is to photograph, GPS, measure from existing structures and facilities that are to remain and keep this information readily available at the site/construction trailer. Contractor is also to mark the above utilities by staking and maintaining stakes for fast and accurate locating of all existing utilities in case of emergencies.

B. BYU will initially provide all on campus blue staking information. It is the Contractor's responsibility to maintain the blue staking locations and information by staking, painting, keeping GPS coordinates or any alternative ways that the Contractor can keep current, accurate information.

SECTION 23 - CUTTING AND PATCHING

A. The Contractor shall coordinate all cutting, fitting, or patching of the Work (including but not limited to cutting or patching of floorings; ceilings; roofs; walls; mechanical, electrical and plumbing; and all other surfaces and structures) that may be required to make the several parts of the Work come together properly. The Contractor shall coordinate all portions of the Work so as to receive or to be received by other portions of the Work, whether previously existing or newly created. The Contractor shall make proper repair or

closure of the Work as needed or as directed by the Architect or the Project Manager.

B. The Contractor shall refrain from cutting or digging in a manner that is harmful to the Owner's premises. Contractor agrees that Contractor will not cut or alter any section of the Owner's premises except as indicated on the plans and specifications without prior consent of the Architect and the Project Manager. The Contractor shall give 48-hour Blue Stake notice to the Project Manager and local Blue Stakes location center.

C. In the event that Contractor shall cause damage to the Owner's premises while cutting or digging, Contractor shall cause the damage to be repaired at the Contractor's expense.

D. All concrete slabs whether suspended or on-grade shall be scanned by the general contractor and/or verified by BYU before demoing, drilling, coring or cutting. It is the responsibility of the general contractor to repair or replace the slab, it's reinforcements and other parts, utilities in the slab and adjacent surfaces as a result of failure to scan the slab.

SECTION 24 - CONDEMNATION OF WORK

A. The Owner or the Architect shall have the right to condemn and require removal of the following at the Contractor's expense:
   1. Any portions of the Work that do not meet the requirements of the Contract either in substance or installation.
   2. Any portions of the work damaged or rendered unsuitable during installation or resulting from the Contractor's failure to properly protect the work.

SECTION 25 - CHANGES IN THE WORK

A. The Owner may make changes within the general scope of the Contract, including but not limited to changes:
1. In the Contract.
2. In the method or manner of performance of the Work.
3. In the Owner-furnished facilities, equipment, materials, or site.
4. In directing acceleration of the Work.

B. Any written order from the Owner or Architect which changes the scope of the work shall be a Change Order.

C. The Architect is authorized to order minor changes during the Work that will not involve significant extra cost or time. The price of such minor changes will be mutually agreed upon between the Project Manager and the Contractor. The Contractor will proceed with the changed work immediately. These minor field changes will subsequently be included in a Change Order.

D. Proposal Requests may be issued which ask the Contractor to submit a price for proposed changes in the scope of the Work. The Contractor is to promptly provide costs associated with the prospective changes, including credits for deleting any unnecessary Work. Cost breakdowns are to be submitted in sufficient detail to verify that the complete scope of the Work is understood by the Contractor, Architect, and Project Manager.

E. Change Orders -
   1. Except for emergencies as covered in Section 8, and to avoid delays, no changes in the work shall be made without a written Change Order. The Contractor's proposal shall be the basis of negotiation for the Change Order price and/or time adjustments.
   2. If the Owner decides it is necessary to proceed with changed work to avoid delay before prices or times have been negotiated, he may order the Contractor to proceed on a time and materials basis or on a mutually agreed not-to-exceed price and time extension. This notice to proceed shall be issued by the Owner's Representative. Upon receipt of such order, the Contractor shall immediately perform the changed work. The Owner and the Contractor will then negotiate the price and/or time when practicable, and a Change Order will be issued.

3. When submitting proposals for Change Orders, the Contractor shall furnish a price breakdown itemizing costs as required by the Owner. Unless otherwise directed, the breakdown shall be in sufficient detail to allow an analysis of all material, labor, equipment, overhead costs and profit, and shall cover all Work involved in the change, whether such Work was deleted or added. Any amount claimed for subcontractors shall be supported by a similar price breakdown. In addition, if the proposal includes a time extension, a justification shall be furnished. The proposal, with the price breakdown and time extension justification, shall be furnished within fourteen (14) days of the date that the first request was made by the Owner's Representative. In such proposals, profit and overhead shall be computed as follows:

a. The Subcontractor's profit and overhead shall not exceed 15% of total direct costs.
b. The Contractor's profit and overhead on work done by his own crews shall not exceed 15% of total direct costs.
c. The Contractor's profit and overhead on work performed by subcontractors shall not exceed 5% of total direct costs or in the case of a CMGC Contract the Contractor's profit and overhead fee on change orders shall not exceed the pre-contract negotiated fee.
d. The subcontractor's profit and overhead on work performed by any of his subcontractors shall not exceed 5% of total direct costs. Contractor's profit and overhead will not exceed 5% of total direct costs.
e. On credit changes, profit and overhead on the originally estimated work will not have to be returned to the Owner.
f. No supervision costs, office managerial costs, or office expenses can be added to Change Orders.
g. Upon signing a Change Order, the Contractor releases the Owner from any further claim for money or time because of the changed work.

SECTION 26 - CLAIMS FOR EXTRA COST

A. If the Contractor intends to assert any additional claim for equitable adjustment of cost or time, he must, within fourteen (14) calendar days of the events or circumstances giving rise to the change, submit to the Architect and the Owner a written statement of the nature and monetary extent of such claim. If a mutually acceptable settlement of the claim cannot be reached within a reasonable time, the parties to the Contract shall handle the matter as a dispute under Section 27 "DISPUTES."

SECTION 27 - DELAYS AND EXTENSION OF TIME

A. All time limits stated in the Contract are of the essence. Contractor agrees to carry out the Work according to the time durations and limits as specified in the Contract.

B. If the Contractor is delayed any time during the progress of the work because of labor disputes, abnormal weather, unusual delays in transportation, or any other causes beyond the Contractor's control, the Contractor may be given additional time to complete the work by Change Order.
   1. All requests for time extensions shall be made in writing to the Project Manager.
      a. Claims for time extension due to abnormal weather shall be made within fourteen (14) days of the abnormal weather.
      b. Claims made beyond these time limits shall not be considered by the Owner.
   2. Requests for time extensions shall be fully documented by including copies of daily logs, letters, shipping orders, delivery tickets and other supporting information.
   3. In case of a continuing cause of delay only one claim is necessary.

SECTION 28 - DISPUTES

A. Except as otherwise provided in the Contract, any dispute concerning a question of fact arising under this Contract that is not disposed of by agreement shall be decided by the Owner's Representative (as represented by the Assistant Administration Vice President/Physical Facilities of Brigham Young University). The decision shall be rendered in writing and mailed or otherwise given to the Contractor. If

the decision is not agreeable to the Contractor, the Contractor will, within fourteen (14) days of the decision, mail or otherwise furnish to the Owner's Representative a written appeal addressed to the Owner.

SECTION 29 - CORRECTION & WARRANTY OF WORK

A. The Contractor shall promptly correct any work that fails to conform to the requirements of the Contract during the progress of the Work. The Contractor shall remedy any defects due to faulty materials, equipment or construction that appear within one year from substantial completion of the Contract or within such longer periods as may be prescribed by law or by the terms of any applicable extended guarantee required by the Contract. The Contractor shall promptly correct all faulty work or pay all costs of correcting the faulty work.

SECTION 30 - OWNER'S RIGHT TO DO WORK

A. If the Contractor defaults or neglects to carry out the Work according to the Contract or fails to perform any provision of the Contract, the Owner may, upon approval of the Architect, after providing seven days written notice to the Contractor and without prejudice to any other remedy Owner may have, make good such deficiencies. In such case, an appropriate Change Order will be issued deducting the cost of correcting such deficiencies, including the cost of the Architect's additional services made necessary by such default, neglect or failure. If the payments due the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner. .

SECTION 31 - CONTRACTOR'S PAY REQUEST

A. The Contractor shall submit to the Project Manager a monthly payment request based on the estimated value of the work completed and materials on the site as of that date. The payment request shall be on the form provided in this document, or on the then-current AIA G702 Application and Certification for Payment (or equivalent) Form. Such payment request shall be based on the schedule of values submitted by the Contractor. The Contractor warrants that title to all work, materials and equipment covered by the payment request, whether incorporated in the Project or not, will pass to the Owner upon the receipt of such payment by the Contractor, free and clear of all liens, claims, security interests or encumbrances. The Project Manager may audit Contractor payments to subcontractors or suppliers anytime.

SECTION 32 - PAYMENTS TO CONTRACTOR

A. Upon approval of the Contractor's monthly payment request, the Owner will, within fourteen (14) days after receipt of said certification, mail to the Contractor a sum equal to 95% of the amount requested, less previous payment thereon. The retention that is withheld by the Owner will be placed in an interest-bearing account and paid to the Contractor after the project is completed and accepted by the Owner.

B. Upon receipt of a payment by the Owner, the Contractor shall pay each subcontractor within fourteen (14) calendar days, the amount allowed to the Contractor for the subcontractor's work.

C. The Contractor's monthly payment request, which shall show the amount paid under the subcontract, shall be made available to the Project Manager for examination. Full and final payment of the Contract amount shall be made within thirty (30) days of the completion of the following requirements:

1. The Architect's and Owner's written acceptance of the work.
2. Payment of all labor and material bills, and receipt of all final lien waivers or lien releases from all subcontractors, mechanics and suppliers.
3. No payment made under this Contract shall be construed to be an acceptance of defective or improper materials or construction.

D. A schedule of dollar values shall be submitted to the Architect and the Owner before the Contractor’s first

payment request will be processed.

E. The schedule of values shall be submitted on the Owner's standard payment request form.
   1. This breakdown shall follow the trade divisions of the specification. Each item shall include its pro rata part of overhead and profit so that the sum of the items will equal the Contract price.
   2. The breakdown will correspond exactly to items of work in the Project schedule including work of subcontractors.

F. The Contractor shall make arrangements to receive all payments from the Owner by direct deposit.

SECTION 33 - PAYMENTS WITHHELD

A. Payments may be withheld from the Contractor by the Owner to protect the Owner from loss due to:
   1. Defective work not remedied.
   2. Liens or claims filed or reasonable evidence of probable filing.
   3. The Contractor's failure to promptly pay subcontractors for labor and materials accepted by the Contractor.
   4. The Architect's or the Project Manager's reasonable doubt that the Project can be completed for the unpaid balance of the Contract price.
   5. Damage to another contractor.
   6. Failure to maintain scheduled progress.

B. Upon satisfactory correction of the above conditions, withheld payments will be made.

SECTION 34 - CONTRACTOR RESPONSIBILITIES

A. The Contractor is fully responsible for the Project and all materials and work until the Owner has accepted the completed Project in writing. The Contractor shall replace or repair, at his own expense, any materials or work damaged or stolen even if the Contractor has received payment for the work or materials.

B. By executing the Contract, the Contractor represents that he has visited the site, familiarized himself with the local conditions under which the Work is to be performed, and correlated his observations with the requirements of the Contract.

C. The Contractor shall employ a competent superintendent satisfactory to the Architect and the Owner. The superintendent shall be present at the Project site during the progress of the Work. This superintendent shall not be changed except with the prior consent of the Project Manager or unless the superintendent ceases to be in the Contractor's employment. The replacement superintendent shall also be subject to these conditions. The superintendent shall represent the Contractor, and all communications given to the superintendent shall be as binding as if given to the Contractor.

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

E. In the event that the Contractor receives purported directions regarding the Work from anyone other than the Project Manager, the Contractor shall forward/direct all communications to the Project Manager.

F. Unless otherwise directed, the Contractor shall, within two (2) hours after the bid opening, furnish the Architect and the Owner a list of the proposed subcontractors who will be working on the Project. The Owner will notify the Contractor in writing if any of the subcontractors are unacceptable.

G. The Contractor shall not contract with any subcontractor who has been rejected by the Owner or the Architect. The Contractor will not be required to contract with any subcontractor, person or organization

against whom he has a reasonable objection if such objection is made before the bid opening. The Contractor is not to use or accept any bid from a subcontractor unless the Contractor is willing and able to work with that subcontractor.

H. If the Owner or the Architect requires a change of any proposed subcontractor or person or organization previously accepted by them, the Contract amount shall be increased or decreased by the difference in cost occasioned by such change and an appropriate Change Order shall be issued.

I. The Contractor shall not make any substitution of a subcontractor who has been accepted by the Owner and the Architect unless the substitution is accepted in writing by the Owner and the Architect. Any increase in cost shall paid by the Contractor.

J. All damage or loss to any property caused in whole or in part by the Contractor, any subcontractor, or by either of their agents, shall be remedied by the Contractor at no cost to the Owner.

K. The Contractor shall be solely responsible for initiating and supervising all safety programs including, but not limited to:
   1. The protection of all persons on the site, including the public.
   2. All conditions specified in this contract.
   3. All conditions required by codes and/or governmental regulations including OSHA.
   4. The protection of all property on the site or affected by the Work.
   5. The Contractor shall designate a responsible member of its organization at the site whose duty will be the prevention of accidents. This person will be Contractor's onsite representative unless otherwise designated in writing by Contractor to Owner and Architect.

L. The Contractor shall be responsible for:
   1. Limiting all Work at the site to Monday through Saturday, between the hours of 7:00 A.M. to 10:00 P.M. No Sunday work is to be performed. Any exceptions to the working hours or days must be made by prior written authorization by the Owner.
   2. Requiring all personnel on site to be appropriately dressed. This includes protective clothing and equipment as needed. Shirts are to be worn at all times.
   3. Limiting all Work at the site according to local noise ordinances or other ordinances.

M. The Contractor's employees shall not be allowed to use radios, boom boxes, etc., are on the site.

N. Renderings representing the Work are the property of the Owner. All photographs of the Work, whether taken during construction or at completion, are the property of the Owner. The Owner reserves all rights including copyrights to renderings and photographs of the Work. Buildings shall not be photographed, and no renderings or photographs shall be taken, obtained, used, or distributed without the prior written consent of the Owner.

O. All information regarding the cost of the Project shall be considered confidential and shall not be disclosed by the Contractor to any third party without the prior written consent of the Owner.

SECTION 35 - SUBCONTRACTORS

A. The Contractor's responsibility for this Project includes the work of all subcontractors and material suppliers, including those recommended or approved by the Owner. The Contractor shall be held responsible to the Owner for proper completion and guarantee of all construction and materials under subcontracts and for the acts and omissions of his subcontractors or their employees. Any warranties required for such work shall be obtained by the Contractor in favor of the Owner and delivered to the Owner. It is expressly agreed that there is no contractual relationship between the Owner and any subcontractor, and under no circumstances shall the Owner be responsible for the nonperformance or financial failure of any subcontractor.

B. The Contractor shall require each subcontractor to agree:
   1. To be bound by terms of the Contract as far as applicable to the subcontractor's work.
   2. To assume toward the Contractor the same obligations the Contractor has assumed toward the Owner, including the prompt payment of his employees and material suppliers affected by this work.
   3. To submit his applications for payment to the Contractor in time to allow the Contractor to make timely application to the Owner.
   4. To execute claim or lien releases or lien waivers as requested by the Contractor for payments made by the Contractor.
   5. To make all claims for extra work or for extensions of time to the Contractor in the same manner the Contractor is to make this type of claim to the Owner.

C. The Contractor agrees in his relationship with the subcontractors:
   1. To bind himself to the subcontractors by all the obligations that the Owner assumes to the Contractor.
   2. To pay the subcontractors within fourteen (14) calendar days upon receipt of payment from the Owner that portion of the funds received as represents the subcontractor's portion of the Work completed to the Contractor's satisfaction for which payment was made by the Owner.

SECTION 36 - LOCKOUT/TAGOUT, CONFINED SPACE, HAZARD COMMUNICATION PROGRAMS, HOT WORK and EXCAVATION PERMIT PROGRAMS

A. The Contractor and the subcontractors will have a written "Lockout/Tagout" program. A copy of this program will be submitted to the Project Manager.

B. The Contractor and subcontractors shall evaluate all work places to determine if any spaces are permit-required confined spaces in accordance with any applicable OSHA regulations. If the workplace contains permit spaces, the Contractor shall inform exposed employees by posting danger signs in compliance with OSHA regulations. If the Contractor decides that its employees will enter permit spaces, the Contractor shall implement a written confined space program. The written program shall be made available to all persons (whether employees of the Contractor or not) and submitted to the Project Manager. The confined space program shall inform the persons that the workplace contains confined spaces that require a permit to enter those spaces. The Contractor shall identify the hazards that may be encountered in the confined space. The Contractor shall specify any precautions or procedures required for the protection of persons in or near confined spaces.

C. Besides complying with the confined space requirements that apply to all employers, the Contractor shall:
   1. Obtain any available information regarding permit space hazards and entry operations.
   2. Coordinate entry operations when both contractor and subcontractor personnel will be working in or near permit spaces.

D. The Contractor shall inform the Project Manager of the methods the Contractor will use to inform all employees on the site of any precautionary measures that need to be taken for protection during the workplace's normal and emergency operating conditions. The Contractor will specify the methods to inform the employees of the labeling system for hazardous materials. The Contractor may rely on an existing hazard communication program to comply with these requirements if it is current with OSHA regulations.

E. The Contractor shall make the written hazard communication program available to all personnel working on the Project and to the Project Manager.

H. In addition to the Hot Work permit required under Section 14, above, the Contractor shall have and implement a Hot Work permitting program that complies with all OSHA regulations. This program must be

communicated to all those who might be involved with Hot Work. Copies of this program shall be made available to the Project Manager upon request.

I. The Contractor shall have and implement a written excavation permitting program that complies with all OSHA regulations. This program must be communicated to all those who might be involved with related work. Pre-task planning and job hazards must be assessed prior to any excavations on the Project. Existing utilities must be identified and procedures put in place to avoid damage or interruptions to existing buildings or operations. Copies of this program shall be made available to the Project Manager upon request.

SECTION 37 - OWNER'S RIGHT TO CANCEL CONTRACT

A. The Contractor shall give the Owner at least twenty-one (21) days written notice before filing any petition for bankruptcy. The Contractor shall be in material breach of the Contract if the Contractor fails to give this notice.

B. Should the Contractor make a general assignment for the benefit of his creditors, or if he should persistently refuse or fail to apply enough properly-skilled workers or proper materials to correctly execute the Work, or if he should fail to make prompt payment to the subcontractors or material suppliers for accepted material or labor, or constantly disregard laws, ordinances or instructions of the Architect and the Owner, or otherwise be guilty of substantial violation of any provision of the Contract, then the Owner may, without any prejudice to any other right or remedy and after giving the Contractor seven (7) days written notice, terminate employment of the Contractor and take possession of the premises and all materials, tools and appliances, and finish the Work by whatever method the Owner deems expedient. In such case, the Contractor shall not be entitled to receive any further payment until the Work is finished. If the unpaid balance of the Contract price exceeds the expense of finishing the Work, including compensation for additional administrative services, such excess shall be paid to the Contractor. If such expense shall exceed the unpaid balance, the Contractor shall pay the difference to the Owner.

SECTION 38 - CONTRACTOR'S RIGHT TO STOP WORK OR TERMINATE CONTRACT

A. If the Work should be stopped under court order, or other public authority for thirty (30) days, or the Owner shall fail to pay the Contractor within thirty (30) days of receipt of a properly prepared and completed payment request, then the Contractor may, on seven (7) days written notice to the Owner and the Architect, terminate this Contract and recover from the Owner the percentage of the Contract price represented by the work completed as of the date of termination with any loss sustained which can be established.

SECTION 39 - SEPARATE CONTRACTS

A. The Owner reserves the right to award separate contracts concerning other portions of the Project under these or similar conditions of the Contract to other contractors.

B. The Contractor shall afford separate contractors reasonable opportunity for the introduction and storage of their materials and equipment and the execution of their work, and shall properly connect and coordinate his work with theirs.

C. If any part of the Contractor's work depends upon the work of another separate contractor, the Contractor shall inspect and promptly report to the Project Manager any apparent discrepancies or defects in such work that render it unsuitable for proper execution and results. Failure of the Contractor to inspect the work is an acceptance of the work of the separate contractor unless defects develop in the other separate contractor's work after the execution of the Contractor's work.

SECTION 40 - ASSIGNMENT

A. The Contractor shall not assign or sublet this Contract or any part of it or any monies due him without prior written consent of the Owner.

SECTION 41 - LIQUIDATED DAMAGES

A. For each calendar day that the Work or any portion of the Work remains incomplete after the expiration of the time limit set in the Contract or by Change Order, the amount per calendar day shown in the Supplementary Conditions will be deducted from the money due or to become due to the Contractor. This deduction is not a penalty, but is liquidated damages and may include additional expenses such as administrative and inspection costs.

B. At the time of substantial completion, and after the meeting to certify substantial completion, the Owner, Architect and Contractor shall agree upon the time that will be allowed for the Contractor to complete the remaining Work on the Project. If the Contractor does not complete the Work within the agreed time, the liquidated damages will continue at a reduced amount as stated in the Supplementary Conditions. The liquidated damages shall be in full force and effect, not as a penalty but as liquidated damages for each additional calendar day it takes to complete the Project. If liquidated damages are required, they shall be accrued and deducted from the money due the Contractor.

SECTION 42 - ACCELERATION OF WORK

A. If, in the judgment of the Architect or the Owner, it becomes necessary at any time to accelerate the Work or part of it, the Contractor shall deploy the workers in such portions of the Project to enable others to properly engage and carry on their work. If circumstances require that the entire Work or a portion of it be completed at a date earlier than the Contract completion date as adjusted by Change Orders, the Contractor shall increase his forces, equipment, hours of work, or number of shifts, and shall speed delivery of materials to meet the altered completion date or dates ordered or directed. Any increase in cost to the Contractor according to such orders or directives will be adjusted by Change Order.

B. If the Work is behind schedule and the rate of placement of work is inadequate to regain scheduled progress, the Contractor shall immediately take action to ensure timely completion of the Work.
   1. This shall be accomplished by any one or a combination of the following or other suitable measures:
      a. An increase in working forces.
      b. An increase in equipment or tools.
      c. An increase in hours of work or number of shifts.
      d. Expediting delivery of materials.
   2. The Contractor shall notify the Project Manager of specific measures taken or planned to increase the rate of progress with an estimate of when scheduled progress will be regained.
   3. Acceleration of work will continue until scheduled progress is regained. Scheduled progress shall be established from the latest revised and approved Project schedule for the job.
   4. Timely completion will be understood as the Contract completion date as revised by all time extensions.
   5. The Contractor shall not be entitled to additional compensation for efforts to regain scheduled progress.

SECTION 43 - CONTRACTOR'S QUALITY CONTROL

A. MATERIAL QUALITY
   1. Materials incorporated into the Project shall be new except as otherwise indicated in the specifications. Materials shall be of specified quality and furnished in sufficient quantity to simplify proper and timely execution of the Work.
   2. The Contractor shall furnish evidence of the quality of materials incorporated into the Project as required by the Contract or at request of the Architect or the Project Manager.
   3. Materials not meeting requirements of the Contract shall be removed from the Project and replaced with materials meeting the Contract requirements by the Contractor at no additional expense to the Owner.

B. ASBESTOS

1. The Contract has been prepared following generally accepted professional architectural and engineering practices. Accordingly, no asbestos or products containing asbestos have been knowingly specified for this Project. The Contractor agrees to notify the Project Manager immediately for instructions if:
   a. Materials containing asbestos are brought to the site for inclusion in the Work.
   b. Asbestos materials are encountered in any existing structures upon which work is being done.
2. At the Architect's direction and with the Owner's approval, an independent testing laboratory will perform testing procedures on suspect materials at Owner's expense.
3. The Contractor shall certify, based upon his best knowledge, information, inspection and belief, that no building materials containing asbestos were used in the construction of the Project. The Contractor will submit certification on form provided by the Owner.

SECTION 44 - TEMPORARY OR TRIAL USAGE OF ANY MECHANICAL DEVICES

A. Temporary or trial usage by the Owner of mechanical devices, machinery, apparatus, elevators, equipment or other work or materials supplied under this Contract before written acceptance by the Owner shall not be construed as evidence of the Owner's acceptance.

SECTION 45 - PROJECT CLOSEOUT

A. FINAL CLEANING

1. Upon completion of the Work, the Contractor shall remove all tools, scaffolding, surplus materials and all rubbish from under and about the building. The Contractor shall leave the building clean and habitable, having thoroughly swept or vacuumed floors, cleaned windows and dusted flat surfaces such as cabinet tops and window sills.
2. Besides general cleaning noted above, the Contractor shall do the following special cleaning for all trades at the completion of the work:
   a. Remove putty or caulking stains from glass. Wash and polish inside and outside, exercising care not to scratch glass.
   b. Remove marks, stains, fingerprints, other soil and dirt from painted, decorated and stained work.
   c. Clean and polish woodwork.
   d. Clean and polish hardware for all trades. This shall include removal of stains, dust, dirt, paint and other similar materials.
   e. Remove spots, soil and paint. Wash tile work.
   f. Clean fixtures and equipment, and remove stains, paint, dirt and dust.
   g. Remove temporary floor protection and clean floors. Spray and buff resilient flooring.
   h. Clean exterior and interior metal surfaces, including doors and windows, required to have polished finishes. Remove oils, stains, dust, and dirt. Polish surfaces, leaving them without fingerprints or other blemishes.
3. If the Contractor fails to clean up, the Owner may do so and the cost will be withheld from the Contractor's final payment.

B. PROJECT RECORD DOCUMENTS

The Contractor shall deliver to the Architect before the substantial completion inspection:

1. Accurate Project "record" drawings, including redline drawings.
2. Certificates of occupancy that may be required by Authorities Having Jurisdiction over the work.

C. OPERATING & MAINTENANCE DATA

Before execution of the certificate of substantial completion, the Contractor shall furnish the operating instructions and maintenance manuals as called for in the Contract.

D. WARRANTIES & GUARANTEES

1. When written guarantees beyond one year after substantial completion are required of any section of the Work, the Contractor shall secure such guarantees properly addressed and signed and in favor

of the Owner. These documents shall be delivered to the Project Manager upon substantial completion of the Contractor's work and before execution of the certificate of substantial completion.

2. Delivery of guarantees and warranties shall not relieve the Contractor from any obligation assumed under any other provisions of his Contract.
3. Nothing within the Contract intends or implies that guarantees shall apply to work abused or neglected by the Owner.

E. PRE-SUBSTANTIAL, SUBSTANTIAL, & FINAL COMPLETION INSPECTIONS

1. Pre-Substantial Completion Inspection:
   a. Upon the Contractor's request and if the request is accompanied by a punch list prepared by the Contractor, the Project Manager and the Architect will make inspections and furnish a list of additional items to be corrected or completed by the Contractor.
   b. The Contractor shall notify the Project Manager when items have been corrected or completed. Upon the Project Manager's verification of correction, the Project Manager will arrange a substantial completion inspection to include the Owner, Architect, engineers and college representatives.

2. Substantial Completion Inspection:
   a. At the substantial completion inspection, unless the Work is rejected, the Architect may execute a certificate of substantial completion (to be signed by the Architect, Owner and Contractor) that states the dates for:
      (1) User occupancy,
      (2) Commencement of warranties,
      (3) Final completion inspection,
      (4) Modifications to the amount assessed for liquidated damages.
   b. After inspection, the Architect will furnish a final list of items to be corrected.
   c. The Owner, Architect and Contractor will decide how much time is to be allowed for completion of the items.
3. Final Completion Inspection:
   a. Final Completion Inspection will ensure that all deficiencies noted at the substantial completion inspection have been corrected.
   b. When all items have been corrected, the Project Manager will process the final payment and send a final completion letter indicating the final completion date to the Contractor.
   c. If all items have not been corrected as agreed, the Owner may elect to complete the work under provisions of Section 29 of the General Conditions.
   d. All lien waivers and releases are to be submitted before final payment can be made.
   e. A copy of the final payment consent form will be obtained from the surety/bonding company.

SECTION 46 - OWNER-PURCHASED MATERIALS AND EQUIPMENT

A. The Owner desires to purchase certain materials which will be utilized in the Work. Contractor's duties with respect to Owner-purchased materials are:

1. Scheduling:
   a. The Contractor shall furnish the Owner with a schedule of dates on which the Contractor requires delivery of Owner-purchased materials. The Owner will arrange for the materials to be delivered to the construction site on or before the specified dates. If delivery dates are changed, rescheduled, or otherwise varied from the original schedule, the Contractor shall notify the Owner in writing of delivery date rescheduling and the Contractor shall coordinate the delivery of the Owner-purchased materials directly with the supplier.
2. Pre-Installation Inspection:
   a. The Contractor shall be responsible for receiving, inspecting and storing all Owner-purchased materials until the materials are needed for installation by the Contractor. Regardless of any inspection performed by the Owner of the Owner-purchased materials, the Contractor shall be responsible for inspecting the Owner-purchased materials to determine suitability, quality and conformance with specifications before installation or at such other

time as the Contractor may desire in order to avoid interruptions and delays in the progress of the Project. The Contractor shall reject any material which does not meet specifications or which appears to have any defect which may make the material unsuitable for use in the Project. The Contractor shall notify the Owner and the manufacturer or supplier of all defects and assist the Owner in arranging for the repair, replacement or correction of the defective condition. The Contractor shall not be entitled to an extension of any deadline or completion date which results from failure to discover defects which the Contractor should have discovered through an inspection.

3. Defective Materials:
   a. The Contractor acknowledges that use of improper or defective material may result in costs and damages to the Owner in excess of the value of the materials; that after use in the Project it may be difficult or impossible to inspect the material to determine the cause of any failure; and that in the event of the failure of material there may be a question as to the cause of the failure. Because the Contractor's employees will be the last to handle and inspect material prior to incorporation into the Project, the Contractor will be liable to the Owner for damages resulting from failure of Owner-purchased materials during the Contractor's warranty period specified herein from any cause whatsoever unless the Contractor provides clear and convincing proof that (1) the entire loss from a failure is covered by a valid manufacturer's or supplier's warranty, or (2) the Contractor could not have prevented the failure by complying with the requirements of this Section concerning Owner-purchased materials.

4. Claims:
   a. The Contractor agrees to assist the Owner to present claims to manufacturers and suppliers for defects in Owner-purchased materials. Where there is any question as to the division of liability between the Contractor and a manufacturer or vendor, the Contractor shall provide all relevant information in the Contractor's possession which may aid the Owner in determining the division of responsibility. The Owner shall have final approval of any proposed adjustment or settlement of warranty claims.
5. Implied Warranties:
   The benefit of contractual and implied warranties with respect to Owner-purchased materials shall run to the Owner and not to the Contractor.
6. Unloading:
   Except as otherwise provided herein, the Contractor shall be responsible for unloading all Owner-purchased materials and verifying delivery amounts to the Owner.
7. Custody and Security:
   The Contractor shall use reasonable care in protecting Owner-purchased materials from loss, deterioration, damage, theft, vandalism or destruction.
8. Reports:
   At Owner's request, the Contractor shall furnish reports to the Project Manager demonstrating the Contractor's compliance with this Section.
9. Retained Ownership:
   All materials purchased by the Owner which remain after completion of the Project shall be the property of the Owner. If the Owner does not wish to retain or dispose of surplus Owner-purchased materials, the Contractor shall remove and dispose of them.

10. Rights of Ownership:

    None of the foregoing duties of the Contractor with respect to Owner-purchased materials shall prevent the Owner from exercising any prerogative of ownership of the materials.

SECTION 47 - OWNER'S SALES TAX EXEMPT STATUS

A. Contractor and subcontractors are authorized to purchase Construction Materials on behalf of Brigham Young University free of Utah sales tax, as defined by applicable Utah State Tax Rule. The grant of this contractual right is conditioned upon and made subject to the following:
   1. The construction materials must be installed or converted into real property owned by Brigham Young University and may not be used for any purpose other than constructing the Project.
   2. All construction materials purchased without sales tax must be clearly identified and segregated at all times between the time of purchase and time of installation into the Project.
   3. Contractor and subcontractors will comply with such instructions and guidance as Brigham Young University may issue from time to time to implement Tax Commission requirements for the sales tax exemption on construction materials.

B. Brigham Young University will provide the Contractor with the Sales Tax Exemption Certificate.

SECTION 48 – FOREIGN PRODUCTS AND CURRENCY

A. All foreign product costs shall be negotiated in U.S. dollars. Owner will not assume any risk for currency fluctuations after bidding. Contractor assumes all responsibility for any change in costs due to foreign currency fluctuations if the Contractor chooses to negotiate product costs in a foreign currency.

SUPPLEMENTARY CONDITIONS

SECTION 1--COMMENCEMENT, PROSECUTION & COMPLETION OF THE WORK

A. The Contractor shall be required to commence work after receipt of the contract from the Owner.

B. The Contractor shall prosecute the work diligently so as to complete it within the time limit allowed in this document.

C. The Contractor agrees to complete this work required by the Contract on or before midnight 16 August 2024.

D. Time is hereby expressly declared to be of the essence of the Contract.

SECTION 2--LIQUIDATED DAMAGES

A. The amount agreed upon and established as liquidated damages up to substantial completion is $300 per calendar day.

B. At the time of substantial completion the Owner and the Contractor will agree on how much time will be allowed for the Contractor to complete the remaining work. If the Contractor exceeds the time allowed, liquidated damages will continue at one third (1/3) of the amount of the original liquidated damages or $300 per calendar day.

SECTION 3--FIRE/SMOKE ALARMS

A. The Contractor shall be charged $1,000.00 for any fire alarm or smoke alarm that is caused by the Contractor and disrupts the building occupants. BYU fire alarm technicians are available to answer any questions concerning the alarm systems. The Contractor is to contact the Project Manager to coordinate alarm technicians.

SECTION 4—EXISTING UTILITIES

A. Prior to execution of the work the contractor is to locate all existing vaults, manholes, valves, meters, etc. Contractor is to photograph, GPS, measure from existing structures and facilities that are to remain and keep this information readily available at the site/construction trailer. Contractor is also to mark the above utilities by staking and maintaining stakes for fast and accurate locating of all existing utilities in case of emergencies.

B. BYU will initially provide all on campus blue staking information. It is the contractor's responsibility to maintain the blue staking locations and information by staking, painting, keeping GPS coordinated or any alternative ways that the contractor can keep current, accurate information.

SECTION 5—CONTRACTOR WORKING HOURS

A. No work will be performed between the hours of 10:00 p.m. and 7 a.m. without prior written authorization or in case of emergency situation approved by BYU Project Manager. No work is allowed on Sunday.

SECTION 6—BUILDER'S RISK INSURANCE

Section 13 of the General Conditions is deleted in its entirety and replaced with the following:

SECTION 13—BUILDERS RISK LOSSES

A. If the Contract Sum is over $100,000, prior to performing any work, Contractor will obtain and maintain during the term of this Agreement All-Risk Builders Risk Insurance Policy – ISO Form CP 00 20 (10/12), Builders' Risk Coverage (or equivalent) and ISO Form CP 10 30 (10/12), Causes of Loss Special Form, including coverage for flood, or equivalent insurance forms, with Limits of Insurance in the amount of the Contract Sum. An installation floater may be used, if approved in writing by Owner. The Policy will:

a. cover materials stored at temporary storage locations and materials in transit;
b. include Owner and all Subcontractors as additional named insureds;
c. be subject to a deductible payable by Contractor of not less than $2,500 per occurrence of any loss, which will be the responsibility of Contractor and will not be included in the Cost of the Work or be a reimbursable expense; and
d. provide that such insurance is primary, non-contributory and not excess coverage.

B. Contractor will provide evidence of this insurance coverage to Owner by providing, if applicable, a Certificate of Insurance on ACORD 27, Evidence of Property Insurance, for the Builder's Risk Insurance Policy, identifying the Project as defined in the Contract, submitted to Owner, attaching the endorsement giving evidence that the Owner and all Subcontractors are listed as named insureds on the Builder's Risk Policy.

Contact the BYU Construction Department (construction@byu.edu) for an electronic Excel version of this form.

Brigham Young University

Physical Facilities -- Construction Department

MONTHLY PAYMENT REQUEST

Date _____
Request No. _____
Period From _____ to _____
TAX ID# _____

Payable To:
Contractor _____
Address _____
City, State, Zip _____

Project Name _____
Project No. _____
Contract No. _____
Contract Date _____

APPLICATION FOR PAYMENT

HOLD FOR PICKUP ☐

1. ORIGINAL CONTRACT AMOUNT		$ -
2. NET CHANGE BY CHANGE ORDERS		$ -
3. CONTRACT AMOUNT TO DATE (line 1 plus line 2)		$ -
4. TOTAL EARNED (work completed and materials stored to date)		$ -
5. **AMOUNT THIS REQUEST**		$ -
6a. RETAINAGE HELD THIS REQUEST (5% of line 5)	$ -	
6b. RETAINAGE RELEASED THIS REQUEST	$ -	
6c. RETAINAGE RELEASED TO DATE (total of line 6b above plus previous pay app line 6c)	$ -	
6d. TOTAL HELD RETAINAGE TO DATE (5% of line 4 minus line 6c)		$ -
7. TOTAL EARNED LESS RETAINAGE HELD TO DATE (line 4 minus line 6d)		$ -
8. LESS PREVIOUS PAYMENTS (line 7 from previous pay app)		$ -
9. **CURRENT PAYMENT DUE** (line 7 minus line 8) (to check take line 5 minus line 6a plus line 6b)		$ -
10. BALANCE TO FINISH, Including Retainage (line 3 minus Line 4 plus Line 6d)	$ -	

Contractor's Representative _____
Date _____

Owner's Representative _____
Date _____

Project Manager _____ Date _____
Director of Construction _____
Director of Planning _____
Accounting _____
Architect _____

Legend
data input

SCHEDULE of VALUES

Project Name _____ **Contractor** _____

Item NO.	DESCRIPTION	Subcontractor or Supplier	% Item of Total	CONTRACT Amount	% THIS ESTIMATE	AMOUNT THIS ESTIMATE	% TO DATE	AMOUNT TO DATE	% of Rentention	Retention Withheld
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
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27										
28										
29										
30										
31										
32										
TOTALS										

SECTION 013000

ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General administrative requirements.
B. Preconstruction meeting.
C. Progress meetings.
D. Construction progress schedule.
E. Contractor's daily reports.
F. Progress photographs.
G. Submittals for review, information, and project closeout.
H. Number of copies of submittals.
I. Requests for Interpretation (RFI) procedures.
J. Submittal procedures.

1.02 RELATED REQUIREMENTS

A. Section 00 00000 - BYU Standard Contract Requirements
B. Section 016000 - Product Requirements: General product requirements.

1.03 GENERAL ADMINISTRATIVE REQUIREMENTS

A. Conform to requirements of Section 017000 - Execution and Closeout Requirements for coordination of execution of administrative tasks with timing of construction activities.
B. Make the following types of submittals to Architect:
    1. Requests for Interpretation (RFI).
    2. Requests for substitution.
    3. Shop drawings, product data, and samples.
    4. Design data.
    5. Manufacturer's instructions and field reports.
    6. Progress schedules.
    7. Coordination drawings.
    8. Correction Punch List and Final Correction Punch List for Substantial Completion.
    9. Closeout submittals.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PRECONSTRUCTION MEETING

A. Owner will schedule a meeting after Notice of Award.
B. Attendance Required:
    1. Owner.

I, Bruce T. Fallon, AIA the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers.

Signature & Date: 03.15.2024

2. Architect.
3. Contractor.

C. Agenda:
1. Execution of Owner-Contractor Agreement.
2. Submission of executed bonds and insurance certificates.
3. Distribution of Contract Documents.
4. Submission of list of subcontractors, list of products, schedule of values, and progress schedule.
5. Submission of initial Submittal schedule.
6. Designation of personnel representing the parties to Contract, _____ and Architect.
7. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
8. Scheduling.
9. Scheduling activities of a Geotechnical Engineer.

D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.02 PROGRESS MEETINGS

A. Schedule and administer meetings throughout progress of the work at maximum weekly intervals.

B. Architect will prepare agenda with copies for participants and will conduct the meeting.

C. Attendance Required:
1. Contractor.
2. Owner.
3. Architect.
4. Contractor's superintendent.
5. Subcontractors by invitation.

D. Agenda:
1. Review minutes of previous meetings.
2. Review overall project schedule. Are we on schedule?
3. Review project budget and potential change orders.
4. Review of work progress.
5. Field observations, problems, and decisions.
6. Identification of problems that impede, or will impede, planned progress.
7. Review of submittals schedule and status of submittals.
8. Review of RFIs log and status of responses.
9. Review of off-site fabrication and delivery schedules.
10. Maintenance of progress schedule.
11. Corrective measures to regain projected schedules.
12. Review three week rolling schedule.
13. Maintenance of quality and work standards.
14. Effect of proposed changes on progress schedule and coordination.
15. Other business relating to work.

E. Architect will record meeting minutes and distribute copies to those who attended the meeting within two days following the meeting.

3.03 CONSTRUCTION PROGRESS SCHEDULE

A. Within 10 days after date of the Agreement, submit preliminary schedule defining planned operations for the first 60 days of work, with a general outline for remainder of work.

B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.

I, Bruce T. Fallon, AIA the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers.

Signature & Date: 03.15.2024

C. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.

3.04 DAILY CONSTRUCTION REPORTS

A. Include only factual information. Do not include personal remarks or opinions regarding operations and/or personnel.

B. Prepare a daily construction report recording the following information concerning events at Project site and project progress:
   1. Date.
   2. High and low temperatures, and general weather conditions.
   3. List of subcontractors at Project site.
   4. Approximate count of personnel at Project site.
      a. Include a breakdown for supervisors, laborers, journeymen, equipment operators, and helpers.
   5. Major equipment at Project site.
   6. Material deliveries.
   7. Safety, environmental, or industrial relations incidents.
   8. Meetings and significant decisions.
   9. Unusual events (submit a separate special report).
   10. Stoppages, delays, shortages, and losses. Include comparison between scheduled work activities (in Contractor's most recently updated and published schedule) and actual activities. Explain differences, if any. Note days or periods when no work was in progress and explain the reasons why.
   11. Meter readings and similar recordings.
   12. Emergency procedures.
   13. Directives and requests of Authority(s) Having Jurisdiction (AHJ).
   14. Change Orders received and implemented.
   15. Testing and/or inspections performed.
   16. List of verbal instruction given by Owner and/or Architect.
   17. Signature of Contractor's authorized representative.

3.05 PROGRESS PHOTOGRAPHS

A. Maintain one set of all photographs at project site for reference.

B. In addition to periodic, recurring views, take photographs of each of the following events:
   1. Completion of site clearing.
   2. Excavations in progress.
   3. Foundations in progress and upon completion.
   4. Structural framing in progress and upon completion.
   5. Enclosure of building, upon completion.
   6. Final completion, minimum of ten (10) photos.

3.06 REQUESTS FOR INTERPRETATION (RFI)

A. Definition: A request seeking one of the following:
   1. An interpretation, amplification, or clarification of some requirement of Contract Documents arising from inability to determine from them the exact material, process, or system to be installed; or when the elements of construction are required to occupy the same space (interference); or when an item of work is described differently at more than one place in the Contract Documents.
   2. A resolution to an issue which has arisen due to field conditions and affects design intent.

I, Bruce T. Fallon, AIA the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers.

Signature & Date: 03.15.2024

B. Preparation: Prepare an RFI immediately upon discovery of a need for interpretation of the Contract Documents. Failure to submit a RFI in a timely manner is not a legitimate cause for claiming additional costs or delays in execution of the work.
   1. Prepare a separate RFI for each specific item.
      a. Review, coordinate, and comment on requests originating with subcontractors and/or materials suppliers.
      b. Do not forward requests which solely require internal coordination between subcontractors.
   2. Prepare in a format and with content acceptable to Owner.

C. Reason for the RFI: Prior to initiation of an RFI, carefully study all Contract Documents to confirm that information sufficient for their interpretation is definitely not included.
   1. Include in each request Contractor's signature attesting to good faith effort to determine from the Contract Documents information requiring interpretation.
   2. Unacceptable Uses for RFIs: Do not use RFIs to request the following::
      a. Approval of submittals (use procedures specified elsewhere in this section).
      b. Approval of substitutions (see Section - 016000 - Product Requirements)
      c. Changes that entail change in Contract Time and Contract Sum (comply with provisions of the Conditions of the Contract).
   3. Improper RFIs: Requests not prepared in conformance to requirements of this section, and/or missing key information required to render an actionable response. They will be returned without a response, with an explanatory notation.

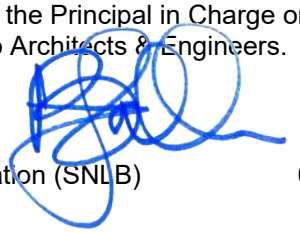
D. Content: Include identifiers necessary for tracking the status of each RFI, and information necessary to provide an actionable response.
   1. Official Project name and number, and any additional required identifiers established in Contract Documents.
   2. Owner's, Architect's, and Contractor's names.
   3. Discrete and consecutive RFI number, and descriptive subject/title.
   4. Issue date, and requested reply date.
   5. Reference to particular Contract Document(s) requiring additional information/interpretation. Identify pertinent drawing and detail number and/or specification section number, title, and paragraph(s).
   6. Annotations: Field dimensions and/or description of conditions which have engendered the request.
   7. Contractor's suggested resolution: A written and/or a graphic solution, to scale, is required in cases where clarification of coordination issues is involved, for example; routing, clearances, and/or specific locations of work shown diagrammatically in Contract Documents. If applicable, state the likely impact of the suggested resolution on Contract Time or the Contract Sum.

E. Attachments: Include sketches, coordination drawings, descriptions, photos, submittals, and other information necessary to substantiate the reason for the request.

F. RFI Log: Prepare and maintain a tabular log of RFIs for the duration of the project.
   1. Indicate current status of every RFI. Update log promptly and on a regular basis.
   2. Note dates of when each request is made, and when a response is received.
   3. Highlight items requiring priority or expedited response.
   4. Highlight items for which a timely response has not been received to date.

G. Review Time: Architect will respond and return RFIs to Contractor within seven calendar days of receipt. For the purpose of establishing the start of the mandated response period, RFIs received after 12:00 noon will be considered as having been received on the following regular working day.
   1. Response period may be shortened or lengthened for specific items, subject to mutual agreement, and recorded in a timely manner in progress meeting minutes.

I, Bruce T. Fallon, AIA the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers.

Signature & Date:  03.15.2024

H. Responses: Content of answered RFIs will not constitute in any manner a directive or authorization to perform extra work or delay the project. If in Contractor's belief it is likely to lead to a change to Contract Sum or Contract Time, promptly issue a notice to this effect, and follow up with an appropriate Change Order request to Owner.
   1. Response may include a request for additional information, in which case the original RFI will be deemed as having been answered, and an amended one is to be issued forthwith. Identify the amended RFI with an R suffix to the original number.
   2. Do not extend applicability of a response to specific item to encompass other similar conditions, unless specifically so noted in the response.
   3. Upon receipt of a response, promptly review and distribute it to all affected parties, and update the RFI Log.
   4. Notify Architect within seven calendar days if an additional or corrected response is required by submitting an amended version of the original RFI, identified as specified above.

3.07 SUBMITTAL SCHEDULE

A. Submit to Architect for review a schedule for submittals in tabular format.
   1. Coordinate with Contractor's construction schedule and schedule of values.
   2. Format schedule to allow tracking of status of submittals throughout duration of construction.
   3. Arrange information to include scheduled date for initial submittal, specification number and title, submittal category (for review or for information), description of item of work covered, and role and name of subcontractor.
   4. Account for time required for preparation, review, manufacturing, fabrication and delivery when establishing submittal delivery and review deadline dates.
      a. For assemblies, equipment, systems comprised of multiple components and/or requiring detailed coordination with other work, allow for additional time to make corrections or revisions to initial submittals, and time for their review.

3.08 SUBMITTALS FOR REVIEW

A. When the following are specified in individual sections, submit them for review:
   1. Product data.
   2. Shop drawings.
   3. Samples for selection.
   4. Samples for verification.

B. Submit to Architect for review for the limited purpose of checking for conformance with information given and the design concept expressed in the contract documents.

C. Samples will be reviewed for aesthetic, color, or finish selection.

D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 017800 - Closeout Submittals.

3.09 SUBMITTALS FOR INFORMATION

A. When the following are specified in individual sections, submit them for information:
   1. Design data.
   2. Certificates.
   3. Test reports.
   4. Inspection reports.
   5. Manufacturer's instructions.
   6. Manufacturer's field reports.
   7. Other types indicated.

B. Submit for Architect's knowledge as contract administrator or for Owner.

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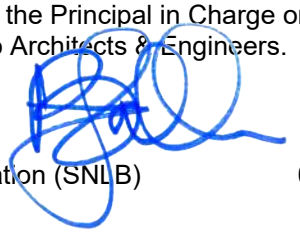
Signature & Date:  03.15.2024

3.10 SUBMITTALS FOR PROJECT CLOSEOUT

A. Submit Correction Punch List for Substantial Completion.

B. Submit Final Correction Punch List for Substantial Completion.

C. When the following are specified in individual sections, submit them at project closeout in conformance to requirements of Section 017800 - Closeout Submittals:
   1. Project record documents.
   2. Operation and maintenance data.
   3. Warranties.

D. Submit for Owner's benefit during and after project completion.

3.11 NUMBER OF COPIES OF SUBMITTALS

A. Electronic Documents: Submit one electronic copy in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.

B. Documents for Review:
   1. Small Size Sheets, Not Larger Than 11 x 17 inches: Submit one copy; the Contractor shall make his own copies from original returned by the Architect after making his own file copy.

C. Samples: Submit the number specified in individual specification sections; one of which will be retained by Architect.
   1. After review, produce duplicates.
   2. Retained samples will not be returned to Contractor unless specifically so stated.

3.12 SUBMITTAL PROCEDURES

3.13 COMPLY WITH BYU STANDARD CONTRACT REQUIREMENTS.

A. General Requirements:
   1. Sequentially identify each item. For revised submittals use original number and a sequential numerical suffix.
   2. Identify: Project; Contractor; subcontractor or supplier; pertinent drawing and detail number; and specification section number and article/paragraph, as appropriate on each copy.
   3. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the work and Contract Documents.
      a. Submittals from sources other than the Contractor, or without Contractor's stamp will not be acknowledged, reviewed, or returned.
   4. Deliver each submittal on date noted in submittal schedule, unless an earlier date has been agreed to by all affected parties, and is of the benefit to the project.
      a. Send submittals in electronic format via email to Architect.
   5. Schedule submittals to expedite the Project, and coordinate submission of related items.
      a. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.
      b. For sequential reviews involving Architect's consultants, Owner, or another affected party, allow an additional 7 days.
   6. Provide space for Contractor and Architect review stamps.
   7. When revised for resubmission, identify all changes made since previous submission.
   8. Distribute reviewed submittals. Instruct parties to promptly report inability to comply with requirements.

B. Product Data Procedures:
   1. Submit only information required by individual specification sections.
   2. Collect required information into a single submittal.
   3. Do not submit (Material) Safety Data Sheets for materials or products.

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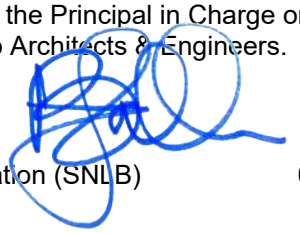
Signature & Date:  03.15.2024

C. Shop Drawing Procedures:
   1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting the Contract Documents and coordinating related work.
   2. Generic, non-project-specific information submitted as shop drawings do not meet the requirements for shop drawings.

D. Samples Procedures:
   1. Transmit related items together as single package.
   2. Identify each item to allow review for applicability in relation to shop drawings showing installation locations.

3.14 SUBMITTAL REVIEW

A. Submittals for Review: Architect will review each submittal, and approve, or take other appropriate action.

B. Architect's actions will be reflected by marking each returned submittal using virtual stamp on electronic submittals.

C. Architect's and his consultants' actions on items submitted for review:
   1. Authorizing purchasing, fabrication, delivery, and installation:
      a. "Approved", or language with same legal meaning.
      b. "Approved as Noted, Resubmission not required", or language with same legal meaning.
         1) At Contractor's option, submit corrected item, with review notations acknowledged and incorporated.
      c. "Approved as Noted, Resubmit for Record", or language with same legal meaning.
         1) Resubmit corrected item, with review notations acknowledged and incorporated. Resubmit separately, or as part of project record documents.
   2. Not Authorizing fabrication, delivery, and installation:
      a. "Revise and Resubmit".
         1) Resubmit revised item, with review notations acknowledged and incorporated.
      b. "Rejected".
         1) Submit item complying with requirements of Contract Documents.

D. No Part of this section relieves the Contractor of the responsibility to comply with the Contract Documents.

END OF SECTION

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SECTION 014000

QUALITY REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Submittals.
B. Quality assurance.
C. References and standards.
D. Testing and inspection agencies and services.
E. Control of installation.
F. Mock-ups.
G. Tolerances.
H. Manufacturers' field services.
I. Defect Assessment.

1.02 RELATED REQUIREMENTS

A. Section 013000 - Administrative Requirements: Submittal procedures.
B. Section 016000 - Product Requirements: Requirements for material and product quality.

1.03 REFERENCE STANDARDS

A. ASTM C1021 - Standard Practice for Laboratories Engaged in Testing of Building Sealants; 2008 (Reapproved 2014).
B. ASTM C1077 - Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation; 2017.
C. ASTM C1093 - Standard Practice for Accreditation of Testing Agencies for Masonry; 2015a, with Editorial Revision (2016).
D. ASTM D3740 - Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction; 2012a.
E. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection; 2014a.
F. IAS AC89 - Accreditation Criteria for Testing Laboratories; 2017.
G. Codes and Regulations Adopted by the State of Utah and Local Jurisdiction.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.
B. Design Data: Submit for Architect's knowledge for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents, or for Owner's information.
C. Test Reports: After each test/inspection, promptly submit a digital or one paper copies of report to owner, Architect and to Contractor.
    1. Include:
        a. Date issued.
        b. Project title and number.
        c. Name of inspector.
        d. Identification of product and specifications section.

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e. Location in the Project.
f. Type of test/inspection.
g. Date of test/inspection.
h. Results of test/inspection.
i. Conformance with Contract Documents.

2. Test report submittals are for Architect's knowledge as for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents, or for Owner's information.

D. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Architect, in quantities specified for Product Data.
1. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

E. Manufacturer's Instructions: When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, for the Owner's information. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

F. Erection Drawings: Submit drawings for Architect's benefit or for Owner.
1. Submit for information for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents.
2. Data indicating inappropriate or unacceptable Work may be subject to action by Architect or Owner.

1.05 QUALITY ASSURANCE

A. Testing Agency Qualifications:
1. Prior to start of Work, submit agency name, address, and telephone number, and names of full time registered Engineer and responsible officer.
2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.
3. Qualification Statement: Provide documentation showing testing laboratory is accredited under IAS AC89.

1.06 REFERENCES AND STANDARDS

A. For products and workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. Conform to reference standard of date of issue current on date of Contract Documents, except where a specific date is established by applicable code.

C. Obtain copies of standards where required by product specification sections.

D. Maintain copy at project site during submittals, planning, and progress of the specific work, until Substantial Completion.

E. Should specified reference standards conflict with Contract Documents, request clarification from Architect before proceeding.

F. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of Architect shall be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.07 TESTING AND INSPECTION AGENCIES AND SERVICES

A. Owner will employ and pay for services of an independent testing agency to perform specified testing.

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B. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.

B. Comply with manufacturers' instructions, including each step in sequence.

C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.

D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Have Work performed by persons qualified to produce required and specified quality.

F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.

G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

3.02 MOCK-UPS

A. Before installing portions of the Work where mock-ups are required, construct mock-ups in location and size indicated for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work. The purpose of mock-up is to demonstrate the proposed range of aesthetic effects and workmanship.

B. Accepted mock-ups establish the standard of quality the Architect will use to judge the Work.

C. Integrated Exterior Mock-ups: construct integrated exterior mock-up as indicated on Drawings. Coordinate installation of exterior envelope materials and products as required in individual Specification Sections. Provide adequate supporting structure for mock-up materials as necessary.

D. Provide a schedule that describes when mock-ups and "first-install" items are available for owner review.

E. Notify Architect and owner fifteen (15) working days in advance of dates and times when mock-ups will be constructed.

F. Provide supervisory personnel who will oversee mock-up construction. Provide workers that will be employed during the construction at Project.

G. Tests shall be performed under provisions identified in this section and identified in the respective product specification sections.

H. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.

I. Obtain Architect's approval of mock-ups before starting work, fabrication, or construction.
   1. Architect will issue written comments within five (5) working days of initial review and each subsequent follow up review of each mock-up.
   2. Make corrections as necessary until Architect's approval is issued.

J. Accepted mock-ups shall be a comparison standard for the remaining Work.

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K. Where mock-up has been accepted by Architect and is specified in product specification sections to be removed, protect mock-up throughout construction, remove mock-up and clear area when directed to do so by Architect.

3.03 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

3.04 TESTING AND INSPECTION

A. Testing Agency Duties:
   1. Test samples of mixes submitted by Contractor.
   2. Provide qualified personnel at site. Cooperate with Owner, Architect and Contractor in performance of services.
   3. Perform specified sampling and testing of products in accordance with specified standards.
   4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
   5. Promptly notify Owner, Architect and Contractor of observed irregularities or non-conformance of Work or products.
   6. Perform additional tests and inspections required by Architect.
   7. Submit reports of all tests/inspections specified.

B. Limits on Testing/Inspection Agency Authority:
   1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
   2. Agency may not approve or accept any portion of the Work.
   3. Agency may not assume any duties of Contractor.
   4. Agency has no authority to stop the Work.

C. Contractor Responsibilities:
   1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
   2. Cooperate with laboratory personnel, and provide access to the Work and to manufacturers' facilities.
   3. Provide incidental labor and facilities:
      a. To provide access to Work to be tested/inspected.
      b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
      c. To facilitate tests/inspections.
      d. To provide storage and curing of test samples.
   4. Notify Owner, Architect and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.
   5. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor's error beyond specified requirements.

D. Re-testing required because of non-conformance to specified requirements shall be performed by the same agency on instructions by Architect.

E. Re-testing required because of non-conformance to specified requirements shall be paid for by Contractor.

3.05 MANUFACTURERS' FIELD SERVICES

A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces

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and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment as applicable, and to initiate instructions when necessary.

B. Submit qualifications of observer to Owner and Architect 30 days in advance of required observations.
   1. Observer subject to approval of Architect.
   2. Observer subject to approval of Owner.

C. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

3.06 DEFECT ASSESSMENT

A. Replace Work or portions of the Work not conforming to specified requirements.

B. If, in the opinion of Owner, it is not practical to remove and replace the Work, Owner will direct an appropriate remedy or adjust payment.

END OF SECTION

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SECTION 015000

TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Temporary utilities.

B. Temporary telecommunications services.

C. Temporary sanitary facilities.

D. Temporary Controls: Barriers, enclosures, and fencing.

E. Security requirements.

F. Vehicular access and parking.

G. Waste removal facilities and services.

H. Project identification sign.

I. Field offices.

1.02 RELATED REQUIREMENTS

A. Section 015500 - Vehicular Access and Parking.

1.03 TEMPORARY UTILITIESSEE BYU STANDARD CONTRACT REQUIREMENTS

1.04 TELECOMMUNICATIONS SERVICES

A. Provide and maintain telecommunications services to field office at time of project mobilization. Coordinate installation with the BYU Construction Project Manager.

1.05 TEMPORARY SANITARY FACILITIES SEE BYU STANDARD CONTRACT REQUIREMENTS

A. Maintain daily in clean and sanitary condition.

1.06 BARRIERS

A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public, to allow for owner's use of site and to protect existing facilities and adjacent properties from damage from construction operations and demolition.

B. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing building.

C. Provide protection for plants designated to remain. Replace damaged plants. Refer to BYU Standard Contract Requirements for more information.

D. Protect stored materials, site, and structures from damage.

1.07 FENCING

A. Construction: Commercial grade chain link fence.

B. Provide 6 foot high fence around construction site; equip with vehicular and pedestrian gates with locks.

1.08 VEHICULAR ACCESS AND PARKING - SEE SECTION 015500

A. Comply with BYU regulations (www.relating to use of streets and sidewalks, access to emergency facilities, and access for emergency vehicles.

B. Coordinate access and haul routes with governing authorities and Owner.

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C. Provide and maintain access to fire hydrants and fire lanes free of obstructions.

D. Provide means of removing mud from vehicle wheels before entering streets.

E. Designated existing on-site roads may be used for construction traffic.

F. Existing parking areas located at LaVell Edwards Stadium (LVES) may be used for construction parking.

1.09 WASTE REMOVAL

A. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.

1.10 PROJECT IDENTIFICATION

A. Provide project identification sign of design and construction indicated on Drawings.

B. Erect on site at location indicated.

C. No other signs are allowed without Owner permission except those required by law.

1.11 FIELD OFFICES

A. Office: Weathertight, with lighting, electrical outlets, heating, cooling equipment, and equipped with sturdy furniture, drawing rack, and drawing display table.

B. Provide space for Project meetings, with table and chairs to accommodate 10 persons as needed.

1.12 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary utilities, equipment, facilities, materials, prior to Date of Substantial Completion inspection.

B. Remove underground installations. Grade site as indicated.

C. Clean and repair damage caused by installation or use of temporary work.

D. Restore existing facilities used during construction to original condition, unless noted otherwise.

E. Restore new permanent facilities used during construction to specified condition.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

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SECTION 016000
PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General product requirements.
B. Re-use of existing products.
C. Transportation, handling, storage and protection.
D. Product option requirements.
E. Procedures for Owner-supplied products.
F. Maintenance materials, including extra materials, spare parts, tools, and software.

1.02 RELATED REQUIREMENTS

A. Section 011000 - Summary: Identification of Owner-supplied products.
B. Section 014000 - Quality Requirements: Product quality monitoring.
C. Section 230513 - Common Motor Requirements for HVAC Equipment: Motors for HVAC equipment.

PART 2 PRODUCTS

2.01 EXISTING PRODUCTS

A. Do not use materials and equipment removed from existing premises unless specifically required or permitted by the Contract Documents.
B. Unforeseen historic items encountered remain the property of the Owner; notify Owner promptly upon discovery; protect, remove, handle, and store as directed by Owner.
C. Existing materials and equipment indicated to be removed, but not to be re-used, relocated, reinstalled, delivered to the Owner, or otherwise indicated as to remain the property of the Owner, become the property of the Contractor; remove from site.

2.02 NEW PRODUCTS

A. Provide new products unless specifically required or permitted by the Contract Documents.
B. Motors: Refer to Section 230513 - Common Motor Requirements for HVAC Equipment, NEMA MG 1 Type. Specific motor type is specified in individual specification sections.

2.03 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.
B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.
C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

2.04 MAINTENANCE MATERIALS

A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.

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B. Deliver and place in location as directed; obtain receipt prior to final payment.

PART 3 EXECUTION

3.01 OWNER-SUPPLIED PRODUCTS

A. See Section 011000 - Summary for identification of Owner-supplied products.

B. Owner's Responsibilities:
   1. Arrange for and deliver Owner reviewed shop drawings, product data, and samples, to Contractor.
   2. Arrange and pay for product delivery to site.
   3. On delivery, inspect products jointly with Contractor.
   4. Submit claims for transportation damage and replace damaged, defective, or deficient items.
   5. Arrange for manufacturers' warranties, inspections, and service.

C. Contractor's Responsibilities:
   1. Review Owner reviewed shop drawings, product data, and samples.
   2. Receive and unload products at site; inspect for completeness or damage jointly with Owner.
   3. Repair or replace items damaged after receipt.

3.02 TRANSPORTATION AND HANDLING

A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.

B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.

C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.

D. Transport and handle products in accordance with manufacturer's instructions.

E. Transport materials in a legal fashion in covered trucks to prevent contamination of product and littering of surrounding areas.

F. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.

G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.

H. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.03 STORAGE AND PROTECTION

A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication.

B. Store and protect products in accordance with manufacturers' instructions.

C. Store with seals and labels intact and legible.

D. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.

E. For exterior storage of fabricated products, place on sloped supports above ground.

F. Provide bonded off-site storage and protection when site does not permit on-site storage or protection.

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G. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.

H. Comply with manufacturer's warranty conditions, if any.

I. Do not store products directly on the ground.

J. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

K. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.

L. Prevent contact with material that may cause corrosion, discoloration, or staining.

M. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

N. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION

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SECTION 017000
EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Examination, preparation, and general installation procedures.

B. Requirements for alterations work, including selective demolition, except removal, disposal, and/or remediation of hazardous materials and toxic substances.

C. Pre-installation meetings.

D. Cutting and patching.

E. Surveying for laying out the work.

F. Cleaning and protection.

G. Starting of systems and equipment.

H. Demonstration and instruction of Owner personnel.

I. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.

J. General requirements for maintenance service.

1.02 RELATED REQUIREMENTS

A. Section 011000 - Summary: Limitations on working in existing building; continued occupancy; work sequence; identification of salvaged and relocated materials.

B. Section 013000 - Administrative Requirements: Submittals procedures.

C. Section 014000 - Quality Requirements: Testing and inspection procedures.

D. Section 015000 - Temporary Facilities and Controls: Temporary exterior enclosures.

E. Section 015000 - Temporary Facilities and Controls: Temporary interior partitions.

F. Section 015100 - Temporary Utilities: Temporary heating, cooling, and ventilating facilities.

G. Section 015713 - Temporary Erosion and Sediment Control: Additional erosion and sedimentation control requirements.

H. Section 017800 - Closeout Submittals: Project record documents, operation and maintenance data, warranties and bonds.

I. Section 017900 - Demonstration and Training: Demonstration of products and systems to be commissioned and where indicated in specific specification sections

J. Section 019113 - General Commissioning Requirements: Contractor's responsibilities in regard to commissioning.

K. Section 024100 - Demolition: Demolition of whole structures and parts thereof; site utility demolition.

L. Standard Contract Requirements - General Conditions

M. Section 078400 - Firestopping.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Survey work: Submit name, address, and telephone number of Surveyor before starting survey work.
   1. On request, submit documentation verifying accuracy of survey work.

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C. Cutting and Patching: Refer to BYU Standard Contract Requirements

D. Project Record Documents: Accurately record actual locations of capped and active utilities.

1.04 QUALIFICATIONS

A. For demolition work, employ a firm specializing in the type of work required.
   1. Minimum of Three years of documented experience.

B. For design of temporary shoring and bracing, employ a Professional Civil Engineer or a Professional Structural Engineer experienced in design of this type of work and licensed in Utah.

1.05 PROJECT CONDITIONS

A. Use of explosives is not permitted.

B. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.

C. Perform dewatering activities, as required, for the duration of the project.

D. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

E. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.
   1. Provide dust-proof barriers between construction areas and areas continuing to be occupied by Owner.

F. Erosion and Sediment Control: Provide SWPPP plan and execute work by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
   1. Provide temporary measures such as berms, dikes, and drains, to prevent water flow.
   2. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.
   3. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.

G. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations to the limits established by the agency having jurisdiction.

H. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations. Comply with federal, state, and local regulations.

1.06 COORDINATION

A. See Section 011000 for occupancy-related requirements.

B. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

C. Notify affected utility companies and comply with their requirements.

D. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

E. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on drawings. Follow routing indicated for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

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F. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.

G. Coordinate completion and clean-up of work of separate sections.

H. After Owner occupancy of premises, coordinate access to site for correction of warranty work, to minimize disruption of Owner's activities.

PART 2 PRODUCTS

2.01 PATCHING MATERIALS

A. New Materials: As specified in product sections; match existing products and work for patching and extending work.

B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.

C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 016000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.

B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.

C. Examine and verify specific conditions described in individual specification sections.

D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.

E. Verify that utility services are available, of the correct characteristics, and in the correct locations.

F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions. Refer also to the BYU Standard Contract Requirements.

3.02 PREPARATION

A. Clean substrate surfaces prior to applying next material or substance.

B. Seal cracks or openings of substrate prior to applying next material or substance.

C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.03 PREINSTALLATION MEETINGS

A. When required in individual specification sections, convene a preinstallation meeting at the site prior to commencing work of the section.

B. Require attendance of parties directly affecting, or affected by, work of the specific section.

C. Notify Owner and Architect four days in advance of meeting date.

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D. Prepare agenda and preside at meeting:
   1. Review conditions of examination, preparation and installation procedures.
   2. Review coordination with related work.

E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.04 LAYING OUT THE WORK

A. Verify locations of survey control points prior to starting work.

B. Promptly notify Owner and Architect of any discrepancies discovered.

C. Contractor shall locate and protect survey control and reference points.

D. Control datum for survey is that indicated on drawings.

E. Protect survey control points prior to starting site work; preserve permanent reference points during construction.

F. Promptly report to Owner and Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.

G. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Owner and Architect.

H. Utilize recognized engineering survey practices.

I. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
   1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
   2. Grid or axis for structures.
   3. Building foundation, column locations, ground floor elevations.

J. Periodically verify layouts by same means.

K. Maintain a complete and accurate log of control and survey work as it progresses.

3.05 GENERAL INSTALLATION REQUIREMENTS

A. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.

B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.

C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.

D. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.

E. Make neat transitions between different surfaces, maintaining texture and appearance.

3.06 ALTERATIONS

A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
   1. Verify that construction and utility arrangements are as indicated.
   2. Report discrepancies to Owner and Architect before disturbing existing installation.
   3. Beginning of alterations work constitutes acceptance of existing conditions.

B. Keep areas in which alterations are being conducted separated from other areas that are still occupied.
   1. Provide, erect, and maintain temporary dustproof partitions of construction indicated on drawings in locations indicated on drawings.

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C. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; prevent water and humidity damage.
   1. Where openings in exterior enclosure exist, provide construction to make exterior enclosure weatherproof.
   2. Insulate existing ducts or pipes that are exposed to outdoor ambient temperatures by alterations work.

D. Remove existing work as indicated and as required to accomplish new work.
   1. Remove rotted wood, corroded metals, and deteriorated masonry and concrete; replace with new construction specified.
   2. Remove items indicated on drawings.
   3. Relocate items indicated on drawings.
   4. Where new surface finishes are to be applied to existing work, perform removals, patch, and prepare existing surfaces as required to receive new finish; remove existing finish if necessary for successful application of new finish.
   5. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces as closely as possible.

E. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove, relocate, and extend existing systems to accommodate new construction as described in documents or directed by Owner.
   1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components; if necessary, modify installation to allow access or provide access panel.
   2. Where existing systems or equipment are not active and Contract Documents require reactivation, put back into operational condition; repair supply, distribution, and equipment as required by Owner.
   3. 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.
      a. Disable existing systems only to make switchovers and connections; minimize duration of outages.
      b. See Section 011000 for other limitations on outages and required notifications.
      c. Provide temporary connections as required to maintain existing systems in service.
   4. Verify that abandoned services serve only abandoned facilities.
   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; patch holes left by removal using materials specified for new construction.

F. Protect existing work to remain.
   1. Prevent movement of structure; provide shoring and bracing if necessary.
   2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
   3. Repair adjacent construction and finishes damaged during removal work.

G. Adapt existing work to fit new work: Make as neat and smooth transition as possible.
   1. When existing finished surfaces are cut so that a smooth transition with new work is not possible, terminate existing surface along a straight line at a natural line of division and make recommendation to Owner and Architect.
   2. Where removal of partitions or walls results in adjacent spaces becoming one, rework floors, walls, and ceilings to a smooth plane without breaks, steps, or bulkheads.
   3. Where a change of plane of 1/4 inch or more occurs in existing work, submit recommendation for providing a smooth transition for Owner and Architect review and request instructions.
   4. Trim existing wood doors as necessary to clear new floor finish. Refinish trim as required.

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H. Patching: Where the existing surface is not indicated to be refinished, patch to match the surface finish that existed prior to cutting. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.

I. Refinish existing surfaces as indicated:
   1. Where rooms or spaces are indicated to be refinished, refinish all visible existing surfaces to remain to the specified condition for each material, with a neat transition to adjacent finishes.
   2. If mechanical or electrical work is exposed accidentally during the work, re-cover and refinish to match.

J. Clean existing systems and equipment.

K. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.

3.07 CUTTING AND PATCHING - REFER ALSO TO BYU STANDARD CONTRACT REQUIREMENTS

A. Whenever possible, execute the work by methods that avoid cutting or patching.

B. See Alterations article above for additional requirements.

C. Perform whatever cutting and patching is necessary to:
   1. Complete the work.
   2. Fit products together to integrate with other work.
   3. Provide openings for penetration of mechanical, electrical, and other services.
   4. Match work that has been cut to adjacent work.
   5. Repair new work damaged by subsequent work.
   6. Remove samples of installed work for testing when requested.
   7. Remove and replace defective and non-conforming work.

D. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.

E. Employ skilled and experienced installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.

F. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.

G. Restore work with new products in accordance with requirements of Contract Documents.

H. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

I. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 078400, to full thickness of the penetrated element.

J. Patching:
   1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
   2. Match color, texture, and appearance.
   3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

3.08 PROGRESS CLEANING

A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.

B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.

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C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.

D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

3.09 PROTECTION OF INSTALLED WORK - REFER ALSO TO BYU STANDARD CONTRACT REQUIREMENTS

A. Protect installed work from damage by construction operations.

B. Provide special protection where specified in individual specification sections.

C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.

E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

F. Protect work from spilled liquids. If work is exposed to spilled liquids, immediately remove protective coverings, dry out work, and replace protective coverings.

G. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

H. Prohibit traffic from landscaped areas.

I. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

3.10 SYSTEM STARTUP

A. Coordinate with requirements of Section 019113 - General Commissioning Requirements_____.

B. Coordinate schedule for start-up of various equipment and systems.

C. Notify Owner and Architect and owner seven days prior to start-up of each item.

D. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.

E. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.

F. Verify that wiring and support components for equipment are complete and tested.

G. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.

H. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.

I. Submit a written report that equipment or system has been properly installed and is functioning correctly.

3.11 DEMONSTRATION AND INSTRUCTION

A. See Section 017900 - Demonstration and Training.

3.12 ADJUSTING

A. Adjust operating products and equipment to ensure smooth and unhindered operation.

B. Testing, adjusting, and balancing HVAC systems: See Section 230593 - Testing, Adjusting, and Balancing for HVAC.

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3.13 FINAL CLEANING

A. Execute final cleaning prior to Substantial Completion.
   1. Clean areas to be occupied by Owner prior to final completion before Owner occupancy.
B. Use cleaning materials that are nonhazardous.
C. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, and others impacted surfaces.
D. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.
E. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned, and approved by the Owner.
F. Clean filters of operating equipment.
G. Clean debris from roofs, gutters, downspouts, scuppers, overflow drains, area drains, and drainage systems.
H. Clean site; sweep paved areas, rake clean landscaped surfaces.
I. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

3.14 CLOSEOUT PROCEDURES

A. Make submittals that are required by governing or other authorities.
   1. Provide copies to Architect and Owner.
B. Refer to BYU standard contract requirements for punch list procedures.

3.15 MAINTENANCE

A. Provide service and maintenance of components indicated in specification sections and coordinate with Owner.

END OF SECTION

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Signature & Date: 03.15.2024

SECTION 017419

CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 GENERAL

1.01 WASTE MANAGEMENT REQUIREMENTS

A. Owner requires that this project generate the least amount of trash and waste possible.

B. Employ processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors.

C. Minimize trash/waste disposal in landfills; reuse, salvage, or recycle as much waste as economically feasible.

D. Methods of trash/waste disposal that are not acceptable are:
   1. Burning on the project site.
   2. Burying on the project site.
   3. Dumping or burying on other property, public or private.
   4. Other illegal dumping or burying.

E. Regulatory Requirements: Contractor is responsible for knowing and complying with regulatory requirements, including but not limited to Federal, state and local requirements, pertaining to legal disposal of all construction and demolition waste materials.

1.02 DEFINITIONS

A. Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk, or the like.

B. Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, remodeling, repair and demolition operations.

C. Hazardous: Exhibiting the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity or reactivity.

D. Nonhazardous: Exhibiting none of the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity, or reactivity.

E. Nontoxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure.

F. Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.

G. Recycle: To remove a waste material from the project site to another site for remanufacture into a new product for reuse by others.

H. Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste.

I. Return: To give back reusable items or unused products to vendors for credit.

J. Reuse: To reuse a construction waste material in some manner on the project site.

K. Salvage: To remove a waste material from the project site to another site for resale or reuse by others.

L. Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.

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M. Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.

N. Toxic: Poisonous to humans either immediately or after a long period of exposure.

O. Trash: Any product or material unable to be reused, returned, recycled, or salvaged.

P. Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

PART 2 PRODUCTS

PART 3 EXECUTION

3.01 WASTE MANAGEMENT PROCEDURES

A. See Section 013000 for additional requirements for project meetings, reports, submittal procedures, and project documentation.

B. See Section 015000 for additional requirements related to trash/waste collection and removal facilities and services.

C. See Section 016000 for waste prevention requirements related to delivery, storage, and handling.

D. See Section 017000 for trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.

END OF SECTION

I, Bruce T. Fallon, AIA the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers.

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SECTION 017800

CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Project Record Documents.

B. Operation and Maintenance Data.

C. Warranties.

1.02 RELATED REQUIREMENTS

A. Section 013000 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.

B. Section 017000 - Execution and Closeout Requirements: Contract closeout procedures.

C. Individual Product Sections: Specific requirements for operation and maintenance data.

D. Individual Product Sections: Warranties required for specific products or Work.

1.03 SUBMITTALS

A. Project Record Documents: Submit documents to Architect who will transfer them to the owner. Provide one hard copy and one electronic copy in pdf and rvt format.

B. Operation and Maintenance Data:

1. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Architect will review draft and return one copy with comments.
2. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
3. Submit one copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Owner and Architect comments. Revise content of all document sets as required prior to final submission.
4. **Submit one hard copy and one electronic copy in pdf format sets of revised final documents in final form within 10 days after final inspection. Updated 26 March 2021**

C. Warranties:

1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the Work:

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1. Drawings.
2. Specifications.
3. Addenda.
4. Change Orders.
5. Reviewed shop drawings, product data, and samples.
6. Manufacturer's instruction for assembly, installation, and adjusting.
7. Owner's Project Requirements document.
8. Commissioning Plan.

B. Ensure entries are complete and accurate, enabling future reference by Owner.

C. Store record documents separate from documents used for construction.

D. Record information concurrent with construction progress.

E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
1. Manufacturer's name and product model and number.
2. Product substitutions or alternates utilized.
3. Changes made by Addenda and modifications.

F. Record Drawings and Shop Drawings: Legibly mark any change from design to record actual construction including:
1. Measured depths of foundations in relation to finish first floor datum.
2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
4. Field changes of dimension and detail.
5. Details not on original Contract drawings.

3.02 OPERATION AND MAINTENANCE DATA

A. Source Data: For each product or system, list names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.

B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.

C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.

D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.03 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

A. For Each Product, Applied Material, and Finish:
1. Product data, with catalog number, size, composition, and color and texture designations.
2. Information for re-ordering custom manufactured products.

B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.

C. Moisture protection and weather-exposed products: Include product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.

D. Additional information as specified in individual product specification sections.

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E. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

3.04 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

A. For Each Item of Equipment and Each System:
   1. Description of unit or system, and component parts.
   2. Identify function, normal operating characteristics, and limiting conditions.
   3. Include performance curves, with engineering data and tests.
   4. Complete nomenclature and model number of replaceable parts.

B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

C. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.

D. Include color coded wiring diagrams as installed.

E. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.

F. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and troubleshooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

G. Provide servicing and lubrication schedule, and list of lubricants required.

H. Include manufacturer's printed operation and maintenance instructions.

I. Include sequence of operation by controls manufacturer.

J. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

K. Provide control diagrams by controls manufacturer as installed.

L. Provide Contractor's coordination drawings, with color coded piping diagrams as installed.

M. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

N. Include test and balancing reports.

O. Additional Requirements: As specified in individual product specification sections.

3.05 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS

A. Assemble operation and maintenance data into durable manuals for Owner's personnel use, with data arranged in the same sequence as, and identified by, the specification sections, unless otherwise directed in individual product specification sections.

B. Where systems involve more than one specification section, provide separate tabbed divider for each system.

C. Binders: Commercial quality, 8-1/2 by 11 inch three D side ring binders with durable plastic covers; 4 inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.

D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.

E. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.

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F. Tables of Contents: List every item separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.

G. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.

H. Text: Manufacturer's printed data, or typewritten data on 20 pound paper.

I. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

J. Arrangement of Contents: Organize each volume in parts as follows:
   1. Project Directory.
   2. Table of Contents, of all volumes, and of this volume.
   3. Operation and Maintenance Data: Arranged by system, then by product category.
      a. Source data.
      b. Product data, shop drawings, and other submittals.
      c. Operation and maintenance data.
      d. Field quality control data.
      e. Photocopies of warranties.
   4. Design Data: To allow for addition of design data furnished by Architect or others, provide a tab labeled "Design Data" and provide a binder large enough to allow for insertion of at least 20 pages of typed text.

3.06 WARRANTIES

A. Obtain warranties, executed in duplicate by responsible subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until date of substantial completion is determined.

B. Verify that documents are in proper form, contain full information.

C. Co-execute submittals when required.

D. Retain warranties until time specified for submittal.

E. Include photocopies of each in operation and maintenance manuals, indexed separately on Table of Contents.

F. Manual: Bind in commercial quality 8-1/2 by 11 inch three D side ring binders with durable plastic covers.

G. Cover: Identify each binder with typed or printed title WARRANTIES, with title of Project; name, address and telephone number of Contractor and equipment supplier; and name of responsible company principal.

H. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the specification section in which specified, and the name of product or work item.

I. Separate each warranty with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List Subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

END OF SECTION

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Signature & Date: 03.15.2024

SECTION 017900
DEMONSTRATION AND TRAINING

PART 1 GENERAL

1.01 SUMMARY

A. Demonstration of products and systems to be commissioned and where indicated in specific specification sections.

B. Training of Owner personnel in operation and maintenance is required for:
   1. All software-operated systems.
   2. HVAC systems and equipment.
   3. Plumbing equipment.
   4. Electrical systems and equipment.
   5. Items specified in individual product Sections.

C. Training of Owner personnel in care, cleaning, maintenance, and repair is required for:
   1. Finishes, including flooring, wall finishes, ceiling finishes.
   2. Fixtures and fittings.
   3. Items specified in individual product Sections.

1.02 RELATED REQUIREMENTS

A. Section 017800 - Closeout Submittals: Operation and maintenance manuals.

B. Section 019113 - General Commissioning Requirements: Additional requirements applicable to demonstration and training.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures; except:
   1. Make all submittals specified in this section, and elsewhere where indicated for commissioning purposes, directly to the Commissioning Authority.
   2. Submit one copy to the Commissioning Authority, not to be returned.
   3. Make commissioning submittals on time schedule specified by Commissioning Authority.
   4. Submittals indicated as "Draft" are intended for the use of the Commissioning Authority in preparation of overall Training Plan; submit in editable electronic format, Microsoft Word 2003 preferred.

B. Draft Training Plans: Owner will designate personnel to be trained; tailor training to needs and skill-level of attendees.
   1. Submit to Commissioning Authority for review and inclusion in overall training plan.
   2. Submit not less than four weeks prior to start of training.
   3. Revise and resubmit until acceptable.
   4. Provide an overall schedule showing all training sessions.
   5. Include at least the following for each training session:
      a. Identification, date, time, and duration.
      b. Description of products and/or systems to be covered.
      c. Name of firm and person conducting training; include qualifications.
      d. Intended audience, such as job description.
      e. Objectives of training and suggested methods of ensuring adequate training.
      f. Methods to be used, such as classroom lecture, live demonstrations, hands-on, etc.
      g. Media to be used, such a slides, hand-outs, etc.

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h. Training equipment required, such as projector, projection screen, etc., to be provided by Contractor.

C. Training Manuals: Provide training manual for each attendee; allow for minimum of two attendees per training session.
   1. Include applicable portion of O&M manuals.
   2. Include copies of all hand-outs, slides, overheads, video presentations, etc., that are not included in O&M manuals.
   3. Provide one extra copy of each training manual to be included with operation and maintenance data.

D. Training Reports:
   1. Identification of each training session, date, time, and duration.
   2. Sign-in sheet showing names and job titles of attendees.
   3. List of attendee questions and written answers given, including copies of and references to supporting documentation required for clarification; include answers to questions that could not be answered in original training session.
   4. Include Commissioning Authority's formal acceptance of training session.

1.04 QUALITY ASSURANCE

A. Instructor Qualifications: Familiar with design, operation, maintenance and troubleshooting of the relevant products and systems.
   1. Provide as instructors the most qualified trainer of those contractors and/or installers who actually supplied and installed the systems and equipment.
   2. Where a single person is not familiar with all aspects, provide specialists with necessary qualifications.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 DEMONSTRATION - GENERAL

A. Demonstrations conducted during system start-up do not qualify as demonstrations for the purposes of this section, unless approved in advance by Owner.

B. Demonstrations conducted during Functional Testing need not be repeated unless Owner personnel training is specified.

C. Demonstration may be combined with Owner personnel training if applicable.

D. Operating Equipment and Systems: Demonstrate operation in all modes, including start-up, shut-down, seasonal changeover, emergency conditions, and troubleshooting, and maintenance procedures, including scheduled and preventive maintenance.
   1. Perform demonstrations not less than two weeks prior to Substantial Completion.
   2. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

E. Non-Operating Products: Demonstrate cleaning, scheduled and preventive maintenance, and repair procedures.
   1. Perform demonstrations not less than two weeks prior to Substantial Completion.

3.02 TRAINING - GENERAL

A. Commissioning Authority will prepare the Training Plan based on draft plans submitted.

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B. Conduct training on-site unless otherwise indicated.

C. Owner will provide classroom and seating at no cost to Contractor.

D. Do not start training until Functional Testing is complete, unless otherwise specified or approved by the Commissioning Authority.

E. Provide training in minimum two hour segments.

F. The Commissioning Authority is responsible for determining that the training was satisfactorily completed and will provide approval forms.

G. Training schedule will be subject to availability of Owner's personnel to be trained; re-schedule training sessions as required by Owner; once schedule has been approved by Owner failure to conduct sessions according to schedule will be cause for Owner to charge Contractor for personnel "show-up" time.

H. Review of Facility Policy on Operation and Maintenance Data: During training discuss:
   1. The location of the O&M manuals and procedures for use and preservation; backup copies.
   2. Typical contents and organization of all manuals, including explanatory information, system narratives, and product specific information.
   3. Typical uses of the O&M manuals.

I. Product- and System-Specific Training:
   1. Review the applicable O&M manuals.
   2. For systems, provide an overview of system operation, design parameters and constraints, and operational strategies.
   3. Review instructions for proper operation in all modes, including start-up, shut-down, seasonal changeover and emergency procedures, and for maintenance, including preventative maintenance.
   4. Provide hands-on training on all operational modes possible and preventive maintenance.
   5. Emphasize safe and proper operating requirements; discuss relevant health and safety issues and emergency procedures.
   6. Discuss common troubleshooting problems and solutions.
   7. Discuss any peculiarities of equipment installation or operation.
   8. Discuss warranties and guarantees, including procedures necessary to avoid voiding coverage.
   9. Review recommended tools and spare parts inventory suggestions of manufacturers.
   10. Review spare parts and tools required to be furnished by Contractor.
   11. Review spare parts suppliers and sources and procurement procedures.

J. Be prepared to answer questions raised by training attendees; if unable to answer during training session, provide written response within three days.

END OF SECTION

I, Bruce T. Fallon, AIA the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers.

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SECTION 019113

GENERAL COMMISSIONING REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY

A. Commissioning is intended to achieve the following specific objectives; this section specifies the Contractor's responsibilities for commissioning:
   1. Verify that the work is installed in accordance with the Contract Documents and the manufacturer's recommendations and instructions, and that it receives adequate operational checkout prior to startup: Startup reports and Prefunctional Checklists executed by Contractor are utilized to achieve this.
   2. Verify and document that functional performance is in accordance with the Contract Documents: Functional Tests executed by Contractor and witnessed by the Commissioning Authority are utilized to achieve this.
   3. Verify that operation and maintenance manuals submitted to Owner are complete: Detailed operation and maintenance (O&M) data submittals by Contractor are utilized to achieve this.
   4. Verify that the Owner's operating personnel are adequately trained: Formal training conducted by Contractor is utilized to achieve this.

B. Commissioning, including Functional Tests, O&M documentation review, and training, is to occur after startup and initial checkout and be completed before Functional Completion with penalty for non-completion as defined in the Conditions of the Contract.

C. The Commissioning Authority directs and coordinates all commissioning activities; this section describes some but not all of the Commissioning Authority's responsibilities.

D. The Commissioning Authority is employed by Owner.

1.02 SCOPE OF COMMISSIONING

A. The following are to be commissioned:

B. Fire Protection Systems.

C. HVAC System, including:
   1. Major and minor equipment items.
   2. Piping systems and equipment.
   3. Ductwork and accessories.
   4. Terminal units.
   5. Control system.
   6. Sound control devices.
   7. Vibration control devices.
   8. Variable frequency drives.

D. Electrical Systems:
   1. Power quality.
   2. Emergency power systems.
   3. Uninterruptible power systems.
   4. Lighting controls other than manual switches.

E. Electronic Safety and Security:
   1. Security system, including doors and hardware.
   2. Fire and smoke alarms.

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F. Other equipment and systems explicitly identified elsewhere in Contract Documents as requiring commissioning.

1.03 RELATED REQUIREMENTS

A. Section 017800 - Closeout Submittals: Scope and procedures for operation and maintenance manuals and project record documents.

B. Section 017900 - Demonstration and Training: Scope and procedures for Owner personnel training.

C. Section 230800 - Commissioning of HVAC: HVAC control system testing; other requirements.

1.04 REFERENCE STANDARDS

A. ASHRAE Std 202 - Commissioning Process for Buildings and Systems; 2013 (2017a).

B. PECI (Samples) - Sample Forms for Prefunctional Checklists and Functional Performance Tests; current edition.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures; except:
   1. Make all submittals specified in this section, and elsewhere where indicated for commissioning purposes, directly to the Commissioning Authority, unless they require review by Architect; in that case, submit to Architect first.
   2. Submit one copy to the Commissioning Authority, not to be returned.
   3. Make commissioning submittals on time schedule specified by Commissioning Authority.
   4. Submittals indicated as "Draft" are intended for the use of the Commissioning Authority in preparation of Prefunctional Checklists or Functional Test requirements; submit in editable electronic format, Microsoft Word 2010 preferred.
   5. As soon as possible after submittals made to Architect are approved, submit copy of approved submittal to the Commissioning Authority.

B. Product Data: If submittals to Architect do not include the following, submit copies as soon as possible:
   1. Manufacturer's product data, cut sheets, and shop drawings.
   2. Manufacturer's installation instructions.
   3. Startup, operating, and troubleshooting procedures.
   4. Fan and pump curves.
   5. Factory test reports.
   6. Warranty information, including details of Owner's responsibilities in regard to keeping warranties in force.

C. Manufacturers' Instructions: Submit copies of all manufacturer-provided instructions that are shipped with the equipment as soon as the equipment is delivered.

D. Startup Plans and Reports.

E. Completed Prefunctional Checklists.

F. Commissioning Issues Log:
   1. Construction observations.
   2. Supporting photographs.

1.06 QUALITY ASSURANCE

A. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

I, Bruce T. Fallon, AIA the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers.

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PART 2 PRODUCTS

2.01 TEST EQUIPMENT

A. Provide all standard testing equipment required to perform startup and initial checkout and required Functional Testing; unless otherwise noted such testing equipment will NOT become the property of Owner.

B. Calibration Tolerances: Provide testing equipment of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified. If not otherwise noted, the following minimum requirements apply:
   1. Temperature Sensors and Digital Thermometers: Certified calibration within past year to accuracy of 0.5 degree F and resolution of plus/minus 0.1 degree F.
   2. Pressure Sensors: Accuracy of plus/minus 2.0 percent of the value range being measured (not full range of meter), calibrated within the last year.
   3. Calibration: According to the manufacturer's recommended intervals and when dropped or damaged; affix calibration tags or keep certificates readily available for inspection.

C. Equipment-Specific Tools: Where special testing equipment, tools and instruments are specific to a piece of equipment, are only available from the vendor, and are required in order to accomplish startup or Functional Testing, provide such equipment, tools, and instruments as part of the work at no extra cost to Owner; such equipment, tools, and instruments are to become the property of Owner.

D. Dataloggers: Independent equipment and software for monitoring flows, currents, status, pressures, etc. of equipment.
   1. Dataloggers required to for Functional Tests will be provided by the Commissioning Authority and will not become the property of Owner.

PART 3 EXECUTION

3.01 COMMISSIONING PLAN

A. Commissioning Authority has prepared the Commissioning Plan.
   1. Attend meetings called by the Commissioning Authority for purposes of completing the commissioning plan.
   2. Require attendance and participation of relevant subcontractors, installers, suppliers, and manufacturer representatives.

B. Contractor is responsible for compliance with the Commissioning Plan.

C. Commissioning Plan: The commissioning schedule, procedures, and coordination requirements for all parties in the commissioning process.

D. Basis of Design Documentation (BOD): Detailed documentation of the functional requirements of the project; descriptions of the systems, components, and methods chosen to meet the design intent; assumptions underlying the design intent.
   1. Basis of Design Documentation is to be prepared by Design-Builder.

E. Commissioning Schedule:
   1. Submit anticipated dates of startup of each item of equipment and system to Commissioning Authority within 60 days after award of Contract.
   2. Re-submit anticipated startup dates monthly, but not less than 4 weeks prior to startup.
   3. Prefunctional Checklists and Functional Tests are to be performed in sequence from components, to subsystems, to systems.
   4. Provide sufficient notice to Commissioning Authority for delivery of relevant Checklists and Functional Test procedures, to avoid delay.

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3.02 STARTUP PLANS AND REPORTS

A. Startup Plans: For each item of equipment and system for which the manufacturer provides a startup plan, submit the plan not less than 8 weeks prior to startup.

B. Startup Reports: For each item of equipment and system for which the manufacturer provides a startup checklist (or startup plan or field checkout sheet), document compliance by submitting the completed startup checklist prior to startup, signed and dated by responsible entity.

C. Submit directly to the Commissioning Authority.

3.03 PREFUNCTIONAL CHECKLISTS

A. A Prefunctional Checklist is required to be filled out for each item of equipment or other assembly specified to be commissioned.
   1. No sampling of identical or near-identical items is allowed.
   2. These checklists do not replace manufacturers' recommended startup checklists, regardless of apparent redundancy.
   3. Prefunctional Checklist forms will not be complete until after award of the contract; the following types of information will be gathered via the completed Checklist forms:
      a. Certification by installing contractor that the unit is properly installed, started up, and operating and ready for Functional Testing.
      b. Confirmation of receipt of each shop drawing and commissioning submittal specified, itemized by unit.
      c. Manufacturer, model number, and relevant capacity information; list information "as specified," "as submitted," and "as installed."
      d. Serial number of installed unit.
      e. List of inspections to be conducted to document proper installation prior to startup and Functional Testing; these will be primarily static inspections and procedures; for equipment and systems may include normal manufacturer's start-up checklist items and minor testing.
      f. Sensor and actuator calibration information.
   4. PECI (Samples) found at http://www.peci.org/library/mcpgs.htm indicate anticipated level of detail for Prefunctional Checklists.

B. Contractor is responsible for filling out Prefunctional Checklists, after completion of installation and before startup; witnessing by the Commissioning Authority is not required unless otherwise specified.
   1. Each line item without deficiency is to be witnessed, initialed, and dated by the actual witness; checklists are not complete until all line items are initialed and dated complete without deficiencies.
   2. Checklists with incomplete items may be submitted for approval provided the Contractor attests that incomplete items do not preclude the performance of safe and reliable Functional Testing; re-submission of the Checklist is required upon completion of remaining items.
   3. Individual Checklists may contain line items that are the responsibility of more than one installer; Contractor shall assign responsibility to appropriate installers or subcontractors, with identification recorded on the form.
   4. If any Checklist line item is not relevant, record reasons on the form.
   5. Contractor may independently perform startup inspections and/or tests, at his option.
   6. Regardless of these reporting requirements, Contractor is responsible for correct startup and operation.
   7. Submit completed Checklists to Commissioning Authority within two days of completion.

C. Commissioning Authority is responsible for furnishing the Prefunctional Checklists to Contractor.
   1. Initial Drafts: Contractor is responsible for initial draft of Prefunctional Checklist where so indicated in the Contract Documents.
   2. Provide all additional information requested by Commissioning Authority to aid in preparation of checklists, such as shop drawing submittals, manufacturers' startup checklists, and O&M data.

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3. Commissioning Authority may add any relevant items deemed necessary regardless of whether they are explicitly mentioned in the Contract Documents or not.
4. When asked to review the proposed Checklists, do so in a timely manner.

D. Commissioning Authority Witnessing: Required for:
1. Each piece of primary equipment, unless sampling of multiple similar units is allowed by the commissioning plan.
2. A sampling of non-primary equipment, as allowed by the commissioning plan.

E. Deficiencies: Correct deficiencies and re-inspect or re-test, as applicable, at no extra cost to Owner.
1. If difficulty in correction would delay progress, report deficiency to the Commissioning Authority immediately.

3.04 FUNCTIONAL TESTS

A. A Functional Test is required for each item of equipment, system, or other assembly specified to be commissioned, unless sampling of multiple identical or near-identical units is allowed by the final test procedures.

B. Contractor is responsible for execution of required Functional Tests, after completion of Prefunctional Checklist and before closeout.

C. Commissioning Authority is responsible for witnessing and reporting results of Functional Tests, including preparation and completion of forms for that purpose.

D. Contractor is responsible for correction of deficiencies and re-testing at no extra cost to Owner; if a deficiency is not corrected and re-tested immediately, the Commissioning Authority will document the deficiency and the Contractor's stated intentions regarding correction.
1. Deficiencies are any condition in the installation or function of a component, piece of equipment or system that is not in compliance with the Contract Documents or does not perform properly.
2. When the deficiency has been corrected, the Contractor completes the form certifying that the item is ready to be re-tested and returns the form to the Commissioning Authority; the Commissioning Authority will reschedule the test and the Contractor shall re-test.
3. Identical or Near-Identical Items: If 10 percent, or three, whichever is greater, of identical or near-identical items fail to perform due to material or manufacturing defect, all items will be considered defective; provide a proposal for correction within 2 weeks after notification of defect, including provision for testing sample installations prior to replacement of all items.
4. Contractor shall bear the cost of Owner and Commissioning Authority personnel time witnessing re-testing.
5. Contractor shall bear the cost of Owner and Commissioning Authority personnel time witnessing re-testing if the test failed due to failure to execute the relevant Prefunctional Checklist correctly; if the test failed for reasons that would not have been identified in the Prefunctional Checklist process, Contractor shall bear the cost of the second and subsequent re-tests.

E. Functional Test Procedures:
1. Some test procedures are included in the Contract Documents; where Functional Test procedures are not included in the Contract Documents, test procedures will be determined by the Commissioning Authority with input by and coordination with Contractor.
2. Examples of Functional Testing:
   a. Test the dynamic function and operation of equipment and systems (rather than just components) using manual (direct observation) or monitoring methods under full operation (e.g., the chiller pump is tested interactively with the chiller functions to see if the pump ramps up and down to maintain the differential pressure setpoint).
   b. Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc.

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c. Systems are run through all the HVAC control system's sequences of operation and components are verified to be responding as the sequence's state.
d. Traditional air or water test and balancing (TAB) is not Functional Testing; spot checking of TAB by demonstration to the Commissioning Authority is Functional Testing.

3. PECI (Samples) found at http://www.peci.org/library/mcpgs.htm indicated anticipated level of detail for Functional Tests.

F. Deferred Functional Tests: Some tests may need to be performed later, after substantial completion, due to partial occupancy, equipment, seasonal requirements, design or other site conditions; performance of these tests remains the Contractor's responsibility regardless of timing.

3.05 SENSOR AND ACTUATOR CALIBRATION

A. Calibrate all field-installed temperature, relative humidity, carbon monoxide, carbon dioxide, and pressure sensors and gages, and all actuators (dampers and valves) on this piece of equipment shall be calibrated. Sensors installed in the unit at the factory with calibration certification provided need not be field calibrated.

B. Calibrate using the methods described below; alternate methods may be used, if approved by Commissioning Authority and Owner beforehand. See PART 2 for test instrument requirements. Record methods used on the relevant Prefunctional Checklist or other suitable forms, documenting initial, intermediate and final results.

C. All Sensors:
1. Verify that sensor location is appropriate and away from potential causes of erratic operation.
2. Verify that sensors with shielded cable are grounded only at one end.
3. For sensor pairs that are used to determine a temperature or pressure difference, for temperature make sure they are reading within 0.2 degree F of each other, and for pressure, within tolerance equal to 2 percent of the reading, of each other.
4. Tolerances for critical applications may be tighter.

D. Sensors Without Transmitters - Standard Application:
1. Make a reading with a calibrated test instrument within 6 inches of the site sensor.
2. Verify that the sensor reading, via the permanent thermostat, gage or building automation system, is within the tolerances in the table below of the instrument-measured value.
3. If not, install offset, calibrate or replace sensor.

E. Sensors With Transmitters - Standard Application.
1. Disconnect sensor.
2. Connect a signal generator in place of sensor.
3. Connect ammeter in series between transmitter and building automation system control panel.
4. Using manufacturer's resistance-temperature data, simulate minimum desired temperature.
5. Adjust transmitter potentiometer zero until 4 mA is read by the ammeter.
6. Repeat for the maximum temperature matching 20 mA to the potentiometer span or maximum and verify at the building automation system.
7. Record all values and recalibrate controller as necessary to conform with specified control ramps, reset schedules, proportional relationship, reset relationship and P/I reaction.
8. Reconnect sensor.
9. Make a reading with a calibrated test instrument within 6 inches of the site sensor.
10. Verify that the sensor reading, via the permanent thermostat, gage or building automation system, is within the tolerances in the table below of the instrument-measured value.
11. If not, replace sensor and repeat.
12. For pressure sensors, perform a similar process with a suitable signal generator.

F. Sensor Tolerances for Standard Applications: Plus/minus the following maximums:
1. Watthour, Voltage, Amperage: 1 percent of design.
2. Pressure, Air, Water, Gas: 3 percent of design.

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3. Air Temperatures (Outside Air, Space Air, Duct Air): 0.4 degrees F.
4. Relative Humidity: 4 percent of design.
5. Barometric Pressure: 0.1 inch of Hg.
6. Flow Rate, Air: 10 percent of design.
7. Flow Rate, Water: 4 percent of design.
8. AHU Wet Bulb and Dew Point: 2.0 degrees F.

G. Critical Applications: For some applications more rigorous calibration techniques may be required for selected sensors. Describe any such methods used on an attached sheet.

H. Valve/Damper Stroke Setup and Check:
1. For all valve/damper actuator positions checked, verify the actual position against the control system readout.
2. Set pump/fan to normal operating mode.
3. Command valve/damper closed; visually verify that valve/damper is closed and adjust output zero signal as required.
4. Command valve/damper to open; verify position is full open and adjust output signal as required.
5. Command valve/damper to a few intermediate positions.
6. If actual valve/damper position does not reasonably correspond, replace actuator or add pilot positioner (for pneumatics).

I. Isolation Valve or System Valve Leak Check: For valves not associated with coils.
1. With full pressure in the system, command valve closed.
2. Use an ultra-sonic flow meter to detect flow or leakage.

3.06 TEST PROCEDURES - GENERAL

A. Provide skilled technicians to execute starting of equipment and to execute the Functional Tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.

B. Provide all necessary materials and system modifications required to produce the flows, pressures, temperatures, and conditions necessary to execute the test according to the specified conditions. At completion of the test, return all affected equipment and systems to their pre-test condition.

C. Sampling: Where Functional Testing of fewer than the total number of multiple identical or near-identical items is explicitly permitted, perform sampling as follows:
1. Identical Units: Defined as units with same application and sequence of operation; only minor size or capacity difference.
2. Sampling is not allowed for:
   a. Major equipment.
   b. Life-safety-critical equipment.
   c. Prefunctional Checklist execution.
3. XX = the percent of the group of identical equipment to be included in each sample; defined for specific type of equipment.
4. YY = the percent of the sample that if failed will require another sample to be tested; defined for specific type of equipment.
5. Randomly test at least XX percent of each group of identical equipment, but not less than three units. This constitutes the "first sample."
6. If YY percent of the units in the first sample fail, test another XX percent of the remaining identical units.
7. If YY percent of the units in the second sample fail, test all remaining identical units.
8. If frequent failures occur, resulting in more troubleshooting than testing, the Commissioning Authority may stop the testing and require Contractor to perform and document a checkout of the remaining units prior to continuing testing.

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D. Manual Testing: Use hand-held instruments, immediate control system readouts, or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the “observation”).

E. Simulating Conditions: Artificially create the necessary condition for the purpose of testing the response of a system; for example apply hot air to a space sensor using a hair dryer to see the response in a VAV box.

F. Simulating Signals: Disconnect the sensor and use a signal generator to send an amperage, resistance or pressure to the transducer and control system to simulate the sensor value.

G. Over-Writing Values: Change the sensor value known to the control system in the control system to see the response of the system; for example, change the outside air temperature value from 50 degrees F to 75 degrees F to verify economizer operation.

H. Indirect Indicators: Remote indicators of a response or condition, such as a reading from a control system screen reporting a damper to be 100 percent closed, are considered indirect indicators.

I. Monitoring: Record parameters (flow, current, status, pressure, etc.) of equipment operation using dataloggers or the trending capabilities of the relevant control systems; where monitoring of specific points is called for in Functional Test Procedures:
   1. All points that are monitored by the relevant control system shall be trended by Contractor; at the Commissioning Authority’s request, Contractor shall trend up to 20 percent more points than specified at no extra charge.
   2. Other points will be monitored by the Commissioning Authority using dataloggers.
   3. At the option of the Commissioning Authority, some control system monitoring may be replaced with datalogger monitoring.
   4. Provide hard copies of monitored data in columnar format with time down left column and at least 5 columns of point values on same page.
   5. Graphical output is desirable and is required for all output if the system can produce it.
   6. Monitoring may be used to augment manual testing.

3.07 OPERATION AND MAINTENANCE MANUALS

A. See Section 017800 - Closeout Submittals for additional requirements.

B. Add design intent documentation furnished by Architect to manuals prior to submission to Owner.

C. Submit manuals related to items that were commissioned to Commissioning Authority for review; make changes recommended by Commissioning Authority.

D. Commissioning Authority will add commissioning records to manuals after submission to Owner.

END OF SECTION

I, Bruce T. Fallon, AIA the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers.

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SECTION 024100

DEMOLITION

PART 1 GENERAL UPDATED OCT 2022

1.01 SECTION INCLUDES

A. **Building demolition including removal of select hazardous materials and toxic substances. Updated 10/22**

B. Selective demolition of built site elements.

C. Selective demolition of building elements for alteration purposes.

D. Abandonment and removal of existing utilities and utility structures.

1.02 RELATED REQUIREMENTS

A. Section 003100 - Available Project Information: Existing building survey conducted by Owner; information about known hazardous materials.

B. Section 015000 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.

C. Section 015713 - Temporary Erosion and Sediment Control.

D. Section 016000 - Product Requirements: Handling and storage of items removed for salvage and relocation.

E. **Section 260505 - Selective Demolition for Electrical.**

~~F. Section 311000 - Site Clearing: Vegetation and existing debris removal.~~

~~G. Section 312200 - Grading: Topsoil removal.~~

~~H. Section 312200 - Grading: Fill material for filling holes, pits, and excavations generated as a result of removal operations.~~

~~I. Section 312323 - Fill: Filling holes, pits, and excavations generated as a result of removal operations.~~

1.03 REFERENCE STANDARDS

A. 29 CFR 1926 - U.S. Occupational Safety and Health Standards; current edition.

B. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2013.

1.04 SUBMITTALS

A. See Section 9 of General Conditions013000 - Administrative Requirements for submittal procedures.

~~B. Site Plan: Showing:~~

~~1. Vegetation to be protected.~~

~~2. Areas for temporary construction and field offices.~~

~~3. Areas for temporary and permanent placement of removed materials.~~

C. Demolition Plan: Submit demolition plan as specified by OSHA and local authorities.

1. Indicate extent of demolition, removal sequence, bracing and shoring, and location and construction of barricades and fences.
2. Identify demolition firm and submit qualifications.
3. Include a summary of safety procedures.

D. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

1.05 QUALITY ASSURANCE

A. Demolition Firm Qualifications: Company specializing in the type of work required.

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1. Minimum of 5 years of experience.

PART 2 PRODUCTS -- NOT USED

PART 3 EXECUTION

3.01 SCOPE

~~A. Remove paving and curbs as required to accomplish new work.~~

B. Remove and legally dispose of all materials, being demolished, indicated on plans.
   1. **Removal and dispose all asbestos containing material (ACM) under 1.49% following all Federal, State and Local requirements. ACM above 1.49% will be abated by Owner.**
   2. **Remove all light fixture ballasts (PCB's) and lamp tubes. Place in Owner-provided collection bins. Place filled bins in dock area or other accessible outdoor location as reviewed with Owner. Owner will remove bins and dispose of contents.**
   3. **Remove and dispose all lead following all Federal, State and Local requirements.**

Updated Oct 2022.

C. Remove other items indicated, for salvage, relocation, and reinstallation.

3.02 GENERAL PROCEDURES AND PROJECT CONDITIONS

A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
   1. Obtain required permits.
   2. Comply with applicable requirements of NFPA 241.
   3. Use of explosives is not permitted.
   4. Provide, erect, and maintain temporary barriers and security devices.
   5. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
   6. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
   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.

B. Do not begin removal until receipt of notification to proceed from Owner.

C. Do not begin removal until built elements to be salvaged or relocated have been removed.

~~D. Do not begin removal until vegetation to be relocated has been removed and specified measures have been taken to protect vegetation to remain.~~

E. Protect existing elements that are not to be 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.

F. 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.

G. If hazardous materials are discovered during removal operations, stop work and notify Architect and Owner; hazardous materials include regulated asbestos containing materials, and mercury.

~~H. Partial Removal of Paving and Curbs: Neatly saw cut at right angle to surface.~~

3.03 EXISTING UTILITIES

A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.

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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 at least 3 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. Use concrete to plug and cap all open ends of abandoned underground utilities which are to remain in place. Some pipelines and conduits will require flowable fill to be placed in pipe see plans for specific areas. Provo City Standards apply to Provo City Utilities review City requirements and permit for specific direction.

H. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.

I. Prepare demolition areas by disconnecting and capping utilities outside the demolition zone; identify and mark utilities to be subsequently reconnected, in same manner as other utilities to remain.

3.04 ABANDONED UTILITIES

A. GPS/Survey of Abandoned and New Utilities.
   1. Coordinate with BYU Construction Project Manager to request BYU Civil Engineer to GPS/Survey abandoned and new utilities that have been installed, capped/plugged and/or abandoned in place before burying the utility.
   2. Provide at least a 24-hour notice.
   3. Utilities include but are not limited to the following: Water, storm & sewer pipelines, valves, hydrants, manholes, catch basins, clean outs, conduits, duct banks, etc.
   4. Contractor will be responsible at their expense to uncover abandoned utilities that have not been properly GPS or surveyed by BYU.

B. Abandoning Pipelines
   1. Abandon utility pipes shown in the plans or designated by the OWNER by emptying the pipeline contents and plugging the ends with grout or flowable fill.
   2. Fill or remove the following abandoned utility pipes:
      a. Fill abandoned pipe with grout or flowable fill. Prepare grout or flowable fill to a consistency that will flow and be vibrated in order for the mix to flow uniformly into the pipe to be filled.
      b. Pipe larger than 24".
      c. Pipe located within the foot print of an existing building, the roadway typical section or the project slope stake line and one of the following:
         1) Pipe 12" to 24" diameter located less than 20 ft below finished grade.
         2) Pipe 6" to 12" diameter located less than 12 ft below finished grade and not made of ductile iron, HDPE or PVC.
         3) Located below groundwater table that could become a conduit for water movement.

C. Remove existing Utility Pipes
   1. Excavate, remove and dispose of properly any abandoned pipe to be removed when so designated in the plans or as directed. When an existing pipe is encountered that is not shown in the plans, do not remove until the Engineer is notified of its presence and has directed its removal.
   2. Remove any abandoned utility pipe exposed by grading operations to a minimum depth of 12" below subgrade elevation of the proposed roadbed or grading plan.
   3. Backfill the resulting trench and properly compact using local excavated material or select backfill as required.

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4. Salvaged pipe is the property of the Contractor unless otherwise indicated by the plans.
5. Plug all abandoned utility pipes. Use grout to plug all abandoned utility pipes at the entrance to all manholes whether the manhole is to be abandoned or not. Use grout to plug all abandoned water mains after new mains are placed in service.
6. Discharge flowable fill material directly from the truck into the space to be filled or by other approved methods. The mix may be placed full depth or in lifts as site conditions warrant.
7. Pipeline abandonment or disconnection to Provo City Utilities shall be as per Provo City Standards.

D. Abandoning Manholes
1. Abandon utility manholes in the construction limits by removing the top of the manhole to the manhole spring line or to an elevation of 2 ft below the roadway subgrade, whichever is greater and filling the manhole barrel with approved material.
2. Plug connecting utility pipes before filling or removing the manhole.
3. Remove the manhole taper, wall and base on all manholes to be removed.
4. Removed frames and covers become the property of the OWNER, unless otherwise noted.

E. Remove Water Meter
1. Remove water meters by disconnecting and plugging the water service piping at the source main and plugging the piping at the right-of-way line. Return the meter to the utility owner. Dispose of all other parts, piping, boxes and structures.
2. As per Provo City Standards

F. Remove Fire Hydrant
1. Remove fire hydrants by disconnecting and plugging the hydrant leg piping as close to the water main as possible. If the hydrant valve is within 4 ft of the main, close the valve, plug the outlet side of the valve and remove the valve box.
2. Removed hydrants become the property of the OWNER, unless otherwise noted.

3.05 SELECTIVE DEMOLITION FOR ALTERATIONS

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

B. Separate areas in which demolition is being conducted from other areas that are still occupied.
1. Provide, erect, and maintain temporary dustproof partitions of construction indicated on drawings in locations indicated on drawings.

C. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.

D. Remove existing work as indicated and as required to accomplish new work.
1. Remove items indicated on drawings.

E. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, Telecommunications, and _____): Remove existing systems and equipment as indicated.
1. Maintain existing active systems that are to remain in operation; 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. Verify that abandoned services serve only abandoned facilities before removal.

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4. 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 if necessary.
   2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
   3. Repair adjacent construction and finishes damaged during removal work.
   4. Patch as specified for patching new work.

3.06 DEBRIS AND WASTE REMOVAL

A. Remove debris, junk, and trash from site.

B. Remove from site all materials not to be reused on site; dispose of these materials in a lawful manner.

C. Leave site in clean condition, ready for subsequent work.

D. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

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SECTION 064100
ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Specially fabricated cabinet units.
B. Cabinet hardware.
C. Factory finishing.
D. Preparation for installing utilities.

1.02 RELATED REQUIREMENTS

A. Section 061000 - Rough Carpentry: Support framing, grounds, and concealed blocking.
B. Section 123600 - Countertops.

1.03 REFERENCE STANDARDS

A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014, with Errata (2016).
B. AWI (QCP) - Quality Certification Program; current edition at www.awiqcp.org.
C. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014, with Errata (2016).
D. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.1; 2016, with Errata (2017).
E. BHMA A156.9 - American National Standard for Cabinet Hardware; 2015.
F. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood; 2016.
G. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting not less than one week before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.
B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
   1. Provide the information required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).
   2. Include certification program label.
C. Product Data: Provide data for hardware accessories.
D. Samples: Submit actual samples of architectural cabinet construction, minimum 12 inches square, illustrating proposed cabinet, countertop, and shelf unit substrate and finish.
E. Samples: Submit actual sample items of proposed pulls, hinges, shelf standards, and locksets, demonstrating hardware design, quality, and finish.
F. Certificate: Submit labels and certificates required by quality assurance and quality control programs.

I, Bruce T. Fallon, AIA the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers.

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1.06 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: www.awiqcp.org/#sle.
   2. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) requirements for grade or grades specified.
   3. Provide designated labels on shop drawings as required by certification program.
   4. Provide designated labels on installed products as required by certification program.
   5. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.
   6. Replace, repair, or rework all work for which certification is refused.

1.07 MOCK-UP

A. Provide mock-up of typical base cabinet, wall cabinet, and countertop, including hardware, finishes, and plumbing accessories.

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

C. Locate where directed.

D. Mock-up may remain as part of the Work.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Protect units from moisture damage.

1.09 FIELD CONDITIONS

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

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. Wood Veneer Faced Cabinet:
   1. Exposed Surfaces: HPVA HP-1 Grade A, Red Oak, Walnut, Maple, or Cherry, Architect to confirm cut type with BYU, Architect to confirm matching type with BYU.
   2. Semi-Exposed Surfaces: HPVA HP-1 Grade A, Red Oak, Cherry, Maple, Walnut, Poplar, Pine, Architect to confirm cut type with BYU, Architect to confirm matching type with BYU.
   3. Concealed Surfaces: Manufacturer's option using plywood materials, not particle board or MDF.
   4. All cabinet material shall be a minimum of 3/4" thick.
   5. No particle board or MDF is allowed in the cabinet construction.

C. Plastic Laminate Faced Cabinets: Not allowed, unless specifically requested by BYU.

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D. Cabinets:
   1. Finish - Exposed Exterior Surfaces: Wood.
   2. Finish - Exposed Interior Surfaces: Wood.
   3. Finish - Semi-Exposed Surfaces: Wood
   4. Finish - Concealed Surfaces: Manufacturer's option using plywood materials, not particle board or MDF.
   5. Door and Drawer Front Edge Profiles: Square edge with thin applied band.
   6. Grained Face Layout for Cabinet and Door Fronts: Flush panel.
      a. Custom Grade: Doors, drawer fronts and false fronts wood grain to run and match vertically within each cabinet unit.
   7. Cabinet Design Series: As indicated on drawings.
   8. Adjustable Shelf Loading: 50 lbs. per sq. ft.
      a. Deflection: L/144.
   9. Cabinet Doors and Drawer Fronts: As indicated.
   10. Drawer Side Construction: Multiple-dovetailed.
   11. Drawer Construction Technique: Dovetail joints.

2.02 LAMINATE MATERIALS

A. Manufacturers:
   1. Formica Corporation; ____: www.formica.com/#sle.
   2. Panolam Industries International, Inc; Nevamar; ____: www.nevamar.com/#sle.
   3. Wilsonart; ____: www.wilsonart.com/#sle.

B. Thermally Fused Laminate (TFL): Melamine resin, NEMA LD 3, Type VGL laminate panels.
   1. Manufacturers:
      a. Wilsonart; _____: www.wilsonart.com/#sle.

C. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications.

D. Provide specific types as follows:
   1. Horizontal Surfaces: HGS, 0.048 inch nominal thickness, through color, color as selected, finish as indicated.
   2. Vertical Surfaces: VGS, 0.028 inch nominal thickness, through color, _____ color, finish as indicated.

2.03 COUNTERTOPS

A. Countertops are specified in Section 123600.

2.04 ACCESSORIES

A. Adhesive: Type recommended by AWI/AWMAC to suit application.

B. Plastic Edge Banding: Extruded PVC, flat 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 at all exposed plywood edges.
   3. Use at all exposed shelf edges.
   4. Min. 3mm edge band thickness.

C. Fasteners: Size and type to suit application.

D. Concealed Joint Fasteners: Threaded steel.

2.05 HARDWARE

A. Hardware: BHMA A156.9, types as indicated for quality grade specified.

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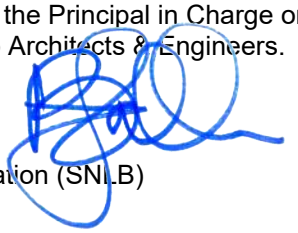
Signature & Date:  03.15.2024

B. Adjustable Shelf Supports: Standard back-mounted system using surface mounted metal shelf standards and coordinated cantilevered shelf brackets, satin chrome (Anochrome) finish, for nominal 1 inch spacing adjustments. Maximum spacing between standards shall not exceed 32-inches. Attachment of standard shall be into studs or solid backing. The brackets shall be seismically - anchored to the wall standard. The shelves shall be seismically-anchored to the brackets.
   1. Product: KV #85, double-slot standard; KV #185 double-slot bracket manufactured by Knape and Vogt (KV).

C. Drawer and Door Pulls: "U" shaped wire pull, steel with satin finish, 4 inch centers.

D. Sliding Door Pulls: Circular shape for recessed installation, steel with satin finish.

E. Cabinet Locks: Keyed cylinder, two keys per lock, master keyed, steel with chrome finish, with manufacturer's lock number stamped on lock face.
   1. Use Deadbolt Style. CompX National Lock C8703-MKKD-14A

F. Catches: Magnetic.

G. Drawer Slides:
   1. Type: Full extension.
   2. Static Load Capacity: medium-duty (150-lbs or less), heavy-duty (more than 150-lbs).
   3. Mounting: side-mounting; a screw in each screw hole..
   4. Stops: Integral type.
   5. Manufacturers:
      a. Accuride International, Inc; Web Address: www.accuride.com/#sle.
      b. Knape & Vogt Manufacturing Company; Heavy-Duty Drawer Slides: www.knapeandvogt.com/#sle.
      c. Substitutions: See Section 016000 - Product Requirements.

H. Hinges: European style concealed self-closing type, steel with satin finish.
   1. Manufacturers:
      a. Hettich America, LP; Web Address: www.hettich.com/#sle.
      b. Blum, Inc; Web Address: www.blum.com/#sle.
      c. No more than 24-inches between hinges..

I. Soft Close Adapter: Concealed, frame-mounted, screw-adjustable damper ; steel with brushed nickel finish.

J. Sliding Door Track Assemblies: Upper and lower track of satin anodized aluminum, with matching shoe equipped with nylon rollers.

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.
   1. Cap exposed plastic laminate finish edges with material of same finish and pattern.

E. Matching Wood Grain: Comply with requirements of quality standard for specified Grade and as follows:
   1. Provide center matched panels at each elevation.
   2. Provide sequence matching across each elevation.

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F. Mechanically fasten back splash to countertops as recommended by laminate manufacturer at 16 inches on center.

G. Provide cutouts for plumbing fixtures, inserts, appliances, outlet boxes, and fixtures and fittings. Verify locations of cutouts from on-site dimensions. Prime paint cut edges.

2.07 SHOP FINISHING

A. Sand work smooth and set exposed nails and screws.

B. For opaque finishes, apply wood filler in exposed nail and screw indentations and sand smooth.

C. On items to receive transparent finishes, use wood filler matching or blending with surrounding surfaces and of types recommended for applied finishes.

D. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:
   1. Transparent:
      a. System - 5, Varnish, Conversion
      b. Stain: As selected by Architect.
      c. Sheen: Semigloss. AWI Sheen Level 50 - 70.
      d. Products:
         1) MEGAVAR, Water White Conversion Varnish 1M.430X (1A.622 Catalyst) by Lenmar Coatings, www.lenmar-coatings.com. _____.
            (a) Application:
               (1) Two Coats.
               (2) Apply in strict compliance with manufacturer's technical data sheet.

         2) Substitutions: Section 016000 - Product Requirements.

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. Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood; finish flush with surrounding surfaces.

3.03 ADJUSTING

A. Adjust installed work.

B. Adjust moving or operating parts to function smoothly and correctly.

I, Bruce T. Fallon, AIA the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers.

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3.04 CLEANING

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

END OF SECTION

I, Bruce T. Fallon, AIA the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers.

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SECTION 072100

THERMAL INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Sound attenuation batt insulation in interior wall construction and above ceilings where indicated on drawings.

1.02 RELATED REQUIREMENTS

A. Section 016116 - Volatile Organic Compound (VOC) Content Restrictions.

B. Section 031119 - Insulating Concrete Forming: Polystyrene insulation used for forms.

C. Section 042723 - Cavity Wall Unit Masonry: Masonry walls enclosing insulation.

D. Section 072119 - Foamed-In-Place Insulation: Plastic foam insulation other than boards.

E. Section 072123 - Loose Fill Insulation: Granular and bead insulation.

F. Section 072126 - Blown Insulation: Blown-in, gravity-held fibrous insulation.

G. Section 072129 - Sprayed Insulation: Sprayed-on, adhered fibrous insulation.

H. Section 072500 - Weather Barriers: Separate air barrier and vapor retarder materials.

I. Section 075300 - Elastomeric Membrane Roofing: Installation requirements for board insulation over low slope roof deck specified in this section.

J. Section 075400 - Thermoplastic Membrane Roofing: Installation requirements for board insulation over low slope roof deck specified in this section.

K. Section 078400 - Firestopping: Insulation as part of fire-rated through-penetration assemblies.

L. Section 092116 - Gypsum Board Assemblies: Acoustic insulation inside walls and partitions.

1.03 REFERENCE STANDARDS

A. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2016.

B. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.

C. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2016.

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.

E. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.

F. ASTM E136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace At 750 Degrees C; 2016a.

G. ASTM E2357 - Standard Test Method for Determining Air Leakage of Air Barrier Assemblies; 2017.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

D. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.

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1.05 QUALITY ASSURANCE

A. Quality Assurance Requirements:
   1. Installer Qualification: Use licensed contractor and installers with minimum of 5 years experience.
   2. Manufacturer Qualification: Use evaluated materials from a single manufacturer regularly engaged in air barrier material manufacture. Use secondary materials approved in writing by primary material manufacturer.
   3. Provide a five year warranty covering materials.

1.06 FIELD CONDITIONS

A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2 PRODUCTS

2.01 APPLICATIONS

A. Insulation in Metal Framed Walls: Sound attenuation batt insulation with no vapor retarder.

2.03 BATT INSULATION MATERIALS

A. Where batt insulation is indicated, either glass fiber or mineral fiber batt insulation may be used, at Contractor's option.

B. Glass Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C665; friction fit.
   1. Flame Spread Index: 75 or less, when tested in accordance with ASTM E84.
   2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
   3. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.
   4. Formaldehyde Content: Zero.
   5. Thickness: As Indicated on Drawings.
   6. Manufacturers:
      a. CertainTeed Corporation; _____: www.certainteed.com
      b. Johns Manville; _____: www.jm.com
      c. Owens Corning Corporation; EcoTouch PINK FIBERGLAS Insulation: www.ocbuildingspec.com

C. Mineral Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C665; friction fit; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.
   1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
   2. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.
   3. Thickness: As Indicated on Drawings.
   4. Manufacturers:
      a. Johns Manville; MinWool Sound Attenuation Fire Batts: www.jm.com
      b. Knauf Insulation; EcoBatt Insulation: www.knaufinsulation.com
      c. ROCKWOOL (ROXUL, Inc); COMFORTBATT: www.rockwool.com
      d. ROCKWOOL (ROXUL, Inc); AFB: www.rockwool.com
      e. ROCKWOOL (ROXUL, Inc); AFB evo™: www.rockwool.com
      f. Thermafiber, Inc; SAFB: www.thermafiber.com
      g. Thermafiber, Inc; SAFB FF: www.thermafiber.com

2.04 ACCESSORIES

A. Insulation Fasteners: Appropriate for purpose intended and approved by roofing manufacturer.

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1. Length as required for thickness of insulation material and penetration of deck substrate.

B. Adhesively Attached, Spindle-Type Anchors:
   1. Description: Plate welded to projecting spindle; capable of holding insulation of thickness indicated securely in position indicated with self-locking washer in place; and complying with the following requirements:
      a. Plate: Perforated galvanized carbon-steel sheet, 0.030 in (0.75mm) thick by 2 in (50mm) square.
      b. Spindle: Copper-coated, low caron steel; fully annealed; 0.105 in (2.62 mm) in diameter; length to suit depth of insulation indicated.
   2. Manufacturers and Products:
      a. AGM Industries, Inc.: Perforated TACTOO Insulation Hangers.
      b. Gemco; Spindle Type Perforated Base Insulation Hangers.

C. Insulation Retaining Washers:
   1. Description: Self Locking washers formed from 0.016 in (0.4mm) thick galvanized steel sheet with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 in (38mm) square or in diameter.
   2. Manufacturers and Products:
      a. AGM Industries, Inc; RC150
      b. AGM Industries, Inc; SC150
      c. Gemco; R-150.
      d. Gemco; S-150.

D. Insulation Standoff:
   1. Description: Spacer fabricated from galvanized mild-steel for fitting over spindle of insulation anchor to maintain air space of 1 in (25 mm) between face of insulation and substrate to which anchor is attached.
   2. Basis of Design Manufacturer and Product: Gemco; Clutch Clip.

E. Anchor Adhesive:
   1. Description: Product with demonstrated capability to bond insulation anchors securely to substrates indicated without damaging insulation, fasteners, and substrates.
   2. Manufacturers and Products:
      a. AGM Industries, Inc.; TACTOO GPA72 Adhesive.
      b. Gemco; Tuff-Bond Hanger Adhesive.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.

B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.02 BATT INSTALLATION

A. Install insulation and vapor retarder in accordance with manufacturer's instructions.

B. Install in exterior wall and roof spaces without gaps or voids. Do not compress insulation.

C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.

D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

I, Bruce T. Fallon, AIA the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers.

Signature & Date: 03.15.2024

3.08 FIELD QUALITY CONTROL

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

B. Coordination of Tests and Inspections:
   1. Testing and inspection by owner.
   2. Notify owner in writing of schedule for testing and inspection.
   3. Cooperate with owners testing agency.
   4. Allow access to insulation work areas and staging.
   5. Do not cover air barrier and insulation work until tested, inspected, and accepted.

3.09 PROTECTION

A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION

I, Bruce T. Fallon, AIA the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers.

Signature & Date: 03.15.2024

SECTION 079200

JOINT SEALANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nonsag gunnable joint sealants.

B. Self-leveling pourable joint sealants.

C. Joint backings and accessories.

D. Owner-provided field quality control.

1.02 RELATED REQUIREMENTS

A. Section 016116 - Volatile Organic Compound (VOC) Content Restrictions: Additional requirements for sealants and primers.

B. Section 071300 - Sheet Waterproofing: Sealing cracks and joints in waterproofing substrate surfaces using materials specified in this section.

C. Section 072500 - Weather Barriers: Sealants required in conjunction with air barriers and vapor retarders.

D. Section 087100 - Door Hardware: Setting exterior door thresholds in sealant.

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

F. Section 092216 - Non-Structural Metal Framing: Sealing between framing and adjacent construction in acoustical and sound-rated walls and ceilings.

G. Section 233100 - HVAC Ducts and Casings: Duct sealants.

1.03 REFERENCE STANDARDS

A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer; 2015.

B. ASTM C834 - Standard Specification for Latex Sealants; 2014.

C. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications; 2012.

D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014a.

E. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016.

F. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants; 2008 (Reapproved 2012).

G. ASTM C1311 - Standard Specification for Solvent Release Sealants; 2014.

H. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints; 2013.

I. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2015.

J. SWRI (VAL) - SWR Institute Validated Products Directory; Current Listings at www.swrionline.org.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes the following.

I, Bruce T. Fallon, AIA the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers.

Signature & Date: 03.15.2024

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. Installation instructions, including precautions, limitations, and recommended backing materials and tools.
7. Sample product warranty.
8. Certification by manufacturer indicating that product complies with specification requirements.
9. SWRI Validation: Provide currently available sealant product validations as listed by SWRI (VAL) for specified sealants.

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.

D. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.

E. Samples for Verification: Where custom sealant color is specified, obtain directions from Owner and Architect and submit at least two physical samples for verification of color of each required sealant.

F. Installation Plan: Submit at least four weeks prior to start of installation.

G. Field Quality Control Plan: Submit at least two weeks prior to start of installation.

H. Installation Log: Submit filled out log for each length or instance of sealant installed.

I. Field Quality Control Log: Submit filled out log for each length or instance of sealant installed, within 10 days after completion of inspections/tests; include bagged test samples and photographic records, if any.

1.05 QUALITY ASSURANCE

A. Maintain one copy of each referenced document covering installation requirements on site.

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 with at least three years of documented experience.

D. Installation Plan: Include schedule of sealed joints, including the following.
1. Approximate date of installation, for evaluation of thermal movement influence.

E. Field Quality Control Plan:
1. Visual inspection of entire length of sealant joints.
2. Destructive field adhesion testing of sealant joints, except interior sealant joints.
   a. For each different sealant and substrate combination, allow for one test every 100 feet in the first 1000 linear feet, and one test per 1000 linear feet thereafter, or once per floor on each elevation.
   b. If any failures occur in the first 1000 linear feet, continue testing at frequency of one test per 500 linear feet at no extra cost to Owner.

1.06 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Correct defective work within a five year period after Date of Substantial Completion.

C. Warranty: Include coverage for installed sealants and accessories that fail to achieve watertight seal , exhibit loss of adhesion or cohesion, or do not cure.

I, Bruce T. Fallon, AIA the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers.

Signature & Date: 03.15.2024

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Non-Sag Sealants: Permits application in joints on vertical surfaces without sagging or slumping.
   1. Dow Chemical Company; _____: consumer.dow.com/en-us/industry/ind-building-construction.html
   2. Sika Corporation; _____: www.usa-sika.com
   3. Tremco Commercial Sealants & Waterproofing; ____: www.tremcosealants.com

B. Self-Leveling Sealants: Pourable or self-leveling sealant that has sufficient flow to form a smooth, level surface when applied in a horizontal joint.
   1. Dow Chemical Company; _____: consumer.dow.com/en-us/industry/ind-building-construction.html
   2. Sika Corporation; _____: www.usa-sika.com
   3. Tremco Commercial Sealants & Waterproofing; ____: www.tremcosealants.com

2.02 JOINT SEALANT APPLICATIONS

A. Scope:
   1. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
      a. Joints between door, window, and other frames and adjacent construction.
      b. In sound-rated wall and ceiling assemblies, gaps at electrical outlets, wiring devices, piping, and other openings; between wall/ceiling and other construction; and other flanking sound paths.
         1) Exception: Such gaps and openings in gypsum board and plaster finished stud walls and suspended ceilings.
         2) Exception: Open-, membrane-, and through-penetrations in sound-rated assemblies that are also fire-rated assemblies.
      c. Other joints indicated below.
   2. Do not seal the following types of joints.
      a. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
      b. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
      c. Joints where installation of sealant is specified in another section.
      d. Joints between suspended panel ceilings/grid and walls.

B. Interior Joints: Use non-sag polyurethane sealant, paintable, unless otherwise indicated.

2.03 JOINT SEALANTS - GENERAL

A. Sealants and Primers: Provide products with levels of volatile organic compound (VOC) content as indicated in Section 016116.

B. Colors: As indicated on drawings.

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. Color: To be selected by Architect from manufacturer's standard range.
   2. Manufacturers:
      a. Dow Chemical Company; 790 Silicone Building Sealant: consumer.dow.com/en-us/industry/ind-building-construction.html
      b. Dow Chemical Company; 795 Silicone Building Sealant: consumer.dow.com/en-us/industry/ind-building-construction.html
      c. Sika Corporation; Sikasil WS-290: www.usa-sika.com

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d. Sika Corporation; Sikasil WS-295: www.usa-sika.com
e. Tremco Commercial Sealants & Waterproofing; Spectrem 1: www.tremcosealants.com
f. Tremco Commercial Sealants & Waterproofing; Spectrem 2: www.tremcosealants.com
g. Substitutions: See Section 016000 - Product Requirements.

B. Type ___ - Hybrid Urethane Sealant: ASTM C920, Grade NS, Uses M and A; single component; not expected to withstand continuous water immersion or traffic.
1. Movement Capability: Plus and minus 35 percent, minimum.
2. Color: To be selected by Architect from manufacturer's standard range.
3. Manufacturers:
a. Substitutions: See Section 016000 - Product Requirements.

C. Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multi-component; not expected to withstand continuous water immersion or traffic.
1. Movement Capability: Plus and minus 25 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 standard range.
4. Manufacturers:
a. Sherwin-Williams Company; Stampede-1/-TX Polyurethane Sealant: www.sherwin-williams.com
b. Tremco Commercial Sealants & Waterproofing; Dymeric 240 FC: www.tremcosealants.com

2.05 SELF-LEVELING SEALANTS

A. Self-Leveling Silicone Sealant: ASTM C920, Grade P, Uses M and A; single-component, explicitly approved by manufacturer for traffic exposure when recessed below traffic surface; not expected to withstand continuous water immersion.
1. Movement Capability: Plus 100 percent, minus 50 percent, minimum.
2. Hardness Range: 0 to 15, Shore A, when tested in accordance with ASTM C661.
3. Color: To be selected by Architect from manufacturer's standard range.
4. Service Temperature Range: Minus 40 to 180 degrees F.
5. Manufacturers:
a. Sika Corporation; Sikasil 728SL: www.usa-sika.com
b. Tremco Commercial Sealants & Waterproofing; Spectrem 900SL: www.tremcosealants.com

2.06 ACCESSORIES

A. Backer Rod: Cylindrical open cellular foam rod compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
1. Open Cell: 40 to 50 percent larger in diameter than joint width.

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.

C. Masking Tape: Self-adhesive, nonabsorbent, non-staining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.

D. Joint Cleaner: Non-corrosive and non-staining type, type recommended by sealant manufacturer; compatible with joint forming materials.

E. Primers: Type recommended by sealant manufacturer to suit application; non-staining.

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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.

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.

E. Concrete Floor Joints That Will Be Exposed in Completed Work: Test joint filler in inconspicuous area to verify that it does not stain or discolor slab.

3.03 INSTALLATION

A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

B. Perform installation in accordance with ASTM C1193.

C. Perform 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 sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.

F. 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.

G. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

H. Concrete Floor Joint Filler: After full cure, shave joint filler flush with top of concrete slab.

3.04 FIELD QUALITY CONTROL

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

B. Perform field quality control inspection/testing as specified in PART 1 under QUALITY ASSURANCE article.

C. Non-Destructive Adhesion Testing: If there are any failures in first 100 linear feet, notify Architect immediately.

D. Destructive Adhesion Testing: If there are any failures in first 1000 linear feet, notify Architect immediately.

E. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.

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F. Repair destructive test location damage immediately after evaluation and recording of results.

END OF SECTION

I, Bruce T. Fallon, AIA the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers.

Signature & Date: 03.15.2024

SECTION 081113
HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Hollow metal frames for wood doors.

B. Hollow metal borrowed lites glazing frames.

C. Accessories, including glazing, louvers, and matching panels.

1.02 RELATED REQUIREMENTS

A. Section 087100 - Door Hardware.

B. Section 088000 - Glazing: Glass for doors and borrowed lites.

C. Section 099123 - 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 - Americans with Disabilities Act (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; 2011.

C. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2014.

D. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2011.

E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

F. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2016.

G. 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; 2015.

H. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009 (Reapproved 2016).

I. ASTM E413 - Classification for Rating Sound Insulation; 2016.

J. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

I, Bruce T. Fallon, AIA the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers.

Signature & Date: 03.15.2024

K. NAAMM HMMA 840 - Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames; 2007.

L. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames; 2006.

M. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2016.

N. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2016.

O. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2012.

P. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames; 2013.

Q. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

R. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

S. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for 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 Qualification Statement.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

C. 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
   2. Curries, an Assa Abloy Group company; _____: www.assaabloydss.com
   3. Steelcraft, an Allegion brand; ____: www.allegion.com
   4. All hardware locations to be per CECO standard locations.

2.02 DESIGN CRITERIA

A. Requirements for Hollow Metal Doors and Frames:

I, Bruce T. Fallon, AIA the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers.

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1. Steel used for fabrication of doors and frames shall comply with one or more of the following requirements; Galvannealed steel conforming to ASTM A653/A653M, cold-rolled steel conforming to ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel conforming to 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. Typical Door Face Sheets: Flush.
5. Zinc Coating for Typical Interior and/or Exterior Locations: Provide metal components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvannealed) 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 (galvannealed) when necessary, coating not required for typical interior door applications, and at least A60/ZF180 (galvannealed) for corrosive locations.

B. Hollow Metal Panels: Same construction, performance, and finish as doors.

C. 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 FRAMES

A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.

B. Frame Finish: Architect to confirm finish with BYU.

C. Interior Door Frames, Non-Fire Rated: Face welded type.
1. Frame Metal Thickness: 16 gage, 0.053 inch, minimum.
2. Knock-down door frames are allowed in remodeling applications but not in new construction.

D. Frames for Wood Doors: Comply with frame requirements in accordance with corresponding door.

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 inch 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.

H. Frames Installed Back-to-Back: Reinforce with steel channels anchored to floor and overhead structure.

2.05 FINISHES

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

2.06 ACCESSORIES

A. Glazing: As specified in Section 088000, factory installed.

B. Astragals for Double Doors: Specified in Section 087100.

C. Mechanical Fasteners for Concealed Metal-to-Metal Connections: Self-drilling, self-tapping, steel with electroplated zinc finish.

D. Grout for Frames: Portland cement grout with maximum 4 inch slump for hand troweling; thinner pumpable grout is prohibited.

I, Bruce T. Fallon, AIA the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers.

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E. 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.

F. 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 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. Coordinate frame anchor placement with wall construction.

C. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.

D. Install door hardware as specified in Section 087100.

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 in accordance with the painting sections of this specification.

3.03 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.

3.04 ADJUSTING

A. Adjust for smooth and balanced door movement.

B. Adjust sound control doors so that seals are fully engaged when door is closed.

C. Test sound control doors for force to close, latch, and unlatch; adjust as necessary in compliance with requirements.

3.05 SCHEDULE

A. Refer to Door and Frame Schedule on the drawings.

END OF SECTION

I, Bruce T. Fallon, AIA the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers.

Signature & Date: 03.15.2024

SECTION 081416

FLUSH WOOD DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

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

B. Transom panels.

1.02 RELATED REQUIREMENTS

A. Section 062000 - Finish Carpentry: Wood door frames.

B. Section 081113 - Hollow Metal Doors and Frames.

C. Section 087100 - Door Hardware.

D. Section 088000 - Glazing.

E. Section 099123 - Interior Painting: Field finishing of doors.

1.03 REFERENCE STANDARDS

A. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2012.

B. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009 (Reapproved 2016).

C. ASTM E413 - Classification for Rating Sound Insulation; 2016.

D. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014, with Errata (2016).

E. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.1; 2016, with Errata (2017).

F. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2016.

G. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

H. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for 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.

D. Samples: Submit two samples of door veneer, 12 x 12 inch in size illustrating wood grain, stain color, and sheen.

E. Certificate: Submit labels and certificates required by quality assurance and quality control programs.

F. Test Reports: Show compliance with specified requirements for the following:
   1. Sound-retardant doors and frames; sealed panel tests are not acceptable.

G. Manufacturer's Installation Instructions: Indicate special installation instructions.

H. Specimen warranty.

I. Warranty, executed in Owner's name.

I, Bruce T. Fallon, AIA the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers.

Signature & Date: 03.15.2024

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.

B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.

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. Inspect for damage.

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

1.07 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Interior Doors: Provide manufacturer's warranty for the life of the installation.

C. 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: www.masonite.com
   2. Marshfield DoorSystems, Inc; ____: www.marshfielddoors.com.
   3. Oshkosh Door Company.
   4. VT Industries
   5. All hardware locations to be per CECO standard locations.

2.02 DOORS AND PANELS

A. Doors: Refer to drawings for locations and additional requirements.
   1. Quality Standard: Custom Grade, Heavy Duty performance, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
   2. Wood Veneer 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.

C. Transom Panels: Same construction and finish as door; same performance rating as door.

2.03 DOOR AND PANEL CORES

A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated.

2.04 DOOR FACINGS

A. Veneer Facing for Transparent Finish: Architect to confirm species type with BYU, veneer grade in accordance with quality standard indicated, plain sliced (flat cut), with Architect to confirm matching type with BYU between leaves of veneer, running match of spliced veneer leaves assembled on door or panel face.
   1. Vertical Edges: Same species as face veneer.
   2. "Running Match" each pair of doors and doors in close proximity to each other.

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3. Transoms: Continuous match to doors.

B. Veneer Facing for Opaque Finish: Medium density overlay (MDO), in compliance with indicated quality standard.

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 for hardware reinforcement.
   2. Provide solid blocking for other through bolted hardware.

C. Where supplementary protective edge trim is required, install trim after veneer facing has been applied full-width.

D. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.

E. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.
   1. Exception: Doors to be field finished.

F. Provide edge clearances in accordance with the quality standard specified.

2.06 FACTORY FINISHING - WOOD VENEER DOORS

A. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:
   1. Transparent:
      a. System - 11, Polyurethane, Catalyzed.
      b. Stain: As selected by Architect.
      c. Sheen: Semigloss.

B. Factory finish doors in accordance with approved sample.

2.07 ACCESSORIES

A. Hollow Metal Door Frames: As specified in Section 081113.

B. Glazed Openings:
   1. Heat-Strengthened and Fully Tempered Glass: ASTM C1048.

C. Glazing Stops: Wood, of same species as door facing, butted corners; prepared for countersink style tamper proof screws.

D. Astragals for Non-Rated Double Doors: Steel, T shaped, overlapping and recessed at face edge.

E. Astragals for Fire-Rated Double Doors: Steel, T shaped, overlapping and recessed at face edge, specifically for double doors.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

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.

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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. Conform to specified quality standard for fit and clearance tolerances.

B. Conform to 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.

3.05 SCHEDULE

A. Refer to Door and Frame Schedule appended to this section.

END OF SECTION

I, Bruce T. Fallon, AIA the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers.

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SECTION 084313

ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aluminum-framed storefront, with vision glass.

B. Infill panels of metal and glass.

C. Aluminum doors and frames.

D. Weatherstripping.

E. Door hardware.

1.02 RELATED REQUIREMENTS

A. Section 072500 - Weather Barriers: Sealing framing to weather barrier installed on adjacent construction.

B. Section 078400 - Firestopping: Firestop at system junction with structure.

C. Section 079200 - Joint Sealants: Sealing joints between frames and adjacent construction.

D. Section 084229 - Automatic Entrances.

E. Section 087100 - Door Hardware: Hardware items other than specified in this section.

F. Section 088000 - Glazing: Glass and glazing accessories.

G. Section 122400 - Window Shades: Attachments to framing members.

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 (Combined Document); 2015.

E. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2014 (2015 Errata).

F. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

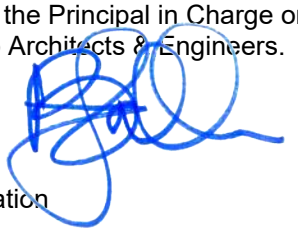
G. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.

H. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.

I. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.

J. 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.

I, Bruce T. Fallon, AIA the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers.

Signature & Date:  03.15.2024

K. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014.

L. ASTM E783 - Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors; 2002 (Reapproved 2010).

M. 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.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with installation of other components that comprise the exterior enclosure.

B. Preinstallation Meeting: Conduct a preinstallation meeting two weeks before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, 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 12 by 12 inches in size illustrating finished aluminum surface, glass, infill panels, glazing materials.

E. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.

F. Design Data: Provide framing member structural and physical characteristics, engineering calculations, and dimensional limitations.

G. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.

H. Report of field testing for water leakage.

I. Designer Qualifications Statement.

J. Manufacturer Qualifications Statement.

K. Installer Qualifications Statement.

L. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

A. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in Utah.

B. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

C. Installer Qualifications: Company specializing in performing work of type specified and with at least three 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.

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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 five year period after Date of Substantial Completion.

C. Provide five year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.

D. Provide five year 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 BASIS OF DESIGN -- FRAMING FOR MONOLITHIC GLAZING

A. Center-Set Style:
   1. Basis of Design: Kawneer.
   2. Vertical Mullion Dimensions: 1-3/4 inches wide by 4-1/2 inches deep (Interior); 2 inches wide by 4-1/2" inches deep, thermally broken (exterior)

2.02 BASIS OF DESIGN -- SWINGING DOORS

A. Wide Stile, Monolithic Glazing:
   1. Basis of Design: Kawneer.
   2. Thickness: 2 inches. Heavy Wall.

B. Wide Stile, Insulating Glazing, Thermally-Broken:
   1. Basis of Design: Kawneer.
   2. Thickness: 2 inches. Heavy wall.

2.03 MANUFACTURERS

A. Aluminum-Framed Storefront and Doors:
   1. Kawneer North America; _____: www.kawneer.com

2.04 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 inch insulating glazing.
   2. Glazing Rabbet: For 1/4 inch monolithic glazing.
   3. Glazing Position: Centered (front to back).
   4. Vertical Mullion Dimensions: 2 inches wide by 4-1/2 inches deep.
   5. Finish: Class I natural anodized.
   6. Aluminum-Framed Storefront Door Framing Package: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
      a. Glazing Rabbet: For 1 inch insulating glazing.
      b. Glazing Rabbet: For 1/4 inch monolithic glazing.
      c. Glazing Position: Centered (front to back).
      d. Vertical and Horizontal Mullion Dimensions: 2 inches wide by 4-1/2 inches deep. Heavy wall heavy.
      e. Finish: Powdercoat

I, Bruce T. Fallon, AIA the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers.

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7. Finish Requirements:
   a. Factory finish all surfaces that will be exposed in completed assemblies.
   b. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
8. Finish Color: As indicated on the drawings.
9. 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.
10. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
11. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
12. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
13. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
14. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
15. Air and Vapor Seal: Maintain continuous air barrier and vapor retarder throughout assembly, primarily in line with inside pane of glazing and inner sheet of infill panel and heel bead of glazing compound.
16. Preparation for Window Treatments: Provide reinforced interior horizontal head rail.

B. PERFORMANCE REQUIREMENTS
1. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
   a. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
2. Air Leakage: 0.06 cfm/sq ft maximum leakage of storefront wall area when tested in accordance with ASTM E283/E283M at 1.57 psf pressure difference.

2.06 COMPONENTS

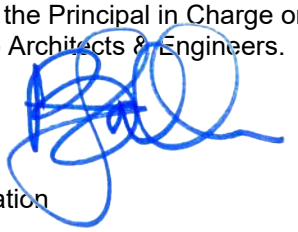
A. Aluminum Framing Members: Tubular aluminum sections, drainage holes and internal weep drainage system.
1. Framing members for interior applications need not be thermally broken.
2. Glazing Stops: Applied.

B. Glazing: As specified in Section 088000.
1. For Exterior Framing: Type Solarband 70XL #2 surfaced, fully tempered.
2. For Interior Framing: Type 1/4" tempered glass.
3. Glass Spandrel Panels: Type 1/4" tempered glass.

C. Infill Panels: Insulated, aluminum sheet face and back, with edges formed to fit glazing channel and sealed.
1. Finish: Same as storefront.

D. Swing Doors: Glazed aluminum.
1. Thickness: 2 inches.
2. Top Rail: 5 inches wide.
3. Vertical Stiles: 5 inches wide.

I, Bruce T. Fallon, AIA the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers.

Signature & Date:  03.15.2024

4. Bottom Rail: 10 inches wide.
5. Glazing Stops: Beveled.
6. Finish: Same as storefront.

2.07 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).

B. Sheet Aluminum: ASTM B209 (ASTM B209M).

C. Fasteners: Stainless steel.

D. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

2.08 FINISHES

A. Kaweneer Permacoat™ AAMA 2604, Powder Coating

B. Color: As indicated on drawings.

2.09 HARDWARE

A. For each door, include weatherstripping, sill sweep strip, and threshold.

B. Hinges: Geared type, heavy duty, concealed leaf; continuous.

C. Push/Pull Set: Standard configuration push/pull handles.

D. Exit Devices: Panic type.

E. Door Closers: Exposed overhead.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other work.

B. Verify that wall openings and adjoining air and vapor seal materials 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. Provide thermal isolation where components penetrate or disrupt building insulation.

F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.

G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.

H. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

I. Set thresholds in bed of sealant and secure.

J. Install hardware using templates provided.

I, Bruce T. Fallon, AIA the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers.

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1. See Section 087100 for hardware installation requirements.
2. See Section 084229 for operator and actuator installation requirements.

K. Install glass and infill panels in accordance with Section 088000, using glazing method required to achieve performance criteria.

L. 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 inches every 3 ft non-cumulative or 1/16 inches per 10 ft, whichever is less.

B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

3.04 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for independent testing and inspection requirements. Inspection will monitor quality of installation and glazing.

B. Provide field testing of installed storefront system by independent laboratory in accordance with AAMA 503 during construction process and before installation of interior finishes.
1. Perform a minimum of two tests in each designated area as indicated on drawings.
2. Conduct tests in each area prior to 10 percent and 50 percent completion of this work.
3. Field test for water penetration in accordance with ASTM E1105 with uniform static air pressure difference (Procedure A) not less than 4.18 psf.
   a. Maximum allowable rate of water penetration in 15-minute test is 0.5 ounce that is not contained in an area with provisions to drain to exterior, or collected on surface of interior horizontal framing member.
4. Field test for air leakage in accordance with ASTM E783 with uniform static air pressure difference of 1.57 psf.
   a. Maximum allowable rate of air leakage is 0.09 cfm/sq ft.

C. Repair or replace storefront components that have failed designated field testing, and retest to verify performance conforms to specified requirements.

3.05 ADJUSTING

A. Adjust operating hardware for smooth operation.

3.06 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. Take care to remove dirt from corners. Wipe surfaces clean.

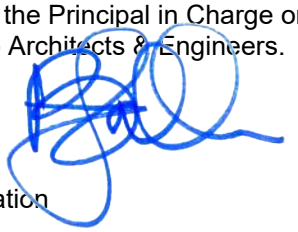
C. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.

3.07 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

I, Bruce T. Fallon, AIA the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers.

Signature & Date:  03.15.2024

SECTION 087100
DOOR HARDWARE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Hardware for solid core wood, aluminum, and hollow metal doors.

B. Note: Lock cylinders are furnished and installed by Owner (NIC)

1.02 PROJECT INFORMATION

A. The architect must work with the following hardware consultant: ASSA ABLOY DSS - Steve Carter (385) 228-3541 steve.carter@assaabloy.com or another person approved by the BYU Access Services Shop Manager (801) 422-5499.

B. The hardware must be coordinated through the BYU Access Services Shop: Lamar Howarth (801) 422-5499 or current shop manager and the BYU Construction PM assigned to this project.

1.03 RELATED REQUIREMENTS

A. Section 062000 - Finish Carpentry: Wood door frames.

B. Section 079200 - Joint Sealants: Sealants for setting exterior door thresholds.

C. Section 080671 - Door Hardware Schedule: Schedule of door hardware sets.

D. Section 081113 - Hollow Metal Doors and Frames.

E. Section 081116 - Aluminum Doors and Frames.

F. Section 081416 - Flush Wood Doors.

G. Section 081700 - Integrated Door Opening Assemblies.

H. Section 084313 - Aluminum-Framed Storefronts: Door hardware, except as noted in section.

1.04 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.

B. BHMA (CPD) - Certified Products Directory; 2017.

C. BHMA A156.2 - American National Standard for Bored and Preassembled Locks & Latches; 2017.

D. BHMA A156.3 - American National Standard for Exit Devices; 2014.

E. BHMA A156.4 - American National Standard for Door Controls - Closers; 2013.

F. BHMA A156.6 - American National Standard for Architectural Door Trim; 2015.

G. BHMA A156.7 - American National Standard for Template Hinge Dimensions; 2016.

H. BHMA A156.8 - American National Standard for Door Controls - Overhead Stops and Holders; 2015.

I. BHMA A156.13 - American National Standard for Mortise Locks & Latches Series 1000; 2017.

J. BHMA A156.15 - American National Standard for Release Devices - Closer Holder, Electromagnetic and Electromechanical; 2015.

K. BHMA A156.16 - American National Standard for Auxiliary Hardware; 2013.

L. BHMA A156.18 - American National Standard for Materials and Finishes; 2016.

M. BHMA A156.25 - American National Standard for Electrified Locking Devices; 2013.

N. BHMA A156.26 - American National Standard for Continuous Hinges; 2012.

O. BHMA A156.36 - American National Standard for Auxiliary Locks; 2016.

P. BHMA A156.115W - Hardware Preparation in Wood Doors with Wood or Steel Frames; 2006.

Q. DHI (H&S) - Sequence and Format for the Hardware Schedule; 1996.

I, Bruce T. Fallon, AIA the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers.

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R. DHI (KSN) - Keying Systems and Nomenclature; 1989.

S. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

T. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

U. NFPA 101 - Life Safety Code; 2015.

V. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2016.

W. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

X. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

Y. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the manufacture, fabrication, and installation of products that door hardware is installed on.

B. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

C. Preinstallation Meeting: Convene a preinstallation meeting one week prior to commencing work of this section; attendance is required by affected installers and the following:
   1. Architect.
   2. Owner's Door Opening Consultant (ASSA ABLOY Steve Carter)
   3. Hardware Supplier.
   4. Hardware Installer.
   5. Owner's Security Consultant.
   6. BYU Access Services - Lamar Howarth.
   7. BYU Construction Project Manager.

D. Furnish templates for door and frame preparation to manufacturers and fabricators of products requiring internal reinforcement for door hardware.

1.06 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's catalog literature for each type of hardware, marked to clearly show products to be furnished for this project, and includes construction details, material descriptions, finishes, and dimensions and profiles of individual components.

C. Shop Drawings - Door Hardware Schedule: Submit detailed listing that includes each item of hardware to be installed on each door. Use door numbering scheme as included in Contract Documents.
   1. Prepared by or under supervision of Architectural Hardware Consultant (AHC).
   2. Conform to DHI (H&S) using door numbers and hardware set numbers as indicated in construction documents.
      a. Submit in vertical format, refer to Section 080671.
   3. List groups and suffixes in proper sequence.
   4. Provide complete description for each door listed.
   5. Provide manufacturer's and product names, and catalog numbers; include functions, types, styles, sizes and finishes of each item.
   6. Include account of abbreviations and symbols used in schedule.

D. Shop Drawings - Electrified Door Hardware: Submit diagrams for power, signal, and control wiring for electrified door hardware that include details of interface with building safety and security systems. Provide elevations and diagrams for each electrified door opening as follows:

I, Bruce T. Fallon, AIA the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers.

Signature & Date: 03.15.2024

1. Prepared by or under supervision of Architectural Hardware Consultant (AHC) and Electrified Hardware Consultant (EHC).
2. Elevations: Submit front and back elevations of each door opening showing electrified devices with connections installed and an operations narrative describing how opening operates from either side at any given time.
3. Diagrams: Submit point-to-point wiring diagram that shows each device in door opening system with related colored wire connections to each device.

E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

F. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.
1. Submit manufacturer's parts lists and templates.

G. Warranty: Submit manufacturer's warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

H. Project Record Documents: Record actual locations of concealed equipment, services, and conduit.

1.07 QUALITY ASSURANCE

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

B. Installer Qualifications: Company specializing in performing work of the type specified for commercial door hardware with at least three years of documented experience.

C. Supplier Qualifications: Company with certified Architectural Hardware Consultant (AHC) to assist in work of this section.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Package hardware items individually; label and identify each package with door opening code to match door hardware schedule.

1.09 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Warranty against defects in material and workmanship for period indicated, from Date of Substantial Completion.
1. Closers: Three Years, minimum.
2. Exit Devices: Three years, minimum.
3. Locksets and Cylinders: Three years, minimum.
4. Other Hardware: Two years, minimum.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Provide specified door hardware as required to make doors fully functional, compliant with applicable codes, and secure to extent indicated.

B. Provide individual items of single type, of same model, and by same manufacturer.

C. Provide door hardware products that comply with the following requirements:
1. Applicable provisions of federal, state, and local codes.
2. Accessibility: ADA Standards and ICC A117.1.
3. Applicable provisions of NFPA 101.
4. Listed and certified compliant with specified standards by BHMA (CPD).

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5. Auxiliary Hardware: BHMA A156.16.
6. Hardware Preparation for Wood Doors with Wood or Steel Frames: BHMA A156.115W.

D. Electrically Operated and/or Controlled Hardware: Provide necessary power supplies, power transfer hinges, relays, and interfaces as required for proper operation; provide wiring between hardware and control components and to building power connection in compliance with NFPA 70.
1. Refer to Section 281000 for additional access control system requirements.

E. Lock Function: Provide lock and latch function numbers and descriptions of manufacturer's series. Refer to Section 080671 for listing of hardware sets.

F. Fasteners:
1. Provide fasteners of proper type, size, quantity, and finish that comply with commercially recognized standards for proposed applications.
   a. Aluminum fasteners are not permitted.
   b. Provide phillips flat-head screws with heads finished to match door surface hardware unless otherwise indicated.
2. Provide machine screws for attachment to reinforced hollow metal and aluminum frames.
   a. Self-drilling (Tek) type screws are not permitted.
3. Provide stainless steel machine screws and lead expansion shields for concrete and masonry substrates.
4. Provide wall grip inserts for hollow wall construction. Provide backing for all hardware in stud walls.
5. Fire-Rated Applications: Comply with NFPA 80.
   a. Provide wood or machine screws for hinges mortised to doors or frames, strike plates to frames, and closers to doors and frames.
   b. Provide steel through bolts for attachment of surface mounted closers, hinges, or exit devices to door panels unless proper door blocking is provided.

2.02 HINGES

A. Manufacturers:
1. Basis of Design: McKinney; an Assa Abloy Group company; www.assaabloydss.com.
2. McKinney; an Assa Abloy Group company; _____: www.assaabloydss.com
3. Hager Companies; _____: www.hagerco.com
4. Stanley, dormakaba Group; _____: www.stanleyhardwarefordoors.com
5. Substitutions: See Section 016000 - Product Requirements.

B. Hinges: Complying with BHMA A156.1, Grade 1.
1. Butt Hinges: Complying with BHMA A156.1 and BHMA A156.7 for templated hinges.
   a. Provide hinge width required to clear surrounding trim.
2. Continuous Hinges: Complying with BHMA A156.26.
3. Provide hinges on every swinging door.
4. Provide five-knuckle full mortise butt hinges unless otherwise indicated.
5. Provide ball-bearing hinges at each door.
6. Provide non-removable pins on exterior out swinging doors.
7. Provide non-removable pins on interior out swinging doors at locations as indicated in Door Hardware Schedule.
8. Provide power transfer hinges where electrified hardware is mounted in door leaf.
9. Provide following quantity of butt hinges for each door:
   a. Doors From 60 inches High up to 90 inches High: Three hinges.
   b. Doors 90 inches High up to 120 inches High: Four hinges.
   c. Doors From 42 inches wide up to 48 inches Wide: Four hinges.
   d. Doors over 120 inches High: One additional hinge per each additional 30 inches in height.
   e. Dutch Doors: Two hinges each leaf.

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2.03 EXIT DEVICES

A. Manufacturers:
   1. Sargent; an Assa Abloy Group company; 88 series: www.assaabloydss.com.

B. Exit Devices: Complying with BHMA A156.3, Grade 1.
   1. Lever design to match lockset trim.
   2. No mortise exit devices.
   3. No vertical rod exit devices.
   4. Provide rim style only.
   5. Provide cylinder with cylinder dogging or locking trim.
   6. Provide exit devices properly sized for door width and height.
   7. Provide strike as recommended by manufacturer for application indicated.
   8. Provide UL (DIR) listed exit device assemblies for fire-rated doors and panic device assemblies for non-fire-rated doors.

2.04 LOCK CYLINDERS NOT IN CONTRACT - BY OWNER

A. Manufacturers:
   1. Basis of Design: ASSA Twin 6000. Provided and installed by BYU Access Services

2.05 CYLINDRICAL LOCKSET

A. Manufacturers:
   1. Sargent; an Assa Abloy Group company; 10 Line: www.assaabloydss.com.
   2. Schlage, an Allegion brand; ND Series Clutch: www.allegion.com/us.

B. Cylindrical Lockset (Bored): Complying with BHMA A156.2, Grade 1, 4000 Series.
   1. Bored Hole: 2-1/8 inch diameter.
   2. Latchbolt Throw: 1/2 inch, minimum.
   3. Backset: 2-3/4 inch unless otherwise indicated.
   4. Strikes: Provide manufacturer's standard strike for each latchset or lockset with strike box and curved lip extending to protect frame in compliance with indicated requirements.
      a. Finish: To match lock or latch.
      b. Extra-Long-Lip Strikes: Provide for locks used on frames with applied wood casing trim.

2.06 AUXILIARY LOCKS (DEADLOCKS)

A. Manufacturers:
   1. Basis of Design: Schlage B660 Series Deadbolts.

B. Auxiliary Locks (Deadlocks): Complying with BHMA A156.36, Grade 1.
   1. Type: Bored (cylindrical).
   2. Application: Bored.
   3. Backset: 2-3/4 inch, unless otherwise indicated.
   4. Bolt Throw: 1/2 inch, with latch made of hardened steel.
   5. Provide strike that matches frame.

2.07 DOOR PULLS AND PUSH PLATES

A. Manufacturers:
   1. Rockwood; an Assa Abloy Group company; 110 x 71F: www.assaabloydss.com.
   2. Substitutions: See Section 016000 - Product Requirements.

B. Door Pulls and Push Plates: Complying with BHMA A156.6.
   1. Pull Type: Straight, unless otherwise indicated.
   2. Push Plate Type: Flat, with square corners, unless otherwise indicated.
      a. Edges: Beveled, unless otherwise indicated.
   3. Material: Stainless steel, unless otherwise indicated.

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4. Provide door pulls and push plates on doors without a lockset, latchset, exit device, or auxiliary lock unless otherwise indicated.
5. Install pull plate and pull with through bolts for pull flush under push plate. No exposed through bolts on push plate.
6. On solid doors, provide matching push plate on opposite faces.

2.08 DOOR PULLS AND PUSH BARS

A. Manufacturers:
1. Rockwood; an Assa Abloy Group company; RM3311-20CTC-36" long with 3/8" mounting bolts: www.assaabloydss.com.
2. IVES - Equal to Rockwood.
3. Substitutions: See Section 016000 - Product Requirements.

B. Door Pulls and Push Bars: Complying with BHMA A156.6.
1. Bar Type: Push bar, unless otherwise indicated.
2. Material: Stainless steel, unless otherwise indicated.

2.09 CLOSERS

A. Manufacturers; Surface Mounted:
1. LCN, an Allegion brand; 4040XP Non-Handed Closers: www.allegion.com/us.

B. Closers: Complying with BHMA A156.4, Grade 1.
1. Type: Surface mounted to door.
2. Provide door closer on each exterior door.
3. Provide door closer on each fire-rated and smoke-rated door.
a. Spring hinges are not an acceptable self-closing device, unless otherwise indicated.
4. At corridor entry doors, mount closer on room side of door.
5. At out swinging exterior doors, mount closer on interior side of door.

2.10 OVERHEAD STOPS AND HOLDERS

A. Manufacturers:
1. Glynn-Johnson, an Allegion brand; 100ADJ: www.allegion.com/us.

B. Overhead Stops and Holders (Door Checks): Complying with BHMA A156.8, Grade 1.
1. Provide stop for swinging doors as indicated in hardware schedule.
2. Provide stop for all doors with automatic operator.

2.11 PROTECTION PLATES

A. Manufacturers:
1. Rockwood; an Assa Abloy Group company; K1050: www.assaabloydss.com.
2. Ives, an Allegion brand; _____: www.allegion.com/us
3. Substitutions: See Section 016000 - Product Requirements.

B. Protection Plates: Complying with BHMA A156.6.

C. Metal Properties: Stainless steel.
1. Metal, Standard Duty: Thickness 0.05 inch, minimum.

D. Edges: Beveled, on four sides unless otherwise indicated.

E. Fasteners: Countersunk screw fasteners.

2.12 KICK PLATES

A. Manufacturers:
1. Rockwood; an Assa Abloy Group company; [K1050]: www.assaabloydss.com
2. Ives, an Allegion brand; _____: www.allegion.com/us
3. Substitutions: See Section 016000 - Product Requirements.

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B. Kick Plates: Provide along bottom edge of push side of every door with closer, except aluminum storefront and glass entry doors, unless otherwise indicated.
   1. Size: 10 inch high by 2 inch less door width (LDW) on push side of door.

2.13 FLOOR STOPS

A. Manufacturers:
   1. Rockwood; an Assa Abloy Group company; 441H: www.assaabloydss.com.
   2. Substitutions: See Section 016000 - Product Requirements.

B. Floor Stops: Complying with BHMA A156.16, Grade 1 and Resilient Material Retention Test as described in this standard.
   1. Provide floor stops when wall surface is not available; be cautious not to create a tripping hazard.

2.14 WALL STOPS

A. Manufacturers:
   1. Basis of Design: _____.
   2. Rockwood; an Assa Abloy Group company; 409: www.assaabloydss.com.
   3. Substitutions: See Section 016000 - Product Requirements.

B. Wall Stops: Complying with BHMA A156.16, Grade 1 and Resilient Material Retention Test as described in this standard.
   1. Provide wall stops to prevent damage to wall surface upon opening door.
   2. Type: Bumper, concave, wall stop.
   3. Material: Stainless steel housing with rubber insert.

2.15 SILENCERS

A. Manufacturers:
   1. Ives, an Allegion brand; _____: www.allegion.com/us
   2. Rockwood; an Assa Abloy Group company; _____: www.assaabloydss.com
   3. Substitutions: See Section 016000 - Product Requirements.

B. Silencers: Provide at equal locations on door frame to mute sound of door's impact upon closing.
   1. Single Door: Provide three on strike jamb of frame.
   2. Pair of Doors: Provide two on head of frame, one for each door at latch side.
   3. Material: Rubber, gray color.

2.16 FINISHES

A. Finishes: Provide door hardware of same finish, unless otherwise indicated.
   1. Primary Finish: 626; satin chromium plated over nickel, with brass or bronze base material (former US equivalent US26D); BHMA A156.18.
   2. Exceptions:
      a. Where base material metal is specified to be different, provide finish that is an equivalent appearance in accordance with BHMA A156.18.
      b. Hinges for Fire-Rated Doors: Steel base material with painted finish, in compliance with NFPA 80.
      c. Door Closer Covers and Arms: Color as selected by Architect from manufacturer's standard colors unless otherwise indicated.
      d. Hardware for Aluminum Storefront Doors: Finished to match door panel finish, except at hand contact surfaces provide stainless steel with satin finish, unless otherwise indicated.

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PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that doors and frames are ready to receive this work; labeled, fire-rated doors and frames are properly installed, and dimensions are as indicated on shop drawings.

B. Verify that electric power is available to power operated devices and of correct characteristics.

3.02 INSTALLATION

A. Install hardware in accordance with manufacturer's instructions and applicable codes.

B. Use templates provided by hardware item manufacturer.

C. Do not install surface mounted items until application of finishes to substrate are fully completed.

D. All hardware mounting to be per CECO locations.

3.03 FIELD QUALITY CONTROL

A. Perform field inspection and testing under provisions of Section 014000 - Quality Requirements.

B. Provide an Architectural Hardware Consultant (AHC) to inspect installation and certify that hardware and installation has been furnished and installed in accordance with manufacturer's instructions and as specified.

3.04 ADJUSTING

A. Adjust work under provisions of Section 017000 - Execution and Closeout Requirements.

B. Adjust hardware for smooth operation.

C. Adjust gasketing for complete, continuous seal; replace if unable to make complete seal.

3.05 CLEANING

A. Clean finished hardware in accordance with manufacturer's written instructions after final adjustments have been made.

B. Clean adjacent surfaces soiled by hardware installation.

C. Replace items that cannot be cleaned to manufacturer's level of finish quality at no additional cost.

3.06 PROTECTION

A. Protect finished Work under provisions of Section 017000 - Execution and Closeout Requirements.

B. Do not permit adjacent work to damage hardware or finish.

3.07 MANUFACTURER'S ABBREVIATIONS:

1. MK – McKinney
2. PE - Pemko
3. SA – SARGENT
4. AD - Adams Rite
5. AA - ASSA High Security Locks
6. RO – Rockwood
7. RF – Rixson
8. OT - Other

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Hardware Sets

Set: 1.0

Doors: 230

2	Continuous Hinge	CFM__SLF-HD1-M		PE
1	Mullion	L980S	PC	SA
1	Rim Exit Device, Dummy	18 PE8810 Less Pull	US32D	SA
1	Rim Exit Device, Storeroom	LC 18 PE8804 Less Pull	US32D	SA
1	Assa Cylinder	Match Facility Standard		AA
1	Assa Cylinder - mullion	Match Facility Standard		AA
2	Door Pull	BF157 Mtg as required	US32D	RO
2	Surface Closer	281 CPS	EN	SA
2	Drop Plate	as required	EN	SA
1	Gasketing	By door manufacturer		OT
1	Mullion Seal	5110BL		PE

Set: 2.0

Doors: 220, 222

1	Continuous Hinge	CFM__SLF-HD1-M		PE
1	Deadlatch	4900	628	AD
1	Paddle Operator	4591	628	AD
1	Assa Cylinder	Match Facility Standard		AA
1	Push Bar & Pull	BF15747 Mtg as required	US32D	RO
1	Surface Closer	281 O/P9	EN	SA
1	Drop Plate	as required	EN	SA
1	Wall/Floor Stop	403/441H	US26D	RO
1	Gasketing	By door manufacturer		OT

Set: 3.0

Doors: 224, 224A

3	Hinge, Full Mortise, Hvy Wt	T4A3786 (NRP)	US26D	MK
1	Rim Exit Device, Classroom	49 PE8816 WEL	US32D	SA
2	Assa Cylinder	Match Facility Standard		AA
1	Surface Closer w/HO	281 PH10	EN	SA
1	Kick Plate	K1050 10" CSK BEV	US32D	RO
1	Wall/Floor Stop	403/441H	US26D	RO
1	Gasketing	S44BL		PE

Set: 4.0

Doors: 234, 236

3	Hinge, Full Mortise	TA2714 (NRP)	US26D	MK
1	Storeroom Lock	LC 10XG04 LL	US26D	SA
1	Assa Cylinder	Match Facility Standard		AA

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ll/Floor Stop	403/441H	US26D	RO
3 Silencer	608-RKW		RO

Set: 5.0

Doors: 232

3 Hinge, Full Mortise	TA2714 (NRP)	US26D	MK
1 Storeroom Lock	LC 10XG04 LL	US26D	SA
1 Assa Cylinder	Match Facility Standard		AA
1 Surf Overhead Stop	55-_36	689	RF
3 Silencer	608-RKW		RO

Set: 6.0

Doors: 250B

3 Hinge, Full Mortise	TA2714 (NRP)	US26D	MK
1 Storeroom Lock	LC 10XG04 LL	US26D	SA
1 Assa Cylinder	Match Facility Standard		AA
1 Surface Closer	281 O/P9	EN	SA
1 Kick Plate	K1050 10" CSK BEV	US32D	RO
1 Wall/Floor Stop	403/441H	US26D	RO
1 Gasketing	S44BL		PE

Notes: Inspect and verify existing frame conditions to accept new hinges.

Set: 7.0

Doors: 230D, 230F, 230H, 230J, 230L, 230N, 230P

3 Hinge, Full Mortise	TA2714 (NRP)	US26D	MK
1 Office Lock	LC 10XG05 LL	US26D	SA
1 Wall/Floor Stop	403/441H	US26D	RO
3 Silencer	608-RKW		RO

Set: 8.0

Doors: 230R

3 Hinge, Full Mortise	TA2714 (NRP)	US26D	MK
1 Passage Latch	10XU15 LL	US26D	SA
1 Wall/Floor Stop	403/441H	US26D	RO
1 Gasketing	S44BL		PE

Set: 9.0

Doors: 230A

3 Hinge, Full Mortise	TA2714 (NRP)	US26D	MK
1 Passage Latch	10XU15 LL	US26D	SA
1 Surface Closer	281 O/P9	EN	SA
1 Kick Plate	K1050 10" CSK BEV	US32D	RO
1 Wall/F			

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loor Stop	403/441H	US26D	RO
3 Silencer	608-RKW		RO

Set: 10.0

Doors: 250A

3 Hinge, Full Mortise	TA2714 (NRP)	US26D	MK
1 Passage Latch	10XU15 LL	US26D	SA
1 Surface Closer	281 CPS	EN	SA
1 Kick Plate	K1050 10" CSK BEV	US32D	RO
3 Silencer	608-RKW		RO

END OF SECTION

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SECTION 088000
GLAZING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Glazing units.

B. Glazing compounds and accessories.

1.02 RELATED REQUIREMENTS

A. Section 084313 - Aluminum-Framed Storefronts: Glazing furnished as part of storefront 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.

C. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; 2010, with 2013 Supplements and Errata.

D. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2015).

E. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014a.

F. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2012.

G. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass; 2014.

H. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016.

I. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass; 2015.

J. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2016a.

K. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2016.

L. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2010.

M. GANA (SM) - GANA Sealant Manual; 2008.

N. ICC (IBC) - International Building Code; 2021

O. ITS (DIR) - Directory of Listed Products; current edition.

P. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting two weeks before starting work of this section; require attendance by each of the affected installers.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data on Glazing Unit 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. Identify available colors.

D. Samples: Submit two samples 12 by 12 inch in size of glass units.

E. Samples: Submit 6 inch long bead of glazing sealant, color as selected.

F. Certificate: Certify that products of this section meet or exceed specified requirements.

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G. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

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

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.

C. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

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.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Glass Fabricators:
1. Oldcastle Glass . (obe.com)
2. Northwesten Industries Inc, NWI (nwiglass.com)

B. Float Glass Manufacturers:
1. Cardinal Glass Industries; _____: www.cardinalcorp.com
2. Guardian Glass, LLC; _____: www.guardianglass.com
3. Pilkington North America Inc; _____: www.pilkington.com/na
4. Trulite Glass & Aluminum Solutions; www.trulite.com
5. Vitro Architectural Glass (formerly PPG Glass); _____: www.vitroglazings.com

C. Laminated Glass Manufacturers:
1. Cardinal Glass Industries; _____: www.cardinalcorp.com

2.03 GLASS MATERIALS

A. Float Glass: Provide float glass based glazing unless noted otherwise.
1. Annealed Type: Not approved for use on Campus.
2. Kind FT - Fully Tempered Type: Complies with ASTM C1048.
3. Fully Tempered Safety Glass: Complies with ANSI Z97.1 and 16 CFR 1201 criteria.
4. Thicknesses: As indicated; provide greater thickness as required for exterior glazing wind load design.

B. Laminated Glass: Float glass laminated in accordance with ASTM C1172.
1. Laminated Safety Glass: Complies with ANSI Z97.1 and 16 CFR 1201 test requirements for Category II.
2. Polyvinyl Butyral (PVB) Interlayer: 0.030 inch thick, minimum.

2.06 GLAZING UNITS

A. Type G-2 - Monolithic Interior Vision Glazing:
1. Applications: Interior glazing unless otherwise indicated.

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2. Glass Type: Fully tempered float glass.
3. Tint: Clear.
4. Thickness: 1/4" or 1/2" inch, nominal, depending on size of pane and application.
5. Glazing Method: Dry glazing method, gasket glazing.

D. Type G-5 - 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. Other locations required by applicable federal, state, and local codes and regulations.
   d. Other locations indicated on drawings.
2. Glass Type: Fully tempered safety glass as specified.
3. Tint: Clear.
4. Thickness: 1/4 inch, nominal except use 1/2" thick at guardrails.

2.07 GLAZING COMPOUNDS

A. Type GC-5 - Silicone Sealant: Single component; neutral curing; capable of water immersion without loss of properties; non-bleeding, non-staining; ASTM C920, Type S, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 15 to 25; Standard color as selected by Architect.

B. Manufacturers:
1. Dow Corning Corporation; 795: www.dowcorning.com/construction.
2. No Substitutions.

2.08 ACCESSORIES

A. Setting Blocks: Neoprene, 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 x width of glazing rabbet space minus 1/16 inch x height to suit glazing method and pane weight and area.

B. Spacer Shims: EPDM, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Minimum 3 inch long x one half the height of the glazing stop x 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.

D. Glazing Gaskets: Resilient polyvinyl chloride extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.

E. Glazing Clips: Manufacturer's standard type.

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.

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D. Verify that sealing between joints of glass framing members has been completed effectively.

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, etc.

G. Prevent spandrel glazing from contact with batt insulation.

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 FIELD QUALITY CONTROL

A. Glass and Glazing product manufacturers to provide field surveillance of the installation of their products.

B. Monitor and report installation procedures and unacceptable conditions.

3.06 CLEANING

A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.

B. Remove non-permanent 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.

3.07 PROTECTION

A. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

END OF SECTION

I, Bruce T. Fallon, AIA the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers.

Signature & Date: 03.15.2024

SECTION 090561
COMMON WORK RESULTS FOR FLOORING PREPARATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This section applies to all floors identified in the contract documents as to receive the following types of floor coverings:
   1. Resilient tile and sheet vinyl.
   2. Carpet tile.

B. Removal of existing floor coverings. Verify with owner if recycling is feasible.

C. Preparation of new 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 REFERENCE STANDARDS

A. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens); 2016a.

B. ASTM C472 - Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters and Gypsum Concrete; 1999 (Reapproved 2014).

C. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2011.

D. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2011.

E. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2017.

F. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings; Resilient Floor Covering Institute; October 2011.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordinate scheduling of cleaning and testing, so that preliminary cleaning has been completed for at least 24 hours prior to testing.

1.04 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.

I, Bruce T. Fallon, AIA the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers.

Signature & Date: 03.15.2024

C. 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. Include certification of accuracy by authorized official of testing agency.
   7. Submit report directly to Owner.
   8. Submit report not more than two business days after conclusion of testing.

D. Adhesive Bond and Compatibility Test Report.

E. Copy of RFCI (RWP).

F. 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.

1.05 QUALITY ASSURANCE

A. Moisture and alkalinity (pH) testing shall be performed by an independent testing agency employed and paid by Contractor.

B. 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.

C. 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.
   5. Notify Architect and BYU Construction PM when specified ambient conditions have been achieved and when testing will start.

1.06 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.

1.07 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 10 percent and not more than 60 percent.

I, Bruce T. Fallon, AIA the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers.

Signature & Date: 03.15.2024

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.

PART 3 EXECUTION

3.01 CONCRETE SLAB PREPARATION

A. Follow recommendations of testing agency.

B. Perform following operations in the order indicated:
   1. Preliminary cleaning.
   2. Moisture vapor emission tests; 3 tests in the first 1000 square feet and one test in each additional 1000 square feet, unless otherwise indicated or required by flooring manufacturer.
   3. Internal relative humidity tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
   4. Alkalinity (pH) tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
   5. Specified remediation, if required.
   6. Patching, smoothing, and leveling, as required.
   7. Other preparation specified.
   8. Adhesive bond and compatibility test.
   9. Protection.

C. 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.

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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.

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. The following procedure is the equivalent of that described in ASTM F710, repeated here for the Contractor's convenience.

C. Use a wide range alkalinity (pH) test paper, its associated chart, and distilled or deionized water.

D. Place several drops of water on a clean surface of concrete, forming a puddle approximately 1 inch in diameter. Allow the puddle to set for approximately 60 seconds, then dip the alkalinity (pH) test paper into the water, remove it, and compare immediately to chart to determine alkalinity (pH) reading.

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 alkalinity (pH) test value is over 10.

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3.07 PREPARATION

A. See individual floor covering section(s) for additional requirements.

B. Comply with recommendations of testing agency.

C. Comply with requirements and recommendations of floor covering manufacturer.

D. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.

E. 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 PROTECTION

A. Cover prepared floors with building paper or other durable covering.

END OF SECTION

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SECTION 092116

GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Performance criteria for gypsum board assemblies.

B. Metal stud wall framing.

C. Metal channel ceiling framing.

D. Acoustic insulation.

E. Gypsum wallboard.

F. Joint treatment and accessories.

1.02 RELATED REQUIREMENTS

A. Section 016116 - Volatile Organic Compound (VOC) Content Restrictions.

B. Section 072100 - Thermal Insulation: Acoustic insulation.

1.03 REFERENCE STANDARDS

A. AISI S100-12 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2012.

B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

D. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members; 2015.

E. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2015.

F. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2014.

G. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.

H. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2017.

I. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2016.

J. 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; 2015.

K. 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; 2016.

L. ASTM C1047 - Standard Specification for Accessories For Gypsum Wallboard and Gypsum Veneer Base; 2014a.

M. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2014a.

N. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2016.

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O. GA-216 - Application and Finishing of Gypsum Board; 2016.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate special details associated with fireproofing and acoustic seals.

C. Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system.

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 gypsum board installation and finishing, with minimum 3 years of experience.

PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES

A. Provide completed assemblies complying with ASTM C840 and GA-216.
   1. See PART 3 for finishing requirements.

B. Interior Partitions: Provide completed assemblies with the following characteristics:
   1. Acoustic Attenuation: STC as indicated calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.

2.02 METAL FRAMING MATERIALS

A. Manufacturers - Metal Framing, Connectors, and Accessories:
   1. Clarkwestern Dietrich Building Systems LLC; ____: www.clarkdietrich.com
   2. Jaimes Industries; ____: www.jaimesind.com
   3. Marino; ____: www.marinoware.com
   4. Phillips Manufacturing Co; ____: www.phillipsmfg.com
   5. CEMCO Steel; www.cemcosteel.com

B. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/360 at 5 psf.
   1. Studs: "C" shaped with flat or formed webs with knurled faces. (1 5/8" x 3 5/8" wide Typical at interior walls - 1 5/8" x 6" studs typical at exterior walls)
   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: 1/2 inch depth, for attachment to substrate through both legs; both legs expanded metal mesh.
      a. Products:
         1) Same manufacturer as other framing materials.

C. Area Separation Wall Studs and Accessories: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with specified performance requirements.

D. 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 fastened as indicated on drawings.

E. Non-Loadbearing Framing Accessories:
   1. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.

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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.
3. Framing Connectors: ASTM A653/A653M G90 galvanized steel clips; secures cold rolled channel to wall studs for lateral bracing.

2.03 BOARD MATERIALS

A. Manufacturers - Gypsum-Based Board:
    1. American Gypsum Company; ____: www.americangypsum.com
    2. CertainTeed Corporation; ____: www.certainteed.com
    3. Georgia-Pacific Gypsum; Dense Shield Tile Baker: www.gpgypsum.com.
    4. USG Corporation; ____: www.usg.com
    5. 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. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
    3. Thickness:
        a. Vertical Surfaces: 5/8 inch.
        b. Ceilings: 5/8 inch.
        c. Multi-Layer Assemblies: Thicknesses as indicated on drawings.
    4. Paper-Faced Products:
        a. American Gypsum Company; FireBloc Type X Gypsum Wallboard.
        b. Continental Building Products; Firecheck Type X.
        c. Georgia-Pacific Gypsum; ToughRock Fireguard X.
        d. National Gypsum Company; Gold Bond BRAND Fire-Shield Gypsum Board.

2.04 ACCESSORIES

A. Acoustic Insulation: As specified in Section 072100.

B. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.

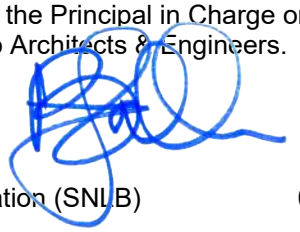
C. Water-Resistive Barrier: As specified in Section 072500.

D. Beads, Joint Accessories, and Other Trim: ASTM C1047, rigid plastic, galvanized steel, or rolled zinc, unless noted otherwise.
    1. Rigid Corner Beads: Low profile, for 90 degree outside corners.
    2. Expansion Joints:

E. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
    1. Tape: 2 inch wide, coated glass fiber tape for joints and corners, except as otherwise indicated.
    2. Tape: 2 inch wide, creased paper tape for joints and corners, except as otherwise indicated.
    3. Ready-mixed vinyl-based joint compound.
    4. Powder-type vinyl-based joint compound.
    5. Chemical hardening type compound.
    6. Thinsets and mastics for backerboard installations.

F. High Build Drywall Surfacer: 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:

I, Bruce T. Fallon, AIA the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers.

Signature & Date:  03.15.2024

a. CertainTeed Corporation; Level V Wall and Ceiling Primer/Surfacer with M2Tech: www.certainteed.com

G. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inch in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion resistant.

H. 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.

I. Anchorage to Substrate: Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

3.02 FRAMING INSTALLATION

A. Metal Framing: Install in accordance with ASTM C754 and manufacturer's instructions.

B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.
1. Level ceiling system to a tolerance of 1/1200.
2. Laterally brace entire suspension system.
3. Install bracing as required at exterior locations to resist wind uplift.

C. Studs: Space studs at 16 inches on center.
1. Extend partition framing to structure where indicated and to ceiling in other locations..
2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
3. Partitions Terminating at Structure: Attach extended leg top runner to structure, maintain clearance between top of studs and structure, and brace both flanges of studs with continuous bridging.
4. 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.

D. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.

E. Standard Wall Furring: Install at concrete walls scheduled to receive gypsum board, not more than 4 inches from floor and ceiling lines and abutting walls. Secure in place on alternate channel flanges at maximum 16 inches on center.
1. Orientation: Vertical.
2. Spacing: As indicated.

F. Blocking: Install mechanically fastened steel sheet blocking for support of:
1. Framed openings.
2. Wall mounted cabinets.
3. Plumbing fixtures.
4. Toilet partitions.
5. Toilet accessories.
6. Wall mounted door hardware.

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3.04 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. Acoustic Sealant: Install in accordance with manufacturer's instructions.
   1. Place one bead continuously on substrate before installation of perimeter framing members.
   2. Place continuous bead at perimeter of each layer of gypsum board.
   3. Seal around all penetrations by conduit, pipe, ducts, and rough-in boxes, except where firestopping is provided.

3.05 BOARD INSTALLATION

A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install interior gypsum board horizontally, especially in Corridors and Highly Visible Locations.

B. Installation on Metal Framing: Use screws for attachment of gypsum board.

3.06 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.
   2. At exterior soffits, not more than 30 feet apart in both directions.

B. Corner Beads: Install at external corners, using longest practical lengths.

C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

D. Exposed finished raw edges are not allowed.

E. All metal fittings to be bedded and finished to designated finish level.

3.07 JOINT TREATMENT

A. Paper Faced Gypsum Board: Use paper joint tape, bedded with ready-mixed vinyl-based joint compound and finished with ready-mixed vinyl-based joint compound.

B. 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 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
   4. Level 1: Fire rated wall areas above finished ceilings, whether or not accessible in the completed construction.

C. 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.
   2. Taping, filling, and sanding is not required at surfaces behind adhesive applied ceramic tile and fixed cabinetry.

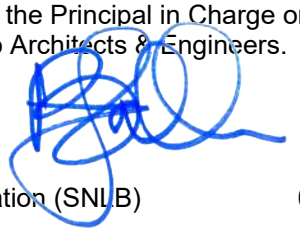
D. Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.

3.08 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

END OF SECTION

I, Bruce T. Fallon, AIA the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers.

Signature & Date:  03.15.2024

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SECTION 095100

ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Suspended metal grid ceiling system.

B. Acoustical units.

C. Supplementary acoustical insulation above ceiling.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

A. ASTM C635/C635M - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2013a.

B. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2013.

C. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2016.

D. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2014.

E. UL (FRD) - Fire Resistance Directory; current edition.

1.04 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.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on suspension system components.

C. Samples: Submit two samples 4x4 inch in size illustrating material and finish of acoustical units.

D. Samples: Submit two samples each, 12 inches long, of suspension system main runner.

E. Manufacturer's Installation Instructions: Indicate special procedures. Include information relative to compliance with seismic requirements contained in the International Building Code (IBC).

F. 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 1 percent of total installed, not less than 100 sf.

1.06 QUALITY ASSURANCE

A. Fire-Resistive Assemblies: Complete assembly listed and classified by 1 for the fire resistance indicated.

B. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

I, Bruce T. Fallon, AIA the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers.

Signature & Date: 03.15.2024

1.07 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: www.armstrong.com.
   2. USG: www.usg.com.

B. Suspension Systems:
   1. Same as for acoustical units.
   2. Armstrong World Industries, Inc; Prelude XL: www.armstrong.com.
   3. USG; DONN DX/DL: www.usg.com.

2.02 ACOUSTICAL UNITS

A. Acoustical Units - General: ASTM E1264, Class A.
   1. Units for Installation in Fire-Rated Suspension System: Listed and classified for the fire-resistive assembly as part of suspension system.
   2. VOC Content: Certified as Low Emission by one of the following:

B. Acoustical Panels Type ACT-1:
   1. Size: 24 by 24 inches.
   2. Panel Edge: Square .
   3. Surface Pattern: Perforated.
   4. Surface Color: White.
   5. Suspension System: Exposed grid.
   6. Products:
      a. USG Radar 22421.
      b. Armstrong Fine Fissured 1713.

2.03 SUSPENSION SYSTEM(S)

A. Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with stabilizer bars, clips, splices, perimeter moldings, and hold down clips as required.

B. Exposed Suspension System: Formed steel, commercial quality cold rolled; heavy-duty.
   1. Profile: Tee; 15/16 inch wide face.
   2. Construction: Double web.
   3. Finish: White Painted.

C. Fire-Rated Exposed Steel Suspension System: Formed steel, commercial quality cold rolled; light-duty.
   1. Profile: Tee; 15/16 inch wide face.
   2. Construction: Double web.
   3. Fire Rating: Listed and classified for use in a 1 hour fire-resistive assembly.
   4. Finish: White painted.

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. Perimeter Moldings: Same material and finish as grid.

I, Bruce T. Fallon, AIA the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers.

Signature & Date: 03.15.2024

1. At Exposed Grid: Provide L-shaped molding for mounting at same elevation as face of grid.

C. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that layout of hangers and compression struts will not interfere with other work.

3.02 INSTALLATION - SUSPENSION SYSTEM

A. Install suspension system in accordance with manufacturer's instructions and as supplemented in this section. The installed system must comply with the International Building Code including the seismic requirements of the code and ASTM 580.

B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.

C. Locate system on room axis according to the reflected ceiling plan. Any changes to the ceiling layout must be approved by the owner and architect.

D. Install after major above-ceiling work is complete. Coordinate the location of hangers and compression struts with other work. The suspension system must attach to structure and not to the work of any other trades.

E. Provide hanger clips during steel deck erection. Provide additional hangers and inserts as required.

F. 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.

G. 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.

H. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability. Refer to manufacture engineering requirements for limitations.

I. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently. Fixtures and equipment exceeding 56 pounds shall be supported to the structure by hangers approved by the ceiling manufacturer.

J. Do not eccentrically load system or induce rotation of runners.

K. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
   1. Use longest practical lengths.
   2. Overlap and rivet corners.

L. Install USG ACM-7 seismic clips or Armstrong BERC seismic clips in accordance with manufacture recommendations on all perimeter material less than 2". Install seismic clips strategically on wall side versus soffit site when grid terminates in perimeter molding at a soffit line.

M. Each grid member that comes into the perimeter shall be supported by suspension wire connected to structure within 8" of the perimeter. The angle of the wire shall be less than 1 in 6. See ASTM 580/580M.

N. Perimeter moldings shall be attached to studs or backing unless approved otherwise by owner and architect.

O. Partition walls that connect to the ceiling grid below shall also be braced to the structure above using stud kickers @ 8'-0" o.c..

I, Bruce T. Fallon, AIA the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers.

Signature & Date: 03.15.2024

P. Leave all ceiling grid work open and accessible as required for inspection by the BYU Construction PM before proceeding to place the ceiling tile in the grid.

3.03 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 units after above-ceiling work is complete.

E. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.

F. Cutting Acoustical Units:
   1. Cut to fit irregular grid and perimeter edge trim.
   2. Make field cut edges of same profile as factory edges.

G. Where round obstructions occur, provide preformed closures to match perimeter molding.

H. Install hold-down clips on each panel to retain panels tight to grid system; comply with fire rating requirements.

I. Install hold-down clips on panels within 20 ft of an exterior door.

3.04 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.

END OF SECTION

I, Bruce T. Fallon, AIA the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers.

Signature & Date: 03.15.2024

SECTION 096500

RESILIENT FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Resilient sheet flooring.

B. Static control resilient sheet flooring.

C. Resilient tile flooring.

D. Static control resilient tile flooring.

E. Resilient base.

F. Installation accessories.

1.02 RELATED REQUIREMENTS

A. Section 260526 - Grounding and Bonding for Electrical Systems: Grounding and bonding of static control flooring to building grounding system.

1.03 REFERENCE STANDARDS

A. ASTM D6329 - Standard Guide for Developing Methodology for Evaluating the Ability of Indoor Materials to Support Microbial Growth Using Static Environmental Chambers; 1998 (Reapproved 2015).

B. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2017.

C. ASTM F150 - Standard Test Method for Electrical Resistance of Conductive and Static Dissipative Resilient Flooring; 2006 (Reapproved 2013).

D. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2011.

E. ASTM F970 - Standard Test Method for Measuring Recovery Properties of Floor Coverings after Static Loading; 2017.

F. ASTM F1066 - Standard Specification for Vinyl Composition Floor Tile; 2004, with Editorial Revision (2014).

G. ASTM F1303 - Standard Specification for Sheet Vinyl Floor Covering with Backing; 2004 (Reapproved 2014).

H. ASTM F1344 - Standard Specification for Rubber Floor Tile; 2015.

I. ASTM F1700 - Standard Specification for Solid Vinyl Floor Tile; 2013a.

J. ASTM F1859 - Standard Specification for Rubber Sheet Floor Covering Without Backing; 2014, with Editorial Revision (2016).

K. ASTM F1861 - Standard Specification for Resilient Wall Base; 2016.

L. ASTM F1913 - Standard Specification for Vinyl Sheet Floor Covering Without Backing; 2004 (Reapproved 2014).

M. ASTM F2034 - Standard Specification for Sheet Linoleum Floor Covering; 2008 (Reapproved 2013).

N. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; 2015.

O. UL 2824 - GREENGUARD Certification Program Method for Measuring Microbial Resistance From Various Sources Using Static Environmental Chambers; Current Edition, Including All Revisions.

I, Bruce T. Fallon, AIA the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers.

Signature & Date: 03.15.2024

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. Selection Samples: Submit manufacturer's complete set of color samples for Architect's initial selection.

E. Verification Samples: Submit two samples, 12 by 12 inch in size illustrating color and pattern for each resilient flooring product specified.

F. Concrete Testing Standard: Submit a copy of ASTM F710.

G. Certification: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of sub-floor is acceptable.

H. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

I. 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: 3% of total square feet of each type and color.
   3. Extra Wall Base: 3% of total linear feet of each type and color.

1.05 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 80 degrees F.

D. Protect roll materials from damage by storing on end.

E. Do not double stack pallets.

1.06 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 TILE FLOORING

A. Luxury Vinyl Tile (LVT): Printed film type, with transparent or translucent wear layer.
   1. Manufacturers:
      a. Johnsonite, a Tarkett Company; _____: www.johnsonite.com
      b. Centiva, a Tarkett Company.
      c. Mannington
   2. Minimum Requirements: Comply with ASTM F1700, 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. Mold and Microbial Resistance: Highly resistant when tested in accordance with ASTM D6329; certified in accordance with UL 2824.
   5. Square Tile Size: 18 by 18 inch.
   6. Plank Tile Size: 6 by 48 inch.

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7. Wear Layer Thickness: 0.032 inch.
8. Total Thickness: 0.125 inch.
9. Color: To be selected by Architect from manufacturer's full range.

2.03 RESILIENT BASE

A. Resilient Base: ASTM F1861, Type TS rubber, vulcanized thermoset; top set Style B, Cove.
   1. Manufacturers:
      a. Johnsonite, a Tarkett Company; _____: www.johnsonite.com
      b. Roppe Corp; _____: www.roppe.com
   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 inch.
   4. Thickness: 0.125 inch.
   5. Finish: Satin.
   6. Length: Roll. In Utility spaces.
   7. Length: 3/8" x 8' Johnsonite Millwork Mandalay at non-Utility spaces.
   8. Color: To be selected by Architect from manufacturer's full range.
   9. Accessories: Premolded external corners and internal corners.

2.04 ACCESSORIES

A. Subfloor Filler: Cementitious; type recommended by adhesive material manufacturer.

B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.

C. Flooring Adhesive for _____:
   1. Manufacturers:
      a. As approved and recommended by flooring manufacturer and BYU..

D. Moldings, Transition and Edge Strips: Same material as flooring.
   1. Manufacturers:
      a. Johnsonite.
      b. Roppe.

E. Copper Grounding Strips: Type and size as recommended by static control flooring manufacturer.

F. 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. 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 resilient base.

C. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for resilient flooring installation by testing for moisture and pH.
   1. Test in accordance with ASTM F710.
   2. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.

D. Verify that required floor-mounted utilities are in correct location.

I, Bruce T. Fallon, AIA the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers.

Signature & Date: 03.15.2024

3.02 PREPARATION

A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.

B. Remove sub-floor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with sub-floor filler to achieve smooth, flat, hard surface.

C. Prohibit traffic until filler is fully cured.

D. Clean substrate.

E. Apply primer as required to prevent "bleed-through" or interference with adhesion by substances that cannot be removed. Apply primer to all flooring surfaces.

3.03 INSTALLATION - GENERAL

A. Starting installation constitutes acceptance of sub-floor conditions.

B. Install in accordance with manufacturer's written instructions.

C. Spread only enough adhesive to permit installation of materials before initial set.

D. Place copper grounding strip in conductive adhesive and apply additional adhesive to top side of strip before installing static control flooring. Allow strip to extend beyond flooring in accordance with static control flooring manufacturer's instructions. Refer to Section 260526 for grounding and bonding to building grounding system.

E. Fit joints and butt seams tightly.

F. Set flooring in place, press with heavy roller to attain full adhesion.

G. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.

H. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
   1. Resilient Strips: Attach to substrate using adhesive.

I. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

J. Install flooring in recessed floor access covers, maintaining floor pattern.

K. At movable partitions, install flooring under partitions without interrupting floor pattern.

L. Install feature strips where indicated.

3.04 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.

3.05 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.

3.06 CLEANING

A. Remove excess adhesive from floor, base, and wall surfaces without damage.

B. Clean in accordance with manufacturer's written instructions.

I, Bruce T. Fallon, AIA the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers.

Signature & Date: 03.15.2024

3.07 PROTECTION

A. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION

I, Bruce T. Fallon, AIA the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers.

Signature & Date: 03.15.2024

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SECTION 096813

TILE CARPETING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Preparation for Not-in- Contract Carpet and base installation. The carpet and base will be furnished and installed by the owner.

1.02 REFERENCE STANDARDS

A. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2011.

1.03 FIELD CONDITIONS

A. Store materials in area of installation for minimum period of 24 hours prior to installation.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that sub-floor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet 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 carpet tile and wall base.

C. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to sub-floor surfaces.

D. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for flooring installation by testing for moisture and pH.
   1. Test in accordance with ASTM F710.
   2. Obtain instructions if test results are not within limits recommended by flooring material manufacturer and adhesive materials manufacturer.

E. 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 sub-floor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with sub-floor filler.

C. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.

D. Vacuum clean substrate.

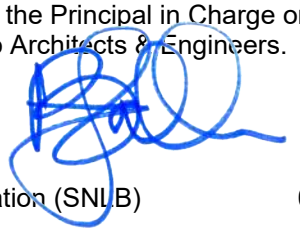
3.03 CLEANING

A. Remove excess adhesive without damage, from floor, base, and wall surfaces.

B. Clean and vacuum carpet surfaces.

END OF SECTION

I, Bruce T. Fallon, AIA the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers.

Signature & Date:  03.15.2024

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SECTION 099123

INTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints.

C. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
   1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
   2. Surfaces inside cabinets.
   3. Prime surfaces to receive wall coverings.
   4. Mechanical and Electrical:
      a. In finished areas, paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.
      b. In finished areas, paint shop-primed items.
      c. Paint interior surfaces of air ducts and convector and baseboard heating cabinets that are visible through grilles and louvers with one coat of flat black paint to visible surfaces.
      d. Paint dampers exposed behind louvers, grilles, and convector and baseboard cabinets to match face panels.

D. Do Not Paint or Finish the Following Items:
   1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
   2. Items indicated to receive other finishes except prime surfaces to receive wall coverings.
   3. Items indicated to remain unfinished.
   4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
   5. Stainless steel, anodized aluminum, bronze, terne coated stainless steel, and lead items.
   6. Marble, granite, slate, and other natural stones.
   7. Floors, unless specifically indicated.
   8. Ceramic and other tiles.
   9. Brick, architectural concrete, cast stone, integrally colored plaster and stucco.
   10. Glass.
   11. Concrete masonry units in utility, mechanical, and electrical spaces.
   12. Acoustical materials.
   13. Concealed pipes, ducts, and conduits.

1.02 RELATED REQUIREMENTS

A. Section 016116 - Volatile Organic Compound (VOC) Content Restrictions.

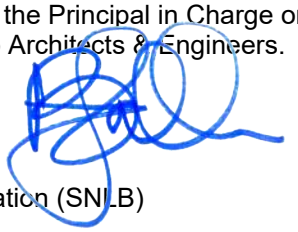
1.03 DEFINITIONS

A. Conform to ASTM D16 for interpretation of terms used in this section.

1.04 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.

I, Bruce T. Fallon, AIA the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers.

Signature & Date:  03.15.2024

B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2016.

C. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board; 2007.

D. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition, www.paintinfo.com.

E. SCAQMD 1113 - South Coast Air Quality Management District Rule No.1113; current edition.

F. SSPC V1 (PM1) - Good Painting Practice: Painting Manual, Volume 1; Fourth Edition.

F. SSPC V2 (PM2) - Systems and Specifications: Steel Structures Painting Manual, Volume 2; Fourth Edition.

G. SSPC-SP 1 - Solvent Cleaning; 2015.

H. SSPC-SP 2 - Hand Tool Cleaning; 1982 (Ed. 2004).

I. SSPC-SP 3 - Power Tool Cleaning; 1982 (Ed. 2004).

J. SSPC-SP 6 - Commercial Blast Cleaning; 2007.

1.05 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. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
   2. MPI product number (e.g. MPI #47).
   3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
   4. Manufacturer's installation instructions.
   5. If proposal of substitutions is allowed under submittal procedures, explanation of substitutions proposed.

C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
   1. Where sheen is specified, submit samples in only that sheen.
   2. Where sheen is not specified, discuss sheen options with Architect and owner before preparing samples, to eliminate sheens definitely not required.
   3. Allow 30 days for approval process, after receipt of complete samples by Architect.
   4. Paint color submittals will not be considered until color submittals for major materials not to be painted, such as masonry, have been approved.

D. Certification: By manufacturer that paints and finishes comply with VOC limits specified.

E. Manufacturer's Instructions: Indicate special surface preparation procedures.

F. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, material safety data sheets (MSDS), care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.
   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 the manufacturer's label.

I, Bruce T. Fallon, AIA the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers.

Signature & Date: 03.15.2024

1.06 QUALITY ASSURANCE

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

B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum 5 years' experience. Individuals applicating products with experience in performing the type of work specified with 5 years' experience or working under direct on-site supervision of an individual meeting this requirement.

1.07 MOCK-UP

A. See Section 014000 - Quality Requirements, for general requirements for mock-up.

B. Locate where directed by Architect.

C. Mock-up may remain as part of the work.

1.08 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, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Container Label with date purchased indicated.

D. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.09 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Do not apply materials when relative humidity exceeds 85 percent; at temperatures less than 5 degrees F above the dew point; or to damp or wet surfaces.

D. Minimum Application Temperatures for Paints: 50 degrees F for interiors unless required otherwise by manufacturer's instructions.

E. Minimum Application Temperature for Varnish Finishes: 65 degrees F for interior, unless required otherwise by manufacturer's instructions.

F. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide paints and finishes from the same manufacturer to the greatest extent possible.
   1. In the event that a single manufacturer cannot provide specified products, minor exceptions will be permitted provided approval by Architect and owner is obtained using the specified procedures for substitutions.
   2. Substitution of other products by the same manufacturer is preferred over substitution of products by a different manufacturer.

B. Paints:
   1. PPG Paints: www.ppgpaints.com
   2. Sherwin-Williams Company: www.sherwin-williams.com

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Signature & Date: 03.15.2024

3. Benjamin Moore: www.benjaminmoore.com.
4. Manufacturers as listed below for the paint systems and substrates.

C. Primer Sealers: Same manufacturer as top coats.

D. Substitutions: See Section 016000 - Product Requirements.

2.02 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready mixed, unless intended to be a field-catalyzed paint.
1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
2. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
3. Supply each paint material in quantity required to complete entire project's work from a single production run.
4. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product 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. CARB (SCM).
   d. Ozone Transport Commission (OTC) Model Rule, Architectural, Industrial, and Maintenance Coatings; www.otcair.org; specifically:
      1) Opaque, Flat: 50 g/L, maximum.
      2) Opaque, Non flat: 150 g/L, maximum.
      3) Opaque, High Gloss: 250 g/L, maximum.
      4) Varnishes: 350 g/L, maximum.
   e. Architectural coatings VOC limits of Utah.
2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.

C. Flammability: Comply with applicable code for surface burning characteristics.

D. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect and owner from the manufacturer's full line.

E. Colors: As indicated on drawings.
1. Allow for minimum of four colors for each system, unless otherwise indicated, without additional cost to Owner.
2. Extend colors to surface edges; colors may change at any edge as directed by Architect.
3. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling they are mounted on/under.
4. In utility areas, finish equipment, piping, conduit, and exposed duct work in colors according to the color coding scheme indicated.

2.03 PAINT SYSTEMS - INTERIOR

A. Interior gypsum board surfaces to be Painted, Unless Otherwise Indicated: Including gypsum board.

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B. Paint I-OP-GB - Interior gypsum board surfaces to be painted, Unless Otherwise Indicated. Normal spaces not requiring special systems for specific spaces and uses included below.
   1. Primer: One coat, BM N534 UltraSpec
      a. Finish coats: Two coats, BM 550 Regal Select Interior Pearl
   2. Option 2: PPG
      a. Primer: One coat, PPG 1000 High Hiding Interior Primer Sealer
      b. Finish Coats: Two coats, PPG Diamond 350 Semi-Gloss
   3. Option 3: Sherwin Williams
      a. Primer: One coat, SW Contractors 152 Pro Primer White
      b. Finish coats: Two coats, SW ProMar 200 Zero VOC Interior Latex Semi-Gloss Extra
      c. Two top coats and one coat primer.

2.04 PRIMERS

A. Primers: Provide the primer recommended by manufacturer of top coats.

2.05 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin application of paints and finishes until substrates have been properly prepared.

B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.

D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

E. Test shop-applied primer for compatibility with subsequent cover materials.

F. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
   1. Gypsum Wallboard: 12 percent.
   2. Masonry, Concrete, and Concrete Masonry Units : 12 percent.

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. Remove or repair existing paints or finishes that exhibit surface defects.

D. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

E. Seal surfaces that might cause bleed through or staining of topcoat.

F. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

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G. Masonry:
   1. Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.
   2. Prepare surface as recommended by top coat manufacturer.
   3. Clean surfaces with pressurized water. Use pressure range of 600 to 1500 psi at 6 to 12 inches. Allow to dry.

H. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.

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 and recommendations in "MPI Architectural Painting Specification Manual".

C. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.

D. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

E. Apply each coat to uniform appearance in thicknesses specified by manufacturer.

F. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply as many coats as necessary for complete hide.

G. Sand wood and metal surfaces lightly between coats to achieve required finish.

H. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

I. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for general requirements for field inspection.

B. Owner will provide field inspection.

3.05 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.06 PROTECTION

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION

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SECTION 122400

WINDOW SHADES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Window shades and accessories.

B. Electric motor operators.

C. Motor controls.

1.02 RELATED REQUIREMENTS

A. Section 061000 - Rough Carpentry: Concealed wood blocking for attachment of headrail brackets.

B. Section 092116 - Gypsum Board Assemblies: Substrate for window shade systems.

1.03 REFERENCE STANDARDS

A. ASTM D4674 - Standard Practice for Accelerated Testing for Color Stability of Plastics Exposed to Indoor Office Environments; 2002a (Reapproved 2010).

B. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2015.

C. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with other trades to provide rough-in of electrical wiring as required for installation of hardwired motorized shades.

B. Preinstallation Meeting: Convene one week prior to commencing work related to products of this section; require attendance of all affected installers.

C. Sequencing:
   1. Do not fabricate shades until field dimensions for each opening have been taken.
   2. Provide Field Measurements to BYU Design PM to be distributed to the BYU Upholstery shop.
   3. Do not install shades until final surface finishes and painting are complete.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets including materials, finishes, fabrication details, dimensions, profiles, mounting requirements, and accessories.
   1. Motorized Shades: Include power requirements and standard wiring diagrams.

C. Shop Drawings: Include shade schedule indicating size, location and keys to details, head, jamb and sill details, mounting dimension requirements for each product and condition, and operation direction.

D. Shop Drawings - Motorized Shades: Provide schematic system riser diagram indicating component interconnections. Include requirements for interface with other systems.

E. Certificates: Manufacturer's documentation that line voltage components are UL listed or UL recognized.

F. Source Quality Control Submittals: Provide test reports indicating compliance with specified fabric properties.

G. Selection Samples: Include fabric samples in full range of available colors and patterns.

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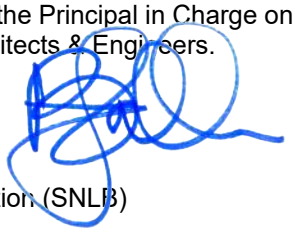
Signature & Date:  03.15.2024

1. Motorized Shades: Include finish selections for controls.

H. Verification Samples: Minimum size 6 inches square, representing actual materials, color and pattern.

I. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation of product.

J. Project Record Documents: Record actual locations of control systems and show interconnecting wiring.

K. Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of shop drawings.

L. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty 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 not less than five years of documented experience.

B. Installer Qualifications: Company specializing in performing work of this type with minimum five years of documented experience.

1.07 MOCK-UP

A. Mock-Up: Provide full size mock-up of window shade complete with selected shade fabric including sample of seam when applicable.
1. Full-sized mock-up may become part of the final installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manually Operated Roller Shades:
1. Mariak, Roller Shade, www.mariak.com. Econo Shade
2. Soleffect. www.soleffectshades.com
3. Substitutions: See Section 016000 - Product Requirements.

B. Motorized Roller Shades, Motors and Motor Controls:
1. Mariak, Roller Shade, www.mariak.com. Econo Shade
2. Soleffect. www.soleffectshades.com
3. Substitutions: See Section 016000 - Product Requirements.

C. Shade Fabric:
1. Mermet Corporation; E-Screen 0% - 3%**:** www.mermetusa.com.
2. Phifer, Inc; Style 2410 0%-3%**:** www.phifer.com.

D. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

2.02 WINDOW SHADE APPLICATIONS

A. Interior Roller Shades: _____
1. Type: Roll down, closed position is at window sill.
2. Fabric Performance Requirements: As Selected by Architect
a. Openness Factor: **0% - 3%.** **Updated 28 April 2021**
3. Color: As selected by Architect from manufacturer’s full range of colors.
4. Mounting: Inside and outside, where indicated on drawings.
5. Operation: Manual and motorized, in locations indicated.

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2.03 ROLLER SHADES

A. Roller Shades: Fabric roller shades complete with mounting brackets, roller tubes, hembars, hardware and accessories.
   1. Drop: Regular roll.
   2. Size: Field Measured.

B. Fabric: Non-flammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
   1. Sheer Shades: Reduce glare yet still reveal considerable details to the outside; no privacy; Openness Factor 1 percent to 3 percent.
   2. Blackout Shades: Block virtually all the light; Openness Factor equal to zero (0).
   3. Flammability: Pass NFPA 701 large and small tests.

C. Roller Tubes: As required for type of operation.
   1. Material: Extruded aluminum or galvanized steel; as required for shade location.
   2. Size: Manufacturer's standard, selected for suitability for installation conditions, span, and weight of shades.
   3. Fabric Attachment: Utilize extruded channel in tube to accept vinyl spline welded to fabric edge.
   4. Finish: Clear anodized.

D. Hembars: Designed for weight requirements and adaptation to uneven surfaces, to maintain bottom of shade straight and flat.
   1. Style: Half wrap fabric covered bottom bar, flat profile with closed ends.

E. Manual Operation for Interior Shades: Clutch operated continuous loop; beaded ball chain.

F. Motor Operation: Motor system housed inside roller tube, controlling shade movement via motor controls indicated; listed to UL 325.
   1. Audible Noise: Maximum 39 dBA measured 3 feet from the motor unit; no audible clicks when motor starts and stops.
   2. Motors: Size and configuration as recommended by manufacturer for the type, size, and arrangement of shades to be operated; integrated into shade operating components and concealed from view.
   3. Motor Type: Both AC and DC motors are acceptable; provide required transformers for DC motors.
   4. Coupling of Multiple Shades: Where possible, minimize number of motors by coupling adjacent shades.
   5. Control Compatibility: Fully compatible with the controls to be installed.

2.04 MOTOR CONTROLS

A. Motorized shades to be controlled by wall-mounted controls and wireless (RF) handheld remote controls as specified below.

B. Control Requirements:
   1. Unless specifically indicated to be excluded, provide all required equipment, conduit, boxes, wiring, connectors, hardware, supports, accessories, software, system programming, etc. as necessary for a complete operating system that provides the control intent indicated.
   2. Capable of assigning shades to groups and subgroups without rewiring.
   3. Capable of storing programmable stop points, including open, close, and any other position.
   4. Capable of synchronizing multiple units of the same size to start, stop and move in unison.
   5. Provide all components and connections necessary to interface with other systems as indicated.

C. Wall-Mounted Controls: UV stabilized visible parts meeting ASTM D4674; provided by shade manufacturer.
   1. Control Functions:
      a. Open: Automatically open controlled shade(s) to fully open position when button is pressed.

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b. Close: Automatically close controlled shade(s) to fully closed position when button is pressed.
c. Raise: Raise controlled shade(s) only while button is pressed.
d. Lower: Lower controlled shade(s) only while button is pressed.
e. Stop shade(s) in motion by tap on any button.
f. Presets: Provide button(s) as indicated for selection of programmable scenes.
g. Multiple Shade Groups: Provide individual controls for each shade group as indicated.

2. Finish: To be selected by Architect.
3. Button Engraving: Manufacturer's standard engraving, unless otherwise indicated.

D. Wireless (Radio Frequency) Handheld Remote Control: Battery-powered; provided by shade manufacturer.
1. Wireless Range: 30 feet.
2. Control Functions:
a. Open: Automatically open controlled shade(s) to fully open position when button is pressed.
b. Close: Automatically close controlled shade(s) to fully closed position when button is pressed.
c. Raise: Raise controlled shade(s) only while button is pressed.
d. Lower: Lower controlled shade(s) only while button is pressed.
e. Preset: Provide button for selection of programmable scene.
3. Finish: To be selected by Architect.

2.05 ACCESSORIES

A. Fascias: Size as required to conceal shade mounting.
1. Style: As selected by Architect from shade manufacturer's full selection.
2. Material and Color: To match shade.

B. Brackets and Mounting Hardware: As recommended by manufacturer for mounting configuration and span indicated.

C. Interior Side Channels: As required for light sealing blackout shade applications.

D. Lifting Cables: Nylon coated cable for lifting bottom-up type shades.

E. Fasteners: Non-corrosive, and as recommended by shade manufacturer.

2.06 FABRICATION

A. Field measure finished openings prior to ordering or fabrication.

B. Fabricate shades to fit openings within specified tolerances.
1. Vertical Dimensions: Fill openings from head to sill with 1/4 inch space between bottom bar and window sill.
2. Horizontal Dimensions - Inside Mounting: Fill openings from jamb to jamb.
3. Horizontal Dimensions - Outside Mounting: Cover window frames, trim, and casings completely.

C. Dimensional Tolerances: As recommended in writing by manufacturer.

D. At openings requiring continuous multiple shade units with separate rollers, locate roller joints at window mullion centers; butt rollers end-to-end.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine finished openings for deficiencies that may preclude satisfactory installation.

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B. If substrate preparation is the responsibility of another installer, notify Architect and BYU Construction PM of unsatisfactory preparation before proceeding.

C. Start of installation shall be considered acceptance of substrates.

3.02 PREPARATION

A. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under the project conditions.

B. Coordinate with window installation and placement of concealed blocking to support shades.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions and approved shop drawings, using mounting devices as indicated.

B. Installation Tolerances:
   1. Inside Mounting: Maximum space between shade and jamb when closed off 1/16 inch.
   2. Maximum Offset From Level: 1/16 inch.

C. Replace shades that exceed specified dimensional tolerances at no extra cost to Owner.

D. Adjust level, projection and shade centering from mounting bracket. Verify there is no telescoping of shade fabric. Ensure smooth shade operation.

3.04 SYSTEM STARTUP

A. Motorized Shade System: Provide services of a manufacturer's authorized representative to perform system startup.

3.05 CLEANING

A. Clean soiled shades and exposed components as recommended by manufacturer.

B. Replace shades that cannot be cleaned to "like new" condition.

3.06 CLOSEOUT ACTIVITIES

A. See Section 017800 - Closeout Submittals, for closeout submittals.

B. Demonstration: Demonstrate operation and maintenance of window shade system to Owner's personnel.

C. Training: Train Owner's personnel on operation and maintenance of system.
   1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
   2. Provide minimum of two hours training by manufacturer's authorized personnel at location designated by the Owner.

3.07 PROTECTION

A. Protect installed products from subsequent construction operations.

3.08 MAINTENANCE

A. See Section 017000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.

END OF SECTION

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SECTION 123600

COUNTERTOPS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Countertops for architectural cabinet work.

B. Countertops for manufactured casework.

1.02 RELATED REQUIREMENTS

A. Section 064100 - Architectural Wood Casework.

1.03 REFERENCE STANDARDS

A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.

C. AWI (QCP) - Quality Certification Program; current edition at www.awiqcp.org.

D. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014, with Errata (2016).

E. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.1; 2016, with Errata (2017).

F. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.

G. PS 1 - Structural Plywood; 2009.

H. SEFA 2 - Installations; 2010.

1.04 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. Shop Drawings: Complete details of materials and installation; combine with shop drawings of cabinets and casework specified in other sections.

D. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.

E. Verification Samples: For each finish product specified, minimum size 6 inches square, representing actual product, color, and patterns.

F. Test Reports: Chemical resistance testing, showing compliance with specified requirements.

G. Certificate: Submit labels and certificates required by quality assurance and quality control programs.

H. Installation Instructions: Manufacturer's installation instructions and recommendations.

I. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

1.05 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.

B. Quality Certification:
   1. Comply with AWI (QCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section: www.awiqcp.org/

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2. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
3. Provide designated labels on shop drawings as required by certification program.
4. Provide designated labels on installed products as required by certification program.
5. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.

1.06 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.

1.07 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. Solid Surfacing Countertops: Solid surfacing sheet or plastic resin casting over continuous substrate.
1. Flat Sheet Thickness: 3/4 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; Corian: www.corian.com/
      2) Formica Corporation; Solid Surface: www.formica.com/
      3) Samsung Staron Solid Surfaces. www.staron.com
      4) Substitutions: See Section 016000 - Product Requirements.
   b. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
   c. NSF approved for food contact.
   d. Sinks and Bowls: Integral castings; minimum 3/4 inch wall thickness; comply with IAPMO Z124.
   e. Finish on Exposed Surfaces: Matte, gloss rating of 5 to 20.
   f. Color and Pattern: As selected by Architect from manufacturer's full line.
3. Other Components Thickness: 1/2 inch, minimum.
4. Exposed Edge Treatment: Built up to minimum 1-1/4 inch thick; radiused edge; use marine edge at sinks.
5. Back and End Splashes: Same sheet material, square top; minimum 4 inches high.
6. Skirts: As indicated on drawings.

2.02 MATERIALS

A. Plywood for Supporting Substrate: PS 1 Exterior Grade, A-C veneer grade, minimum 5-ply; minimum 3/4 inch thick; join lengths using metal splines.

B. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.

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.

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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.

C. Solid Surfacing: Fabricate tops and wall panels up to 144 inches long in one piece; join pieces with adhesive sealant in accordance with manufacturer's recommendations and instructions.
1. Integral sinks: Shop-mount securely to countertop with adhesives, using flush configuration, as per manufacturer's instructions, and as detailed on drawings.

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.

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. 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

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SECTION 220523

GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Applications.
B. General requirements.
C. Angle valves.
D. Ball valves.
E. Butterfly valves.
F. Check valves.
G. Gate valves.
H. Globe valves.

1.02 RELATED REQUIREMENTS

A. Section 078400 - Firestopping.
B. Section 083100 - Access Doors and Panels.
C. Section 220548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.
D. Section 220553 - Identification for Plumbing Piping and Equipment.
E. Section 220716 - Plumbing Equipment Insulation.
F. Section 220719 - Plumbing Piping Insulation.
G. Section 221005 - Plumbing Piping.
H. Section 221500 - General-Service Compressed-Air Systems.

1.03 ABBREVIATIONS AND ACRONYMS

A. CWP: Cold working pressure.
B. EPDM: Ethylene propylene copolymer rubber.
C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
D. NRS: Non-rising stem.
E. OS&Y: Outside screw and yoke.
F. PTFE: Polytetrafluoroethylene.
G. RS: Rising stem.
H. SWP: Steam working pressure.
I. TFE: Tetrafluoroethylene.

1.04 REFERENCE STANDARDS

A. API STD 594 - Check Valves: Flanged, Lug Wafer, and Butt-Welding; 2017.
B. ASME B1.20.1 - Pipe Threads, General Purpose (Inch); 2013.
C. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2015.
D. ASME B16.5 - Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard; 2017.
E. ASME B16.10 - Face-to-Face and End-to-End Dimensions of Valves; 2017.
F. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2012.

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G. ASME B16.34 - Valves - Flanged, Threaded and Welding End; 2017.
H. ASME B31.9 - Building Services Piping; 2014.
I. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing and Fusing Operators; 2017.
J. ASTM A48/A48M - Standard Specification for Gray Iron Castings; 2003 (Reapproved 2016).
K. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings; 2004 (Reapproved 2014).
L. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures; 1999 (Reapproved 2014).
M. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984 (Reapproved 2014).
N. ASTM B61 - Standard Specification for Steam or Valve Bronze Castings; 2015.
O. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings; 2017.
P. AWWA C606 - Grooved and Shouldered Joints; 2015.
Q. MSS SP-45 - Bypass and Drain Connections; 2003 (Reaffirmed 2008).
R. MSS SP-67 - Butterfly Valves; 2011.
S. MSS SP-70 - Cast Iron Gate Valves, Flanged and Threaded Ends; 2011.
T. MSS SP-71 - Cast Iron Swing Check Valves, Flanged and Threaded Ends; 2011.
U. MSS SP-72 - Ball Valves with Flanged or Butt-Welding Ends for General Service; 2010.
V. MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves; 2013.
W. MSS SP-85 - Cast Iron Globe & Angle Valves, Flanged and Threaded Ends; 2011.
X. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010.
Y. MSS SP-125 - Gray Iron and Ductile Iron In-Line, Spring-Loaded, Center-Guided Check Valves; 2010.
Z. NSF 61 - Drinking Water System Components - Health Effects; 2016.
AA. NSF 372 - Drinking Water System Components - Lead Content; 2016.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
C. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.

1.06 QUALITY ASSURANCE

A. Manufacturer:
   1. Obtain valves for each valve type from single manufacturer.
   2. Company must specialize in manufacturing products specified in this section, with not less than three years of documented experience.
B. Welding Materials and Procedures: Conform to ASME BPVC-IX.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
   1. Minimize exposure of operable surfaces by setting ball valves to open position.
   2. Protect valve parts exposed to piped medium against rust and corrosion.

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3. Protect valve piping connections such as grooves, weld ends, threads, and flange faces.
4. Adjust globe, gate, and angle valves to the closed position to avoid clattering.
5. Secure check valves in either the closed position or open position.
6. Adjust butterfly valves to closed or partially closed position.

B. Use the following precautions during storage:
1. Maintain valve end protection and protect flanges and specialties from dirt.
a. Provide temporary inlet and outlet caps.
b. Maintain caps in place until installation.
2. Store valves in shipping containers and maintain in place until installation.
a. Store valves indoors in dry environment.
b. Store valves off the ground in watertight enclosures when indoor storage is not an option.

C. Exercise the following precautions for handling:
1. Handle large valves with sling, modified to avoid damage to exposed parts.
2. Avoid the use of operating handles or stems as rigging or lifting points.

PART 2 PRODUCTS

2.01 APPLICATIONS

A. See Drawings for specific valve locations.

B. Listed pipe sizes shown using nominal pipe sizes (NPS) and nominal diameter (DN).

C. Provide the following valves for the applications if not indicated on Drawings:
1. Shutoff: Ball, gate.
2. Dead-End: For up to 2", Ball, 2-1/2" and above, Non rising stem gate valve, epoxy coated resilient wedge type.
3. Throttling: Provide globe, angle, or ball.
4. Swing Check (Pump Outlet):
a. 2 NPS and Smaller: Bronze swing check valves with bronze, nonmetallic, or stainless steel disc.
b. 2-1/2 NPS and Larger for Domestic Water: Iron swing check valves with closure control, metal, resilient, or stainless steel seat check valves.
c. 2-1/2 NPS and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.

D. Substitutions of valves with higher CWP classes or SWP ratings for same valve types are permitted when specified CWP ratings or SWP classes are not available.

E. Required Valve End Connections for Non-Wafer Types:
1. Stainless Steel Pipe:
a. 2 NPS and Smaller: Threaded ends, mechanical compression fittings.
b. 2-1/2 NPS to 4 NPS: Mechanical compression fittings, grooved or flanged ends except where threaded valve-end option is indicated in valve schedules below.
c. 5 NPS and Larger: Grooved or flanged ends.
2. Copper Tube:
a. 2 NPS and Smaller: Threaded ends, mechanical compression fittings, except where solder-joint valve-end option is indicated in valve schedules below.
b. 2-1/2 NPS to 4 NPS: Mechanical compression fittings, grooved or flanged ends except where threaded valve-end option is indicated in valve schedules below.
c. 5 NPS and Larger: Grooved or flanged ends.
3. HDPE/HDPR Tube:
a. 2 NPS and Smaller: Threaded ends, mechanical compression fittings.
b. 2-1/2 NPS to 4 NPS: Mechanical compression fittings, grooved or flanged ends except where threaded valve-end option is indicated in valve schedules below.

c. 5 NPS and Larger: Grooved or flanged ends.

4. Cross-linked Polyethylene Tube:
   a. 2 NPS and Smaller: Threaded ends, mechanical compression fittings.
   b. 2-1/2 NPS to 4 NPS: Mechanical compression fittings, grooved or flanged ends except where threaded valve-end option is indicated in valve schedules below.
   c. 5 NPS and Larger: Grooved or flanged ends.

F. Low Pressure, Compressed Air Valves 150 psig or Less:
   1. 2 NPS and Smaller:
      a. Bronze , Brass or Stainless Steel: Provide with solder-joint, threaded, or mechanical compression ends.
      b. Ball: One piece, full port, stainless steel with stainless steel trim.
      c. Bronze Lift Check: Class 150, nonmetallic disc.
      d. Bronze Swing Check: Class 150, nonmetallic disc.
      e. Bronze Gate: Class 150, NRS.
   2. 2-1/2 NPS and Larger:
      a. Iron, 2-1/2 NPS to 4 NPS: Provide with threaded or flanged ends.
      b. Iron Single-Flange Butterfly: 200 CWP, NBR Seat, ductile-iron disc.
      c. Iron Grooved-End Butterfly: 175 CWP.
      d. Iron Swing Check: Class 125, metal seats.
      e. Iron Grooved-End Swing Check: 300 CWP.
      f. Iron Center-Guided Check: Class 150, compact-wafer, resilient seat.
      g. Iron Plate-Type Check: Class 150; single plate; metal seat.
      h. Iron Gate: Class 125, NRS.

G. Domestic, Hot and Cold Water Valves:
   1. 2 NPS and Smaller:
      a. Bronze, Stainless Steel, and Brass: Provide with grooved, solder-joint, threaded, or mechanical compression ends.
      b. Bronze Angle: Class 125, bronze disc.
      c. Ball: Two piece, full port, stainless steel with stainless-steel trim.
      d. Bronze Swing Check: Class 125, stainless steel disc.
      e. Bronze Gate: Class 125, NRS.
      f. Bronze Globe: Class 125, stainless steel disc.
   2. 2-1/2 NPS and Larger:
      a. Iron, 2-1/2 NPS to 4 NPS: Provide with grooved, threaded, flanged, or mechanical compression ends.
      b. Iron Ball: Class 150.
      c. Iron Swing Check: Class 125, metal seats.
      d. Iron Swing Check with Closure Control: Class 125, lever and spring.
      e. Iron Grooved-End Swing Check: 300 CWP.
      f. Iron Center-Guided Check: Class 125, compact-wafer, resilient seat.
      g. Iron Plate-Type Check: Class 125; single plate; resilient seat.
      h. Iron Gate: Class 125, NRS.
      i. Iron Globe: Class 125.
      j. Epoxy coated resilient wedge.

H. Sanitary Waste, Storm Drainage, and Forced Main Water Valves:
   1. 2 NPS and Smaller:
      a. Bronze, Stainless Steel and Brass: Provide with grooved, solder-joint, threaded, or mechanical compression ends.
      b. Bronze Angle: Class 125, bronze disc.
      c. Ball: Two piece, full port, stainless steel with stainless-steel trim.

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d. Bronze Swing Check: Class 125, stainless steel disc.
e. Bronze Gate: Class 125, NRS.
f. Bronze Globe: Class 125, stainless steel disc.

2. 2-1/2 NPS and Larger:
   a. Iron, 2-1/2 NPS to 4 NPS: Provide with mechanical compression, threaded, flanged, or grooved ends.
   b. Iron Ball: Class 150.
   c. Iron Swing Check: Class 125, nonmetallic-to-metal seats.
   d. Iron Swing Check with Closure Control: Class 125, lever and spring.
   e. Iron Grooved-End Swing Check: 300 CWP.
   f. Iron Gate: Class 125, NRS.
   g. Iron Globe: Class 125.

2.02 GENERAL REQUIREMENTS

A. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.

B. Valve Sizes: Match upstream piping unless otherwise indicated.

C. Valve Actuator Types:
   1. Gear Actuator: Quarter-turn valves 8 NPS and larger.
   2. Handwheel: Valves other than quarter-turn types.
   3. Hand Lever: Quarter-turn valves 6 NPS and smaller.

D. Valves in Insulated Piping: With 2 NPS stem extensions and the following features:
   1. Gate Valves: Rising stem.
   2. Ball Valves: Extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
   3. Butterfly Valves: Extended neck.
   4. Memory Stops: Fully adjustable after insulation is installed.

E. Valve-End Connections:
   1. Threaded End Valves: ASME B1.20.1.
   2. Flanges on Iron Valves: ASME B16.1 for flanges on iron valves.
   3. Pipe Flanges and Flanged Fittings 1/2 NPS through 24 NPS: ASME B16.5.
   4. Solder Joint Connections: ASME B16.18.
   5. Grooved End Connections: AWWA C606.
   6. Mechanical Compression Connections:
   7. Cross-linked polyethylene:

F. General ASME Compliance:
   1. Ferrous Valve Dimensions and Design Criteria: ASME B16.10 and ASME B16.34.
   2. Solder-joint Connections: ASME B16.18.
   3. Building Services Piping Valves: ASME B31.9.

G. Valve Materials for Potable Water: NSF 61 and NSF 372.

H. Bronze Valves:
   1. Fabricate from dezincification resistant material.
   2. Copper alloys containing more than 15 percent zinc are not permitted.

I. Valve Bypass and Drain Connections: MSS SP-45.

2.03 BRASS BALL VALVES

A. One-Piece, Reduced-Port with Stainless Steel Trim:
   1. Comply with MSS SP-110.
   2. CWP Rating: 600 psig.

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3. Body: Forged brass.
4. Ends: Threaded.
5. Seats: PTFE.
6. Stem: Stainless Steel.
7. Ball: Stainless steel.
8. Manufacturers:
    a. Nibco.
    b. Watts.
    c. Apollo.
    d. Milwaukee.
    e. Viega.
    f. Substitutions: See Section 016000 - Product Requirements.

B. Two Piece, Full Port with Stainless Steel Trim:
1. Comply with MSS SP-110.
2. SWP Rating: 150 psig.
3. CWP Rating: 600 psig.
4. Body: Forged brass.
5. Ends: Mechanical Compression, Threaded or soldered.
6. Seats: PTFE.
7. Stem: Stainless Steel.
8. Ball: Stainless Steel.
9. Manufacturers:
    a. Apollo.
    b. Nibco.
    c. Watts.
    d. Milwaukee.
    e. Viega.
    f. Substitutions: See Section 016000 - Product Requirements.

C. Three Piece, Full Port with Stainless Steel Trim:
1. Comply with MSS SP-110.
2. SWP Rating: 150 psig.
3. CWP Rating: 600 psig.
4. Body: Forged brass.
5. Ends: Mechanical Compression,Threaded, or soldered.
6. Seats: PTFE.
7. Stem: Stainless steel.
8. Ball: Stainless steel, Stainless Steel.
9. Manufacturers:
    a. Apollo.
    b. Nibco.
    c. Watts.
    d. Milwaukee.
    e. Viega.
    f. Substitutions: See Section 016000 - Product Requirements.

2.04 BRONZE BALL VALVES

A. One Piece, Reduced Port with Stainless Steel Trim:
1. Comply with MSS SP-110.
2. SWP Rating: 400 psig.
3. CWP Rating: 600 psig.

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4. Body: Bronze.
5. Ends: Threaded, mechanical compression, or soldered.
6. Seats: PTFE.
7. Stem: Stainless steel.
8. Ball: Stainless Steel
9. Manufacturers:
    a. Apollo Valves.
    b. Viega LLC; _____: www.viega.us
    c. Nibco.
    d. Watts.
    e. Milwaukee.
    f. Substitutions: See Section 016000 - Product Requirements.

B. Two Piece, Full Port with Stainless Steel Trim:
1. Comply with MSS SP-110.
2. SWP Rating: 150 psig.
3. CWP Rating: 600 psig.
4. Body: Bronze.
5. Ends: Threaded, mechanical compression, or soldered.
6. Seats: PTFE.
7. Stem: Stainless steel.
8. Ball: Stainless Steel.
9. Manufacturers:
    a. Apollo Valves; _____: www.apollovalves.com
    b. Viega LLC; _____: www.viega.us
    c. Milwaukee.
    d. Nibco.
    e. Watts.
    f. Substitutions: See Section 016000 - Product Requirements.

C. Three Piece, Full Port with Stainless Steel Trim:
1. Comply with MSS SP-110.
2. SWP Rating: 150 psig.
3. CWP Rating: 600 psig.
4. Body: Bronze.
5. Ends: Threaded, mechanical compression, or soldered.
6. Seats: PTFE
7. Stem: Stainless steel.
8. Ball: Stainless Steel.
9. Manufacturers:
    a. Apollo Valves; _____: www.apollovalves.com/#sle.
    b. Viega LLC; _____: www.viega.us
    c. Milwaukee.
    d. Nibco.
    e. Watts.
    f. Substitutions: See Section 016000 - Product Requirements.

2.05 IRON BALL VALVES

A. Class 125, Full Port, Stainless Steel Trim:
1. Comply with MSS SP-72.
2. CWP Rating: 200 psig.
3. Body: ASTM A536, Grade 65-45-12, ductile iron.

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4. Ends: Flanged or Grooved..
5. Seats: PTFE.
6. Stem: Stainless steel.
7. Ball: Stainless steel.
8. Operator: Lever, with locking handle.
9. Manufacturers:
    a. Apollo Valves; _____: www.apollovalves.com
    b. Viega LLC.
    c. Nibco.
    d. Watts.
    e. Milwaukee.
10. Not for use in potable water systems.

2.06 IRON, SINGLE FLANGE BUTTERFLY VALVES

A. Lug type: Bi-directional dead-end service without use of downstream flange.
1. Comply with MSS SP-67, Type I.
2. CWP Rating: 200 psig.
3. Body: ASTM A126, cast iron or ASTM A536, ductile iron.
4. Stem: One or two-piece stainless steel.
5. Seat: EPDM.
6. Disc: Coated ductile iron.
7. Manufacturers:
    a. Apollo Valves; _____: www.apollovalves.com
    b. Viega LLC.
    c. Milwaukee.
    d. Nibco.
    e. Watts.

2.07 IRON, GROOVED-END BUTTERFLY VALVES

A. CWP Rating: 175 psig (1200 kPa).
1. Comply with MSS SP-67, Type I.
2. Body: Coated ductile iron.
3. Stem: Two-piece stainless steel.
4. Disc: Coated ductile iron.
5. Disc Seal: EPDM.
6. Manufacturers:
    a. Apollo Valves.
    b. Viega LLC.
    c. Milwaukee.
    d. Nibco.
    e. Watts.
    f. Substitutions: See Section 016000 - Product Requirements.

2.08 BRONZE LIFT CHECK VALVES

A. Class 125:
1. Comply with MSS SP-80, Type 1, Metal Disc to Metal Seat, Type 2, Nonmetallic Disc to Metal Seat, and _____.
2. CWP Rating: 200 psig.
3. Design: Vertical flow.
4. Body: Comply with ASTM B61 or ASTM B62, bronze.
5. Ends: Threaded as indicated.
6. Disc (Type 1): Bronze.

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7. Disc (Type 2): NBR or ____.
8. Manufacturers:
    a. Apollo Valves.
    b. Viega LLC.
    c. Milwaukee.
    d. Nibco.
    e. Watts.

2.09 BRONZE SWING CHECK VALVES

A. Class 125: CWP Rating: 200 psig (1380 kPa) and _____.
1. Comply with MSS SP-80, Type 3.
2. Design: Horizontal flow.
3. Body: Bronze, ASTM B62.
4. Ends: Threaded as indicated.
5. Disc: Bronze.
6. Manufacturers:
    a. Viega LLC.
    b. Milwaukee.
    c. Nibco.
    d. Watts.

2.10 IRON SWING CHECK VALVES

A. Class 125:
1. Comply with MSS SP-71, Type I.
2. Design: T-body style for clear or full waterways.
3. CWP Rating: 200 psig.
4. Design: Clear or full waterway.
5. Body: ASTM A126, gray iron with bolted bonnet.
6. Ends: Flanged as indicated.
7. Trim: Composition.
8. Seat Ring and Disc Holder: Bronze.
9. Disc: PTFE or ____.
10. Gasket: Asbestos free.
11. Manufacturers:
    a. Apollo Valves; _____: www.apollovalves.com
    b. Viega LLC.
    c. Milwaukee.
    d. Nibco.
    e. Watts.

2.11 IRON GROOVED-END SWING CHECK VALVES

A. 300 CWP:
1. CWP Rating: 300 psig.
2. Body: ASTM A536, Grade 65-45-12 ductile iron.
3. Seal: EPDM or Nitrile.
4. Disc: Ductile iron.
5. Coating: Black, non-lead paint.
6. Manufacturers:
    a. Apollo Valves; [_____]: www.apollovalves.com
    b. Viega LLC.
    c. Milwaukee.

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d. Nibco.
e. Watts.

2.12 IRON CENTER-GUIDED CHECK VALVES

A. Class 125, Globe:
1. Comply with MSS SP-125.
2. CWP Rating: 200 psig.
3. Body: ASTM A126, gray iron.
4. Style: Spring loaded.
5. Ends: Flanged.
6. Metal Seat: Unleaded bronze.
7. Resilient Seat: EPDM or NBR.
8. Manufacturers:
a. Apollo Valves; [_____]: www.apollovalves.com
b. Viega LLC.
c. Milwaukee.
d. Nibco.
e. Watts.

B. Class 150, Compact-Wafer:
1. Comply with MSS SP-125.
2. CW P Rating: 300 psig.

C. Class 150, Globe:
1. Comply with MSS SP-125.
2. CWP Rating: 300 psig.
3. Style: Spring loaded.
4. Ends: Flanged.

2.13 IRON PLATE TYPE CHECK VALVES

A. Class 150, Dual-Plate:
1. Comply with API STD 594.
2. CWP Rating: 300 psig.
3. Design: Wafer, spring-loaded plates.
4. Body: ASTM A395/A395M or ASTM A536, ductile iron.
5. Resilient Seat: EPDM or NBR.
6. Manufacturers:
a. Apollo Valves; [_____]: www.apollovalves.com
b. Viega LLC.
c. Milwaukee.
d. Nibco.
e. Watts.

B. Class 300, Dual-Plate:
1. Comply with API STD 594.
2. CWP Rating: 500 psig.
3. Design: Wafer, spring-loaded plates.
4. Body: ASTM A395/A395M or ASTM A536, ductile iron.
5. Metal Seat: Unleaded bronze.
6. Manufacturers:
a. Apollo Valves; [_____]: www.apollovalves.com
b. Viega LLC.
c. Milwaukee.

d. Nibco.
e. Watts.

2.14 BRONZE GATE VALVES

A. Non-Rising Stem (NRS) or Rising Stem (RS):
1. Comply with MSS SP-80, Type I.
2. Class 150: CWP Rating: 300 psig:.
3. Body: ASTM B62, bronze with integral seat and screw-in bonnet.
4. Ends: Threaded solder joint, or mechanical press joint.
5. Stem: Unleaded bronze.
6. Disc: Solid wedge; unleaded bronze.
7. Packing: Asbestos free.
8. Handwheel: Malleable iron, bronze, or aluminum.
9. Manufacturers:
a. Apollo Valves; [_____]: www.apollovalves.com
b. Viega LLC.
c. Milwaukee.
d. Nibco.
e. Watts.
f. Substitutions: See Section 016000 - Product Requirements.

2.15 IRON GATE VALVES

A. NRS:
1. Comply with MSS SP-70, Type I.
2. Class 125: CWP Rating: 200 psig:, and Class 250: CWP Rating: 500 psig:.
3. Body: ASTM A126, gray iron with bolted bonnet.
4. Ends: Flanged.
5. Trim: Stainless Steel.
6. Disc: Solid wedge.
7. Packing and Gasket: Asbestos free.
8. Epoxy coated.
9. Manufacturers:
a. Mueller
b. American.
c. Nibco.
d. Watts.
e. Substitutions: See Section 016000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Discard all packing materials and verify that valve interior, including threads and flanges are completely clean without signs of damage or degradation that could result in leakage.

B. Verify valve parts to be fully operational in all positions from closed to fully open.

C. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.

D. Should valve be determined to be defective, replace with new valve.

3.02 INSTALLATION

A. Provide union or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.

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B. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.

C. Where valve support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.

D. Install check valves where necessary to maintain direction of flow as follows:
   1. Lift Check: Install with stem plumb and vertical.
   2. Swing Check: Install horizontal maintaining hinge pin level.
   3. Orient plate-type and center-guided into horizontal or vertical position, between flanges.

END OF SECTION

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SECTION 220529

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Support and attachment components for equipment, piping, and other plumbing work.

B. Retrofit piping cover system.

1.02 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Concrete equipment pads.

B. Section 055000 - Metal Fabrications: Materials and requirements for fabricated metal supports.

1.03 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.

C. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General - Purpose Piping; 2014.

D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.

E. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999 (Reapproved 2014).

F. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2015.

G. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2014.

H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.

I. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.

J. MFMA-4 - Metal Framing Standards Publication; 2004.

K. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2009.

L. NFPA 101 - Life Safety Code; 2015.

M. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
2. Coordinate the work with other trades to provide additional framing and materials required for installation.
3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.

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5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 033000.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for metal channel (strut) framing systems, nonpenetrating rooftop supports, post-installed concrete and masonry anchors, and thermal insulated pipe supports.
   1. Fiberglass Channel (Strut) Framing Systems: Include requirements for strength derating according to ambient temperature.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.06 QUALITY ASSURANCE

A. Comply with current adopted version of IMC and/or ANSI/MSS SP-58.

B. Installer Qualifications for Field-Welding: As specified in Section 055000.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:
   1. Comply with current adopted version of IMC and or ANSI/MSS SP-58.
   2. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of plumbing work.
   3. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
   4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported with a minimum safety factor as specified by structural engineer. Include consideration for vibration, equipment operation, and shock loads where applicable.
   5. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
   6. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
      a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
      b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
      c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
      d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Materials for Metal Fabricated Supports: Comply with Section 055000.

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C. Metal Channel (Strut) Framing Systems:
   1. Manufacturers:
      a. Cooper B-Line, a division of Eaton Corporation; _____: www.cooperindustries.com
      b. Thomas & Betts Corporation; _____: www.tnb.com
      c. Unistrut, a brand of Atkore International Inc; _____: www.unistrut.com
      d. Miro Industries_____.
      e. Substitutions: See Section 016000 - Product Requirements.
   2. Comply with MFMA-4.
   3. Channel Material:
      a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
      b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
   4. Minimum Channel Thickness: Steel sheet, 12 gage, 0.1046 inch.
   5. Minimum Channel Dimensions: 1-5/8 inch width by 1-5/8 inch height.

D. Fiberglass Channel (Strut) Framing Systems: Factory-fabricated continuous-slot fiberglass channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
   1. Channel Material: Use polyester resin or vinyl ester resin.
   2. Minimum Channel Dimensions: 1-5/8 inch width by 1 inch height.
   3. Flammability: Fire retardant with NFPA 101, Class A flame spread index (maximum of 25) when tested in accordance with ASTM E84; self-extinguishing in accordance with ASTM D635.

E. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.
   1. Minimum Size, Unless Otherwise Indicated or Required:
      a. Equipment Supports: 1/2 inch diameter.
      b. Piping 2" and smaller: 3/8 inch diameter.
      c. Piping 2-1/2" to 4": 1/2 inch diameter.
      d. Piping larger than 4": refer to engineered drawings and/or manufacturer's requirements.
      e. Trapeze Support for Multiple Pipes: refer to engineered drawings and/or manufacturer's requirements.

F. Thermal Insulated Pipe Supports:
   1. General Construction and Requirements:
      a. Insulated pipe supports to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
      b. Surface Burning Characteristics: Flame spread index/smoke developed index of 5/30, maximum, when tested in accordance with 1 or 1.
      c. Pipe supports to be provided for nominally sized, 2-1/2 inch to 18 inch iron pipes.
      d. Insulation inserts to consist of calcium silicate insulation surrounded by a 90 degree galvanized steel jacketing.
   2. PVC Jacket:
      a. Minimum Service Temperature: Minus 40 degrees F.
      b. Maximum Service Temperature: 180 degrees F.
      c. Moisture Vapor Transmission: 0.0071 perm inch, when tested in accordance with ASTM E96/E96M.
      d. Thickness: 60 mil.
      e. Connections: Brush on welding adhesive.
   3. Pipe insulation protection shields to be provided at the hanger points and guide locations on pipes requiring insulation as indicated on drawings.

G. Pipe Supports:
   1. Liquid Temperatures Up To 140 degrees F:

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a. Overhead Support: MSS SP-58 Types 1, 3 through 12.
b. Support From Below: MSS SP-58 Types 35 through 38.

2. Operating Temperatures from 140 to 446 degrees F:
   a. Overhead Support: MSS SP-58 Type 1 or 3 through 12, with appropriate saddle of MSS SP-58 Type 40 for insulated pipe.
   b. Roller Support: MSS SP-58 Types 41 or 43 through 46, with appropriate saddle of MSS SP-58 Type 39 for insulated pipe.
   c. Sliding Support: MSS SP-58 Types 35 through 38.

H. Beam Clamps: MSS SP-58 Types 19 through 23, 25 or 27 through 30 based on required load.
1. Material: ASTM A36/A36M carbon steel or ASTM A181/A181M forged steel.
2. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.

I. Riser Clamps:
1. Provide copper plated clamps for copper tubing support.
2. For insulated pipe runs, provide two bolt-type clamps designed for installation under insulation.

J. Strut Clamps: Two-piece pipe clamp.

K. Strut-Mount Vibration-Damping Routing Clamps (for refrigeration piping).
1. Zinc-plated steel or stainless steel clamp with TPE cushion.
   a. Adjustable metal body with oil and chemical resistant TPE cushion.
   b. Manufacturers:
      1) Hydra-Zorb:
      2) Substitutions: See Section 016000 - Product Requirements.

L. Insulation Clamps: Two bolt-type clamps designed for installation under insulation.

M. Pipe Hangers: For a given pipe run, use hangers of the same type and material.
1. Material: Malleable iron, ASTM A47/A47M; or carbon steel, ASTM A36/A36M.
2. Provide coated or plated hangers to isolate steel hangers from dissimilar metal tube or pipe.

N. Intermediate Pipe Guides: Use pipe clamps with oversize pipe sleeve that provides clearance around pipe.
1. Pipe Diameter 6 inches and Smaller: Provide minimum clearance of 0.16 inch.
2. Pipe Diameter 8 inches: Provide U-bolts with double nuts providing minimum clearance of 0.28 inch.
3. Pipe Diameter 8 inches: 0.625 inch U-bolt.
4. Pipe Diameter 10 inches: 0.75 inch U-bolt.
5. Pipe Diameter 12 to 16 inches: 0.875 inch U-bolt.
6. Pipe Diameter 18 to 30 inches: 1 inch U-bolt.

O. Pipe Alignment Guides: Galvanized steel.
1. Pipe Diameter 8 inches and Smaller: Spider or sleeve type.
2. Pipe Diameter 10 inches and Larger: Roller type.
3. Pipe Diameter 18 to 30 inches: 1 inch U-bolt.

P. Dielectric Barriers: Provide between metallic supports and metallic piping and associated items of dissimilar type; acceptable dielectric barriers include rubber or plastic sheets or coatings attached securely to pipe or item.

Q. Nonpenetrating Rooftop Supports for Low-Slope Roofs:
1. Manufacturers:
   a. Cooper B-Line, a division of Eaton Corporation; _____: www.cooperindustries.com
   b. Unistrut, a brand of Atkore International Inc; _____: www.unistrut.com

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c. Miro Industries.
d. Substitutions: See Section 016000 - Product Requirements.

2. Provide steel pedestals with thermoplastic or rubber base that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified. Ensure that slip sheet is provided between the pipe support and roofing membrane.
3. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
4. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
5. Mounting Height: Provide minimum clearance of 12 inches under supported component to top of roofing.

R. Pipe Shields for Insulated Piping:
1. General Construction and Requirements:
a. Surface Burning Characteristics: Comply with 1 or 1.
b. Shields Material: 180 degree galvanized steel or aluminum jacketing.
c. Maximum Insulated Pipe Outer Diameter: 12-5/8 inch.
d. Minimum Service Temperature: Minus 40 degrees F.
e. Maximum Service Temperature: 178 degrees F.
f. Pipe shields to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.

S. Anchors and Fasteners:
1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
4. Hollow Masonry: Use toggle bolts.
5. Hollow Stud Walls: Use toggle bolts.
6. Steel: Use beam clamps, machine bolts, or welded threaded studs.
7. Sheet Metal: Use sheet metal screws.
8. Wood: Use wood screws.
9. Plastic and lead anchors are not permitted.
10. Powder-actuated fasteners are permitted only as follows:
a. Where approved by Architect.
b. Use only threaded studs; do not use pins.
11. Hammer-driven anchors and fasteners are permitted only as follows:
a. Nails are permitted for attachment of nonmetallic boxes to wood frame construction (when specified).
b. Staples are permitted for attachment of nonmetallic-sheathed cable to wood frame construction (when specified).
12. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
a. Comply with MFMA-4.
b. Channel Material: Use galvanized steel.
c. Minimum Channel Thickness: Steel sheet, 12 gage, 0.1046 inch minimum base metal thickness.
13. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.

T. Pipe Installation Accessories:

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1. Copper Pipe Supports: Use pre-manufactured support.
2. PEX Pipe Supports: Use pre-manufactured support, except where allowed by Architect.
3. CPVC Pipe Supports: Use pre-manufactured support, except where allowed by Architect.
4. Thermal Insulated Pipe Supports: Use pre-manufactured support, except where allowed by Architect.
5. Overhead Pipe Supports: Use pre-manufactured support, except where allowed by Architect.
6. Plenum Pipe Supports: Use pre-manufactured support, except where allowed by Architect.
7. Telescoping Pipe Supports: Use pre-manufactured support, except where allowed by Architect.
8. Inserts and Clamps: Use pre-manufactured support, except where allowed by Architect.

2.02 RETROFIT PIPING COVER SYSTEM

A. General Requirements:
   1. Surface Burning Characteristics: Flame spread index/smoke developed index of 20/250, maximum, when tested in accordance with ASTM E84 or UL 723.

B. Materials:
   1. Piping Cover System: Removal-resistant, modular, snap-fit cover units, clips, and anchors for use with CPVC, steel, and copper piping systems.
   2. Cover Units: L-shaped and U-shaped cross-section units of flame retardant resin material, paintable finish.
   3. Unit Length: Per manufacturer.
   4. Provide coupling fittings for joining units end to end and prefabricated inside and outside corner fittings and end caps as required.
   5. Provide mounting clips to secure covers to wall-ceiling per manufacturer requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive support and attachment components.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.

C. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.

D. Do not provide support from suspended ceiling support system or ceiling grid.

E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.

F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

G. Field-Welding (where approved by Architect): Comply with Section 055000.

H. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.

I. Equipment Support and Attachment:
   1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.

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2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
4. Unless otherwise indicated, mount floor-mounted equipment on properly sized 4 inch high concrete pad constructed in accordance with Section 033000.
5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

J. Preset Concrete Inserts: Use manufacturer-provided closure strips to inhibit concrete seepage during concrete pour.

K. Secure fasteners according to manufacturer's recommended torque settings.

L. Remove temporary supports.

3.03 FIELD QUALITY CONTROL

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

B. Inspect support and attachment components for damage and defects.

C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION

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SECTION 220548

VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Vibration isolation requirements.

B. Seismic control requirements.
   1. Includes requirements for seismic qualification of equipment not specified in this section.

C. Equipment support bases.

D. Vibration isolators.

E. Seismic restraints for suspended components and equipment.

1.02 RELATED REQUIREMENTS

A. Section 014533 - Code-Required Special Inspections: Statement of Special Inspections; additional requirements for code-required special inspections.

B. Section 033000 - Cast-in-Place Concrete.

C. Section 055000 - Metal Fabrications: Materials and requirements for fabricated metal supports.

D. Section 220529 - Hangers and Supports for Plumbing Piping and Equipment.

E. Section 230548 - Vibration and Seismic Controls for HVAC Piping and Equipment.

1.03 DEFINITIONS

A. Plumbing Component: Where referenced in this section in regards to seismic controls, applies to any portion of the plumbing system subject to seismic evaluation in accordance with applicable codes, including distributed systems (e.g., piping).

B. Seismic Restraint: Structural members or assemblies of members or manufactured elements specifically designed and applied for transmitting seismic forces between components and the seismic force-resisting system of the structure.

1.04 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; 2010, with 2013 Supplements and Errata.

B. ASCE 19 - Structural Applications of Steel Cables for Buildings; 2016.

C. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications; 2015.

D. ICC (IBC) - International Building Code; 2015.

E. ICC-ES AC156 - Acceptance Criteria for Seismic Certification by Shake-Table Testing of Nonstructural Components; 2010, with Editorial Revision (2015).

F. MFMA-4 - Metal Framing Standards Publication; 2004.

G. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel; 2017.

H. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems; Sheet Metal and Air Conditioning Contractors' National Association; 2008.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate selection and arrangement of vibration isolation and/or seismic control components with the actual equipment to be installed.

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2. Coordinate the work with other trades to provide additional framing and materials required for installation.
3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
4. Seismic Controls:
    a. Coordinate the arrangement of seismic restraints with piping, conduit, equipment, and other potential conflicts installed under other sections or by others.
    b. Coordinate the work with other trades to accommodate relative positioning of essential and nonessential components in consideration of seismic interaction.
5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 033000.

1.06 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Design Documents: Prepare and submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, details, and calculations.

C. Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.
1. Vibration Isolators: Include rated load capacities and deflections; include information on color coding or other identification methods for spring element load capacities.
2. Seismic Controls: Include seismic load capacities.

D. Shop Drawings - Vibration Isolation Systems:
1. Include dimensioned plan views and sections indicating proposed arrangement of vibration isolators; indicate equipment weights and static deflections.
2. Vibration-Isolated Equipment Support Bases: Include base weights, including concrete fill where applicable; indicate equipment mounting provisions.

E. Shop Drawings - Seismic Controls:
1. Include dimensioned plan views and sections indicating proposed plumbing component locations and distributed system routing, with locations and details of gravity supports and seismic restraints and associated attachments.
2. Identify mounting conditions required for equipment seismic qualification.
3. Identify anchor manufacturer, type, minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
4. Indicate proposed arrangement of distributed system trapeze support groupings.
5. Indicate proposed locations for distributed system flexible fittings and/or connections.
6. Indicate locations of seismic separations where applicable.
7. Include point load drawings indicating design loads transmitted to structure at each attachment location.

F. Seismic Design Data:
1. Compile information on project-specific characteristics of actual installed plumbing components necessary for determining seismic design forces required to design appropriate seismic controls.
2. Include structural calculations, stamped or sealed by seismic controls designer, demonstrating suitability of seismic controls for seismic design forces.

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1.07 QUALITY ASSURANCE

A. Comply with ICC (IBC).

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Seismic Controls Designer Qualifications: Registered professional engineer licensed in Utah and with minimum five years' experience designing seismic restraints for nonstructural components.
   1. Designer may be employed by the manufacturer of the seismic restraint products.

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

1.08 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 VIBRATION ISOLATION REQUIREMENTS

A. Provide vibration isolation systems to reduce vibration transmission to supporting structure from vibration-producing plumbing equipment and/or plumbing connections to vibration-isolated equipment.

B. Comply with applicable general recommendations of ASHRAE (HVACA), where not in conflict with other specified requirements:

C. General Requirements:
   1. Select vibration isolators to provide required static deflection.
   2. Select vibration isolators for uniform deflection based on distributed operating weight of actual installed equipment.
   3. Select seismic type vibration isolators to comply with seismic design requirements, including conditions of equipment seismic certification where applicable.
   4. Select vibration isolators for outdoor equipment to comply with wind design requirements.

D. Equipment Isolation: As indicated on drawings.

2.02 SEISMIC CONTROL REQUIREMENTS

A. Provide plumbing component restraints, supports, and attachments suitable for seismic loads determined in accordance with applicable codes, as well as gravity and operating loads and other structural design considerations of the installed location. Consider wind loads for outdoor plumbing components.

B. Seismic Design Criteria: As indicated on drawings.

C. Component Importance Factor (Ip) [if building is determined to be Risk Category IV]: Plumbing components essential to life safety to be assigned a component importance factor (Ip) of 1.5 as indicated or as required. This includes but is not limited to :
   1. Plumbing components required to function for life safety purposes after an earthquake.
   2. Plumbing components that support or otherwise contain hazardous substances.

D. Seismic Qualification of Equipment [if building is determined to be Risk Category IV]:
   1. Provide special certification for plumbing equipment furnished under other sections and assigned a component importance factor (Ip) of 1.5, certifying that equipment will remain operable following a design level earthquake.
   2. Seismic qualification to be by shake table testing in accordance with recognized testing standard procedure, such as ICC-ES AC156, acceptable to authorities having jurisdiction.
   3. Notify Architect and obtain direction where mounting restrictions required by conditions of seismic certification conflict with specified requirements.

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4. Seismically qualified equipment to be furnished with factory-installed labels referencing certificate of compliance and associated mounting restrictions.

E. Premanufactured Modular Plumbing Equipment: Where not otherwise seismically qualified, premanufactured modules 6 feet high and taller furnished under other sections to be designed in accordance with seismic provisions for nonbuilding structures.

F. Seismic Restraints:
   1. Provide seismic restraints for plumbing components except where exempt according to applicable codes and specified seismic design criteria, as approved by authorities having jurisdiction.
   2. Seismic Restraint Exemptions:
      a. Exemptions for Seismic Design Category D, E, and F:
         1) Discrete plumbing components that are positively attached to the structure where either of the following apply:
            (a) The component weighs 400 pounds or less, has a center of mass located 4 feet or less above the adjacent floor level, flexible connections are provided between the component and associated ductwork, piping, and conduit, and the component importance factor (Ip) is 1.0.
            (b) The component weighs 20 pounds or less or, in the case of a distributed system, 5 pounds per foot or less.
         2) Plumbing piping with component importance factor (Ip) of 1.0 and nominal pipe size of 3 inch or less, or with component importance factor (Ip) of 1.5 and nominal pipe size of 1 inch or less, where flexible connections, expansion loops, or other assemblies are provided between piping and associated components, and where piping is positively attached to the structure; exemption does not apply to piping constructed of low-deformability materials (e.g., cast iron, glass, nonductile plastics).
      b. Plumbing Piping Exemptions, All Seismic Design Categories:
         1) Plumbing piping where flexible connections, expansion loops, or other assemblies are provided between piping and associated components, where piping is positively attached to the structure, and where one of the following apply:
            (a) Trapeze supported piping weighing less than 10 pounds per foot, where all pipes supported meet size requirements for exemption as single pipes described under specific seismic design category exemptions above.
            (b) Trapeze supported piping with trapeze assemblies using 3/8 inch diameter rod hangers not exceeding 12 inches in length from support point connection to the supporting structure, where all pipes supported have a component importance factor (Ip) of 1.0 and meet size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single trapeze is 100 pounds or less.
            (c) Trapeze supported piping with trapeze assemblies using 1/2 inch diameter rod hangers not exceeding 12 inches in length from support point connection to the supporting structure, where all pipes supported have a component importance factor (Ip) of 1.0 and meet size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single trapeze is 200 pounds or less.
            (d) Trapeze supported piping with trapeze assemblies using 1/2 inch diameter rod hangers not exceeding 24 inches in length from support point connection to the supporting structure, where all pipes supported have a component importance factor (Ip) of 1.0 and meet size requirements for exemption as single pipes

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described under specific seismic design category exemptions above, and where the total weight supported by any single trapeze is 100 pounds or less.

(e) Hanger supported piping with individual rod hangers 3/8 inch or 1/2 inch in diameter not exceeding 12 inches in length from support point connection to the supporting structure, where pipe has a component importance factor (Ip) of 1.0 and meets size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single rod is 50 pounds or less.

3. Seismic Restraint Systems:
   a. Except where otherwise restricted, use of either cable or rigid restraints is permitted.
   b. Use only cable restraints to restrain vibration-isolated plumbing components, including distributed systems.
   c. Use only one restraint system type for a given plumbing component or distributed system (e.g., piping) run; mixing of cable and rigid restraints on a given component/run is not permitted.
   d. Size restraint elements, including anchorage, to resist seismic loads as necessary to restrain plumbing component in all lateral directions; consider bracket geometry in anchor load calculations.
   e. Use rod stiffener clips to attach bracing to hanger rods as required to prevent rod buckling from vertical (upward) compressive load introduced by cable or rigid restraints loaded in tension, in excess of downward tensile load due to supported plumbing component weight.
   f. Select hanger rods and associated anchorage as required to accommodate vertical (downward) tensile load introduced by rigid restraints loaded in compression, in addition to downward tensile load due to supported plumbing component weight.
   g. Clevis hangers may only be used for attachment of transverse restraints; do not use for attachment of longitudinal restraints.
   h. Where seismic restraints are attached to clevis hangers, provide clevis bolt reinforcement accessory to prevent clevis hanger deformation.
   i. Do not introduce lateral loads on open bar joist chords or the weak axis of beams, or loads in any direction at other than panel points unless approved by project Structural Engineer of Record.

G. Seismic Attachments:
   1. Attachments to be bolted, welded, or otherwise positively fastened without consideration of frictional resistance produced by the effects of gravity.
   2. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) or qualified evaluation service acceptable to authorities having jurisdiction for compliance with applicable building code, and qualified for seismic applications; concrete anchors to be qualified for installation in both cracked and uncracked concrete.
   3. Do not use power-actuated fasteners.
   4. Do not use friction clips (devices that rely on mechanically applied friction to resist loads). Beam clamps may be used for supporting sustained loads where provided with restraining straps.
   5. Comply with anchor minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.

H. Seismic Interactions:
   1. Include provisions to prevent seismic impact between plumbing components and other structural or nonstructural components.
   2. Include provisions such that failure of a component, either essential or nonessential, does not cause the failure of an essential component.

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3. Comply with minimum clearance requirements between plumbing equipment, distribution systems, and associated supports and fire protection sprinkler system drops and sprigs.

I. Seismic Relative Displacement Provisions:
   1. Use suitable fittings or flexible connections to accommodate:
      a. Relative displacements at connections between components, including distributed systems (e.g., piping); do not exceed load limits for equipment utility connections.
      b. Relative displacements between component supports attached to dissimilar parts of structure that may move differently during an earthquake.
      c. Design displacements at seismic separations.
      d. Anticipated drifts between floors.

2.03 EQUIPMENT SUPPORT BASES

A. Manufacturers:
   1. Vibration-Isolated Equipment Support Bases:
      a. Kinetics Noise Control, Inc; _____: www.kineticsnoise.com
      b. Mason Industries; _____: www.mason-ind.com
      c. Substitutions: See Section 016000 - Product Requirements.

2.04 VIBRATION ISOLATORS

A. Manufacturers:
   1. Vibration Isolators:
      a. Kinetics Noise Control, Inc; _____: www.kineticsnoise.com
      b. Mason Industries; _____: www.mason-ind.com
      c. Substitutions: See Section 016000 - Product Requirements.

B. General Requirements:
   1. Resilient Materials for Vibration Isolators: Oil, ozone, and oxidant resistant.
   2. Spring Elements for Spring Isolators:
      a. Color code or otherwise identify springs to indicate load capacity.
      b. Lateral Stability: Minimum lateral stiffness to vertical stiffness ratio of 0.8.
      c. Designed to operate in the linear portion of their load versus deflection curve over deflection range of not less than 50 percent above specified deflection.
      d. Designed to provide additional travel to solid of not less than 50 percent of rated deflection at rated load.
      e. Selected to provide designed deflection of not less than 75 percent of specified deflection.
      f. Selected to function without undue stress or overloading.

C. Vibration Isolators for Non seismic Applications:
   1. Resilient Material Isolator Pads:
      a. Description: Single or multiple layer pads utilizing elastomeric (e.g., neoprene, rubber) isolator material.
      b. Pad Thickness: As required for specified minimum static deflection; minimum 0.25 inch thickness.
      c. Multiple Layer Pads: Provide bonded, galvanized sheet metal separation plate between each layer.

2.05 SEISMIC RESTRAINT SYSTEMS

A. Manufacturers:
   1. Seismic Restraint Systems:
      a. AFCON, a brand of Anvil International; _____: www.anvilintl.com
      b. Eaton Corporation; _____: www.eaton.com

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c. Kinetics Noise Control, Inc; _____: www.kineticsnoise.com
d. Mason Industries; _____: www.mason-ind.com
e. Substitutions: See Section 016000 - Product Requirements.

B. Description: System components and accessories specifically designed for field assembly and attachment of seismic restraints.

C. Cable Restraints:
1. Comply with ASCE 19.
2. Cables: Pre-stretched, galvanized steel wire rope with certified break strength.
3. Cable Connections: Use only swaged end fittings. Cable clips and wedge type end fittings are not permitted in accordance with ASCE 19.
4. Use protective thimbles for cable loops where potential for cable damage exists.

D. Rigid Restraints: Use MFMA-4 steel channel (strut), steel angle, or steel pipe for structural element; suitable for both compressive and tensile design loads.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that conditions are satisfactory for installation prior to starting work.

3.02 CODE-REQUIRED SPECIAL INSPECTIONS (ENGINEER OF RECORD TO VERIFY APPLICABILITY OF THIS SECTION)

A. Arrange work to accommodate tests and/or inspections performed by Special Inspection Agency employed by Owner or Architect in accordance with Section 014533 and statement of special inspections as required by applicable building code.

B. Frequency of Special Inspections: Where special inspections are designated as continuous or periodic, arrange work accordingly.
1. Periodic Special Inspections: Special Inspection Agency to be present in the area where work is being performed and observe the work part-time or intermittently and at the completion of the work.

C. Seismic special inspections include, but are not limited to:
1. Seismically Qualified Equipment: Verification that label, anchorage, and mounting comply with the certificate of compliance.
2. Installation and anchorage of piping systems designed to carry hazardous materials and their associated mechanical units for Seismic Design Categories C, D, E, and F; periodic inspection.
3. Installation and anchorage of vibration isolation systems for Seismic Design Categories C, D, E, and F where the approved Contract Documents require a nominal clearance of 1/4 inch or less between equipment support frame and seismic restraint; periodic inspection.
4. Verification of required clearances between plumbing equipment, distribution systems, and associated supports and fire protection sprinkler system drops and sprigs for Seismic Design Categories C, D, E, and F; periodic inspection.

D. Prior to starting work, Contractor to submit written statement of responsibility to authorities having jurisdiction and to Owner acknowledging awareness of special requirements contained in the statement of special inspections.

E. Special Inspection Agency services do not relieve Contractor from performing inspections and testing specified elsewhere.

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3.03 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.

C. Secure fasteners according to manufacturer's recommended torque settings.

D. Field-Welding (where approved by Architect): Comply with Section 055000.

E. Install flexible piping connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.

F. Seismic Controls:
   1. Use only specified components, anchorage, and hardware evaluated by seismic design. Comply with conditions of seismic certification where applicable.
   2. Seismic Restraint Systems:
      a. Do not attach seismic restraints and gravity supports to dissimilar parts of structure that may move differently during an earthquake.
      b. Install restraints within permissible angles in accordance with seismic design.
      c. Install cable restraints straight between component/run and structural attachment; do not bend around other nonstructural components or structural elements.
      d. Install cable restraints for vibration-isolated components slightly slack to prevent short-circuiting of isolation.
      e. Install hanger rod stiffeners where indicated using only specified clamps; do not weld stiffeners to hanger rod.

3.04 FIELD QUALITY CONTROL

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

B. Inspect vibration isolation and/or seismic control components for damage and defects.

C. Vibration Isolation Systems:
   1. Verify isolator static deflections.
   2. Verify vibration isolation performance during normal operation; investigate sources of isolation short circuits.

D. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.

E. Submit detailed reports indicating inspection and testing results and corrective actions taken.

END OF SECTION

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SECTION 220553

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL **UPDATED NOV 2021**

1.01 SECTION INCLUDES **THIS COMPLETE SECTION IS UPDATED.**

A. For identification for plumbing piping and equipment comply with Section 230553 - Identification for HVAC Piping and Equipment.

END OF SECTION

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SECTION 220719
PLUMBING PIPING INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Flexible elastomeric cellular insulation.
B. Cellular melamine insulation.
C. Glass Fiber insulation.
D. Jackets and accessories.

1.02 RELATED REQUIREMENTS

A. Section 078400 - Firestopping.
B. Section 099113 - Exterior Painting: Painting insulation jacket.
C. Section 099123 - Interior Painting: Painting insulation jacket.
D. Section 221005 - Plumbing Piping: Placement of hangers and hanger inserts.
E. Section 232113 - Hydronic Piping: Placement of hangers and hanger inserts.
F. Section 232213 - Steam and Steam Condensate Piping: Placement of hangers and hanger inserts.
G. Section 232300 - Refrigerant Piping: Placement of inserts.

1.03 REFERENCE STANDARDS

A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
B. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
C. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.
D. ASTM C14 - Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe; 2015a.
E. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2013.
F. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2013).
G. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement; 2007 (Reapproved 2013).
H. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2017.
I. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation; 2013.
J. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2016.
K. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2017.
L. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation; 2016a.
M. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013.
N. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2016.

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O. ASTM C585 - Standard Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing; 2010 (Reapproved 2016).

P. ASTM C591 - Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation; 2017.

Q. ASTM C610 - Standard Specification for Molded Expanded Perlite Block and Pipe Thermal Insulation; 2016.

R. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2013).

S. ASTM C1410 - Standard Specification for Cellular Melamine Thermal and Sound-Absorbing Insulation; 2014.

T. ASTM C1695 - Standard Specification for Fabrication of Flexible Removable and Reusable Blanket Insulation for Hot Service; 2010 (Reapproved 2015).

U. ASTM D1056 - Standard Specification for Flexible Cellular Materials--Sponge or Expanded Rubber; 2014.

V. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics; 2012.

W. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.

X. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009 (Reapproved 2016).

Y. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.

Z. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015.

AA. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

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.

B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum three years of experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.07 FIELD CONDITIONS

A. Maintain ambient conditions required by manufacturers of each product.

B. Maintain temperature before, during, and after installation for minimum of 24 hours.

C. Protect from moisture, sun, elements.

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PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

B. Insulation shall have a 'K' value that meets the minimum requirements of the latest International Energy Conservation Code (IECC).

2.02 CELLULAR MELAMINE

A. Manufacturers:
   1. TECHLITE; _____
   2. Substitutions: See Section 016000 - Product Requirements.

B. Insulation: Flexible preformed open-cell polymeric foam tubing, slit lengthwise for installation, complying with applicable requirements of ASTM C1410.
   1. 'K' Value: ASTM C177; 0.25 at 75 degrees F.
   2. Minimum Service Temperature: Minus 40 degrees F.
   3. Maximum Service Temperature: 350 degrees F.
   4. Density: 0.56 lb/cu ft.
   5. Factory-Applied Jacketing Material: PVC, flexible with UV resistant and flame retardant additives.
      a. Color: White.
   6. Jacketing material to be field-applied.

2.03 GLASS FIBER

A. Manufacturers:
   1. CertainTeed Corporation; _____
   2. Johns Manville Corporation; _____
   3. Knauf Insulation; Earthwool 1000 Degree Pipe Insulation
   4. Owens Corning Corporation
   5. Substitutions: See Section 016000 - Product Requirements.

B. Insulation: ASTM C547 and ASTM C795; semi-rigid, noncombustible, end grain adhered to jacket.
   1. 'K' Value: ASTM C177, 0.24 at 75 degrees F.
   2. Maximum Service Temperature: 650 degrees F.
   3. Maximum Moisture Absorption: 0.2 percent by volume.

C. Vapor Barrier Jacket: White Kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches.

D. Vapor Barrier Lap Adhesive: Compatible with insulation.

E. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

2.04 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Manufacturer:
   1. Aeroflex USA, Inc; _____
   2. Armacell LLC; AP Armaflex
   3. K-Flex USA LLC; Insul-Tube
   4. Substitutions: See Section 016000 - Product Requirements.

B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1; use molded tubular material wherever possible.
   1. Minimum Service Temperature: Minus 40 degrees F.
   2. Maximum Service Temperature: 220 degrees F.

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3. Connection: Waterproof vapor barrier adhesive.

C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.
   1. Manufacturers:
      a. Substitutions: See Section 016000 - Product Requirements.

2.05 JACKETS

A. PVC Plastic.
   1. Manufacturers:
      a. Johns Manville Corporation; _____
      b. Substitutions: See Section 016000 - Product Requirements.
   2. Jacket: One piece molded type fitting covers and sheet material, white color.
      a. Minimum Service Temperature: 0 degrees F.
      b. Maximum Service Temperature: 150 degrees F.
      c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
      d. Thickness: 10 mil.
      e. Connections: Brush-on welding adhesive and/or tacks.
   3. Covering Adhesive Mastic: Compatible with insulation.

B. Aluminum Jacket: ASTM B209 (ASTM B209M) formed aluminum sheet.
   1. Thickness: 0.016 inch sheet.
   2. Finish: Smooth or embossed.
   3. Joining: Longitudinal slip joints and 2 inch laps.
   4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
   5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum, or
   6. Metal Jacket Bands: 3/8 inch wide; 0.010 inch thick stainless steel.

C. Stainless Steel Jacket: ASTM A666, Type 316 stainless steel.
   1. Thickness: 0.010 inch.
   2. Finish: Smooth for interior appications, corrugated for exterior.
   3. Metal Jacket Bands: 3/8 inch wide; 0.010 inch thick stainless steel.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that piping has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with North American Insulation Manufacturers Association (NAIMA) National Insulation Standards.

C. Exposed Piping: Locate insulation and cover seams in least visible locations.

D. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, roof drain bodies, and expansion joints.

E. Install cellular melamine with factory-applied jackets with a manufacturer-approved adhesive along seams, both straight lap joints and circumferential lap joints.
   1. Install seal over seams with factory-approved room temperature vulcanization (RTV) silicone sealant to ensure a positive vapor barrier seal in outdoor and sanitary washdown environments.

F. Glass fiber insulated pipes conveying fluids below ambient temperature:

1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.

G. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

H. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.

I. Glass fiber insulated pipes conveying fluids above ambient temperature:
1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.
2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.

J. Inserts and Shields:
1. Application: Piping 2 inches diameter or larger.
2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
3. Insert Location: Between support shield and piping and under the finish jacket.
4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

K. **Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations.** Finish at supports, protrusions, and interruptions. At fire separations, refer to Section 078400.

L. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish exposed pipe in Mechanical Equipment Rooms with PVC jacket and fitting covers. Finish exposed pipe in Finished Spaces with paper and foil scrim suitable for appication of paint, or PVC jacket and fitting covers. Coordinate with owner.

M. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

N. Minimum pipe insulation thicknesses (in inches):
1. Cold Piping:
a. Potable cold water piping, chilled domestic water supply and return, roof drain bodies, interior above-ground storm water piping, including roof drain, deck drain and landscape drain piping and plumbing vents within 6 lineal feet of roof or wall outlet.
1) Glass fiber with jacket, self sealing lap: 1" thickness.
2) Flexible elastomeric: 1/2" thickness.
2. Hot Piping:
a. Potable hot water piping, potable hot water recirculating piping and hot drain piping.
1) Glass fiber with jacket, self sealing lap: 1" thick for pipe sizes up to and including 2"; 1-1/2" thick for pipe sizes over 2".
2) Flexible elastomeric: 1/2" thick for pipe sizes up to and including 2" (largest size permitted) with contact cement or heat fused joints.

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FT (°F)	Insulation Conductivity		Nominal pipe or tube size (inches)				
	Conductivity	TR (°F)	< 1	1 to < 1½	1½ to < 4	4 to < 8	≥ 8
> 350	0.32 – 0.34	250	4.5	5.0	5.0	5.0	5.0
251 – 350	0.29 – 0.32	200	3.0	4.0	4.5	4.5	4.5
201 – 250	0.27 – 0.30	150	2.5	2.5	2.5	3.0	3.0
141 – 200	0.25 – 0.29	125	1.5	1.5	2.0	2.0	2.0
105 – 140	0.21 – 0.28	100	1.0	1.0	1.5	1.5	1.5
40 – 60	0.21 – 0.27	75	0.5	0.5	1.0	1.0	1.0
< 40	0.20 – 0.26	50	0.5	1.0	1.0	1.0	1.5

FT = Fluid Operating Temperature Range and Usage

TR = Mean Temperature Rating

Conductivity units are shown in $\frac{btu \cdot in}{h \cdot ft^2 \cdot °F}$

END OF SECTION

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SECTION 221005

PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pipe, pipe fittings, specialties, and connections for piping systems.
   1. Sanitary sewer.
   2. Chemical resistant sewer.
   3. Domestic water.
   4. Flanges, unions, and couplings.
   5. Pipe hangers and supports.
   6. Manufactured sleeve-seal systems.
   7. Valves.
   8. Flow controls.
   9. Water pressure reducing valves.
   10. Relief valves.
   11. Strainers.

1.02 RELATED REQUIREMENTS

A. Section _____: Roof penetrations.

B. Section 078400 - Firestopping.

C. Section 083100 - Access Doors and Panels.

D. Section 099113 - Exterior Painting.

E. Section 099123 - Interior Painting.

F. Section 220516 - Expansion Fittings and Loops for Plumbing Piping.

G. Section 220548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.

H. Section 220553 - Identification for Plumbing Piping and Equipment.

I. Section 220719 - Plumbing Piping Insulation.

J. Section 312316 - Excavation.

K. Section 312323 - Fill.

L. Section 330110.58 - Disinfection of Water Utility Piping Systems.

1.03 REFERENCE STANDARDS

A. ANSI Z21.22 - American National Standard for Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems; 2015.

B. ANSI Z223.1 - National Fuel Gas Code; 2016.

C. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2015.

D. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2016.

E. ASME B16.4 - Gray Iron Threaded Fittings: Classes 125 and 250; 2016.

F. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2012.

G. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2013.

H. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings - DWV; 2016.

I. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes; 2013.

J. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV; 2012.

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K. ASME B31.1 - Power Piping; 2016.

L. ASME B31.9 - Building Services Piping; 2014.

M. ASME BPVC-IV - Boiler and Pressure Vessel Code, Section IV - Rules for Construction of Heating Boilers; 2017.

N. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing and Fusing Operators; 2017.

O. ASSE 1003 - Performance Requirements for Water Pressure Reducing Valves for Domestic Water Distribution Systems; 2009.

P. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999 (Reapproved 2014).

Q. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.

R. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings; 2017.

S. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

T. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2017.

U. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2015a.

V. ASTM B32 - Standard Specification for Solder Metal; 2008 (Reapproved 2014).

W. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes; 2015a.

X. ASTM B68/B68M - Standard Specification for Seamless Copper Tube, Bright Annealed; 2011.

Y. ASTM B75/B75M - Standard Specification for Seamless Copper Tube; 2011.

Z. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2016.

AA. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2016.

AB. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube; 2016.

AC. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings; 2016.

AD. ASTM C14 - Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe; 2015a.

AE. ASTM C14M - Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, Culvert Pipe and (Metric); 2015a.

AF. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe; 2016.

AG. ASTM C76M - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe (Metric); 2016.

AH. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets; 2012 (Reapproved 2017).

AI. ASTM C443M - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric); 2011 (Reapproved 2017).

AJ. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings; 2014.

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AK. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2015.

AL. ASTM D2235 - Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings; 2004 (Reapproved 2016).

AM. ASTM D2239 - Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter; 2012a.

AN. ASTM D2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series); 2015.

AO. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40; 2017.

AP. ASTM D2513 - Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings; 2016a.

AQ. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems; 2012.

AR. ASTM D2609 - Standard Specification for Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe; 2015.

AS. ASTM D2661 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings; 2014.

AT. ASTM D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings; 2014.

AU. ASTM D2683 - Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing; 2014.

AV. ASTM D2729 - Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2011.

AW. ASTM D2846/D2846M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems; 2017a.

AX. ASTM D2855 - Standard Practice for the Two-Step (Primer & Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets; 2015.

AY. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2016.

AZ. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.

BA. ASTM F437 - Standard Specification for Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80; 2015.

BB. ASTM F438 - Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40; 2015.

BC. ASTM F439 - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80; 2013.

BD. ASTM F441/F441M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80; 2015.

BE. ASTM F442/F442M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR); 2013.

BF. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe; 2014.

BG. ASTM F493 - Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings; 2014.

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BH. ASTM F628 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe With a Cellular Core; 2012e2.

BI. ASTM F679 - Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings; 2016.

BJ. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers; 1992 (Reapproved 2014).

BK. ASTM F876 - Standard Specification for Crosslinked Polyethylene (PEX) Tubing; 2015a.

BL. ASTM F877 - Standard Specification for Crosslinked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems; 2011a.

BM. ASTM F1281 - Standard Specification for Crosslinked Polyethylene/Aluminum/Crosslinked Polyethylene (PEX-AL-PEX) Pressure Pipe; 2011.

BN. ASTM F1282 - Standard Specification for Polyethylene/Aluminum/Polyethylene (PE-AL-PE) Composite Pressure Pipe; 2010.

BO. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2011-AMD 1.

BP. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015 (with March 2016 Errata).

BQ. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; 2010.

BR. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings; 2012.

BS. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; 2017.

BT. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast; 2009.

BU. AWWA C550 - Protective Interior Coatings for Valves and Hydrants; 2013.

BV. AWWA C606 - Grooved and Shouldered Joints; 2015.

BW. AWWA C651 - Disinfecting Water Mains; 2014.

BX. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution; 2016.

BY. AWWA C901 - Polyethylene (PE) Pressure Pipe and Tubing, 1/2 In. (13 mm) Through 3 In. (76 mm), for Water Service; 2008.

BZ. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications; 2009 (Revised 2012).

CA. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2011 (Revised 2012).

CB. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2015.

CC. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements; 2015.

CD. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2015.

CE. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2016.

CF. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2009.

CG. MSS SP-67 - Butterfly Valves; 2011.

CH. MSS SP-70 - Cast Iron Gate Valves, Flanged and Threaded Ends; 2011.

CI. MSS SP-71 - Cast Iron Swing Check Valves, Flanged and Threaded Ends; 2011.

CJ. MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves; 2013.

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CK. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010.

CL. NSF 61 - Drinking Water System Components - Health Effects; 2016.

CM. NSF 372 - Drinking Water System Components - Lead Content; 2016.

CN. PPI TR-4 - PPI Listing of Hydrostatic Design Basis (HDB), Hydrostatic Design Stress (HDS), Strength Design Basis (SDB), Pressure Design Basis (PDB), and Minimum Required Strength (MRS) Ratings For Thermoplastic Piping Materials or Pipe; 2016.

CO. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

C. Welder Certificate: Include welders certification of compliance with ASME BPVC-IX.

D. Shop Drawings: For non-penetrating rooftop supports, submit detailed layout developed for this project, with design calculations for loadings and spacings.

E. Project Record Documents: Record actual locations of valves.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.

1.05 QUALITY ASSURANCE

A. Perform work in accordance with applicable codes.

B. Valves: Manufacturer's name and pressure rating marked on valve body.

C. Welding Materials and Procedures: Conform to ASME BPVC-IX.

D. Welder Qualifications: Certified in accordance with ASME BPVC-IX.

E. Identify pipe with marking including ASTM material classification, ASTM specification, potable water certification, water pressure rating.

F. All pipe, fittings, and products shall be domestic only.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.07 FIELD CONDITIONS

A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Potable Water Supply Systems: Provide piping, pipe fittings, and solder and flux (if used), that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

B. Plenum-Installed Acid Waste Piping: Flame-spread index equal or below 25 and smoke-spread index equal or below 50 according to ASTM E84 or UL 723 tests.

2.02 SANITARY SEWER PIPING, ABOVE GRADE

A. Cast Iron Pipe: CISPI 301, hubless, service weight.

1. Fittings: Cast iron.
2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.

B. Steel Pipe: ASTM A53/A53M Schedule 40, galvanized, using one of the following joint types:
1. Flanged Joints: ASME B16.1 cast iron fittings.
2. Threaded Joints: ASME B16.4 cast iron fittings.
3. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.

C. PVC Pipe (permitted for trap arms only): ASTM D2729.
1. Fittings: PVC.
2. Joints: Solvent welded, with ASTM D2564 solvent cement.
3. Pipe: Solid core.

2.03 CHEMICAL RESISTANT SEWER PIPING

A. PP Pipe: Polypropylene, flame retardant.
1. Fittings: Polypropylene.
2. Joints: Electrical resistance fusion.
3. Manufacturers:
a. IPEX USA, LLC; Enfield Electrofusion: www.ipexna.com
b. Orion.
c. Aquatherm.
d. Substitutions: See Section 016000 - Product Requirements.

2.04 DOMESTIC WATER PIPING, ABOVE GRADE

A. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), Drawn (H).
1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
2. Fittings: Cast iron, epoxy coated.
3. Joints: ASTM B32, alloy Sn95 solder, BCuP copper/silver braze.
4. Joints: Grooved mechanical couplings.
5. Joints: Mechanical Press Sealed Fittings; Pressed type, NSF 61 and NSF 372 approved or certified, utilizing EPDM, non toxic synthetic rubber sealing elements.
a. Manufacturers:
1) Anvil International; _____: www.anvilintl.com
2) Apollo Valves; _____: www.apollovalves.com
3) Grinnell Products, a Tyco Business; _____: www.grinnell.com
4) Viega LLC; _____: www.viega.com
5) Substitutions: See Section 016000 - Product Requirements.

B. Cross-Linked Polyethylene (PEX) Pipe: ASTM F876 or ASTM F877.
1. Housing applications only, where approved. Branch lines only.
2. Manufacturers:
a. Uponor, Inc; _____: www.uponorengineering.com
b. Viega LLC; _____: www.viega.com
c. Zurn Industries, LLC; _____: www.zurn.com
d. Substitutions: See Section 016000 - Product Requirements.
3. PPI TR-4 Pressure Design Basis:
a. 160 psig at maximum 73 degrees F.
b. 100 psig at maximum 180 degrees F.
c. 80 psig at maximum 200 degrees F.
4. Fittings: Brass and copper.
5. Fittings: Brass and engineered polymer (EP) ASTM F1960.
6. Joints: Mechanical compression fittings.

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C. Stainless Steel Pipe: ASTM A269/A269M, Grade TP304 alloy.
   1. Mechanical Press Sealed Fittings: Pressed type, NSF 61 and NSF 372 approved or certified, utilizing EPDM, non toxic synthetic rubber sealing elements.
      a. Manufacturers:
         1) Apollo Valves; _____: www.apollovalves.com
         2) Grinnell Products, a Tyco Business; _____: www.grinnell.com
         3) Viega LLC; _____: www.viega.com
         4) Substitutions: See Section 016000 - Product Requirements.

D. PP (Pressure-rated Polypropylene): ASTM F2389.
   1. Pipe and fittings shall be polypropylene material of type PP-R or PP-RCT in accordance with ASTM F2389.
   2. Manufacturers:
      a. Aquatherm
      b. Nupi
      c. Substitutions: See Section 016000 - Product Requirements.

2.05 FLANGES, UNIONS, AND COUPLINGS

A. Unions for Pipe Sizes 3 Inches and Under:
   1. Ferrous pipe: Class 150 malleable iron threaded unions.
   2. Copper tube and pipe: Class 150 bronze unions with soldered joints.

B. Flanges for Pipe Size Over 1 Inch:
   1. Ferrous Pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.
   2. Copper Tube and Pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.

C. Mechanical Couplings for Grooved and Shouldered Joints: Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket.
   1. Dimensions and Testing: In accordance with AWWA C606.
   2. Housing Material: Provide ASTM A47/A47M malleable iron, ductile iron, or _____, galvanized.
   3. Gasket Material: EPDM suitable for operating temperature range from minus 30 degrees F to 230 degrees F.
   4. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel.
   5. When pipe is field grooved, provide coupling manufacturer's grooving tools.
   6. Manufacturers:
      a. Grinnell Products, a Tyco Business; _____: www.grinnell.com
      b. Substitutions: See Section 016000 - Product Requirements.

D. Mechanical Press Fittings, 1/2" to 4":
   1. Manufacturers:
      a. Viega LLC; [_____]: www.viega.com
      b. Apollo Valves; [_____]: www.apollovalves.com
      c. Nibco.
      d. Substitutions: See Section 016000 - Product Requirements.

E. No-Hub Couplings:
   1. Gasket Material: Neoprene complying with ASTM C564.
   2. Heavy Duty Band Material: Stainless steel.
   3. Eyelet Material: Stainless steel.

F. Dielectric Connections: Nipple type for pipes sizes less than 2". 2" and larger, flange type is permitted.

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2.06 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58.
   1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
   2. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
      a. As per drawings.
   3. Trapeze Hangers: Welded steel channel frames attached to structure.
   4. Vertical Pipe Support: Steel riser clamp.
   5. Floor Supports: Steel pedestal with floor flange; fixture attachment.
   6. Rooftop Supports for Low-Slope Roofs: See section 3.03D. Steel pedestals with bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified; and as follows:
      a. Bases: High density polypropylene.
      b. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
      c. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
      d. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports; corrosion resistant material.
      e. Height: Provide minimum clearance of 6 inches under pipe to top of roofing.
      f. Manufacturers:
         1) PHP Systems/Design; _____: www.phpsd.com
         2) Uni-Strut.
         3) Miro Industries.
         4) Substitutions: See Section 016000 - Product Requirements.

B. Plumbing Piping - Drain, Waste, and Vent:
   1. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inches: Malleable iron, adjustable, clevis.
   2. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
   3. Wall Support for Pipe Sizes 2-1/2 and Over: Welded steel bracket and wrought steel clamp.
   4. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and steel support.
   5. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

C. Plumbing Piping - Water:
   1. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inches: Malleable iron, adjustable, clevis.
   2. Hangers for Cold Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
   3. Hangers for Hot Pipe Sizes 2 Inches to 4 Inches: Carbon steel, adjustable, clevis.
   4. Hangers for Hot Pipe Sizes 6 Inches and Over: Carbon steel, adjustable, clevis.
   5. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
   6. Wall Support for Hot Pipe Sizes 6 Inches and Over: Unistrut supports with cast iron pipe roll.
   7. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and steel support.
   8. Floor Support for Hot Pipe Sizes to 4 Inches: Cast iron adjustable pipe saddle, locknut, nipple, floor flange, and steel support.
   9. Floor Support for Hot Pipe Sizes 6 Inches and Over: Adjustable cast iron pipe roll and stand, steel screws, and steel support.
   10. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

D. Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
   1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
   2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
   3. Concrete Screw Type Anchors: Complying with ICC-ES AC193.

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4. Masonry Screw Type Anchors: Complying with ICC-ES AC106.
5. Concrete Adhesive Type Anchors: Complying with ICC-ES AC308.
6. Substitutions: See Section 016000 - Product Requirements.

2.07 MANUFACTURED SLEEVE-SEAL SYSTEMS

A. Modular/Mechanical Seal:
   1. Synthetic rubber interlocking links continuously fill annular space between pipe and wall/casing opening.
   2. Provide watertight seal between pipe and wall/casing opening.
   3. Elastomer element size and material in accordance with manufacturer's recommendations.
   4. Glass reinforced plastic pressure end plates.

2.08 BALL VALVES

A. Manufacturers:
   1. Nibco, Inc; _____: www.nibco.com
   2. Viega LLC; _____: www.viega.us
   3. Apollo.
   4. Watts.
   5. Milwaukee.
   6. Substitutions: See Section 016000 - Product Requirements.

B. Construction, 4 Inches and Smaller: MSS SP-110, Class 150, 400 psi CWP, bronze or ductile iron body, 304 stainless steel ball and stem, regular port, teflon seats and stuffing box ring, blow-out proof stem, lever handle, solder, threaded, grooved, or Mechanical Press ends.

2.09 BUTTERFLY VALVES

A. Manufacturers:
   1. Nibco
   2. Apollo
   3. Watts
   4. Victaulic

B. Construction 1-1/2 Inches and Larger: MSS SP-67, 200 psi CWP, cast or ductile iron body, elastomer coated ductile iron disc, resilient replaceable EPDM seat, wafer ends, extended neck, 10 position lever handle.

C. Provide gear operators for valves 8 inches and larger, and chain-wheel operators for valves mounted over 8 feet above floor.

2.10 FLOW CONTROLS

A. Manufacturers:
   1. ITT Bell & Gossett; Model [_____]: www.bellgossett.com
   2. Griswold Controls; Model [_____]: www.griswoldcontrols.com
   3. Taco, Inc; Model [_____]: www.taco-hvac.com
   4. Watts
   5. Substitutions: See Section 016000 - Product Requirements.
   6. Construction: Class 125, Brass or bronze body , temperature and pressure test plug on inlet, blowdown/backflush drain.
   7. Calibration: Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 psi.

2.11 WATER PRESSURE REDUCING VALVES

A. Manufacturers:
   1. Amtrol Inc; _____: www.amtrol.com
   2. Cla-Val Company; _____: www.cla-val.com

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3. Watts Regulator Company; _____: www.wattsregulator.com
4. Wilkins
5. Victaulic
6. Substitutions: See Section 016000 - Product Requirements.

B. Up to 2 Inches:
1. ASSE 1003, bronze body, stainless steel, and thermoplastic internal parts, fabric reinforced diaphragm, strainer, threaded single union ends. No roll seal type valves permitted.

C. Over 2 Inches:
1. ASSE 1003, cast iron body with interior lining complying with AWWA C550, bronze fitted, elastomeric diaphragm and seat disc, flanged.

2.12 RELIEF VALVES

A. Pressure:
1. Manufacturers:
a. Cla-Val Co; Model _____: www.cla-val.com
b. Watts Regulator Company; Model _____: www.wattsregulator.com
c. Substitutions: See Section 016000 - Product Requirements.
2. ANSI Z21.22, AGA certified, bronze body, teflon seat, steel stem and springs, automatic, direct pressure actuated.

B. Temperature and Pressure:
1. Manufacturers:
a. Cla-Val Co; Model _____: www.cla-val.com
b. Watts Regulator Company; Model _____: www.wattsregulator.com
c. Substitutions: See Section 016000 - Product Requirements.
2. ANSI Z21.22, AGA certified, bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, temperature relief maximum 210 degrees F, capacity ASME BPVC-IV certified and labelled.

2.13 STRAINERS

A. Manufacturers:
1. Watts
2. Armstrong International, Inc; Model _____: www.armstronginternational.com
3. Substitutions: See Section 016000 - Product Requirements.

B. Size 2 inch and Under:
1. Threaded brass body for 175 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.
2. Class 150, threaded bronze body 300 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.
3. Installer to remove plug and install ball valve and male hose thread adaptor in its place.

C. Size 1-1/2 inch to 4 inch:
1. Class 125, flanged iron body, Y pattern with 1/16 inch stainless steel perforated screen.
2. Installer to remove plug and install ball valve and male hose thread adaptor in its place.

D. Size 5 inch and Larger:
1. Class 125, flanged iron body, basket pattern with 1/8 inch stainless steel perforated screen.
2. Installer to remove plug and install ball valve and male hose thread adaptor in its place.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that excavations are to required grade, dry, and not over-excavated.

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3.02 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide non-conducting dielectric nipples or flanges wherever jointing dissimilar metals.

C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

D. Piping is not permitted on roofs unless specifically indicated on drawings.

E. Install piping to maintain headroom, conserve space, and not interfere with use of space.

F. Group piping whenever practical at common elevations.

G. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 220516.

H. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
   1. Refer to Section 220719.

I. Provide access where valves and fittings are not exposed.
   1. Coordinate size and location of access doors with Section 083100, and with architectural plans.

J. Establish elevations of buried piping outside the building to ensure not less than 3 ft of cover.

K. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

L. Provide support for utility meters in accordance with requirements of utility companies.

M. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting.
   1. Painting of interior plumbing systems and components is specified in Section 099123.
   2. Painting of exterior plumbing systems and components is specified in Section 099113.

N. Excavate in accordance with Section 312316.

O. Backfill in accordance with Section 312323.

P. Install bell and spigot pipe with bell end upstream.

Q. Install valves with stems upright or horizontal, not inverted. Refer to Section 220523.

R. Install water piping to ASME B31.9.

S. Copper Pipe and Tube: Make soldered joints in accordance with ASTM B828, using specified solder, and flux meeting ASTM B813; in potable water systems use flux also complying with NSF 61 and NSF 372. For mechanical press joints, refer to manufacturer's instructions.

T. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.

U. Sleeve pipes passing through partitions, walls and floors.

V. Inserts:
   1. Provide inserts for placement in concrete formwork.
   2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
   3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
   4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

W. Pipe Hangers and Supports:
   1. Install in accordance with ASME B31.9.

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2. Support horizontal piping as indicated.
3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
4. Place hangers within 12 inches of each horizontal elbow.
5. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
6. Support vertical piping as per plumbing code and local AHJ requirements, and at minimum at every floor. Support riser piping independently of connected horizontal piping.
7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
8. Provide copper plated hangers and supports for copper piping.
9. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
    a. Painting of interior plumbing systems and components is specified in Section 099123.
    b. Painting of exterior plumbing systems and components is specified in Section 099113.
10. Provide hangers adjacent to motor driven equipment with vibration isolation; refer to Section 220548.
11. Support cast iron drainage piping at every joint.

X. Manufactured Sleeve-Seal Systems:
1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
3. Locate piping in center of sleeve or penetration.
4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
5. Tighten bolting for a water-tight seal.
6. Install in accordance with manufacturer's recommendations.

Y. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

3.04 APPLICATION

A. Install unions downstream of valves and at equipment or apparatus connections.

B. Install ball or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.

C. Install globe valves for throttling, bypass, or manual flow control services.

D. Provide lug end butterfly valves adjacent to equipment when provided to isolate equipment.

E. Provide spring loaded check valves on discharge of water pumps.

F. Provide flow controls in water recirculating systems where indicated.

3.05 TOLERANCES

A. Drainage Piping: Establish invert elevations within 1/2 inch vertically of location indicated and slope to drain at minimum of 1/4 inch per foot slope or per plumbing code.

3.06 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Disinfect water distribution system in accordance with Section 330110.58.

B. Prior to starting work, verify system is complete, flushed and clean.

C. Ensure acidity (pH) of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).

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D. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.

E. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.

F. Maintain disinfectant in system for 24 hours.

G. If final disinfectant residual tests less than 25 mg/L, repeat treatment.

H. Flush disinfectant from system until residual is equal to that of incoming water or 1.0 mg/L.

I. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

3.07 SERVICE CONNECTIONS

A. Provide new sanitary sewer services. Before commencing work check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.

B. Provide new water service complete with code approved backflow prevention assembly, water meter with by-pass valves, pressure reducing valve, and sand strainer. If service enters below grade and rises through floor, cast in place. If service enters through wall, provide with link seal between concrete core wall and service pipe, or temporary sleeve which is removed and link seal placed in space between service pipe and concrete. Provide anchor plate support at wall, either cast inside wall or bolted inside building.

END OF SECTION

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SECTION 221006

PLUMBING PIPING SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Drains.
B. Cleanouts.
C. Hose bibbs.
D. Hydrants.
E. Washing machine boxes and valves.
F. Refrigerator valve and recessed box.
G. Back water valves.
H. Backflow preventers.
I. Double check valve assemblies.
J. Water hammer arrestors.
K. Sumps.
L. Sanitary waste interceptors.
M. Mixing valves.
N. Floor drain trap seals.
O. Floor drains and trap seals.

1.02 RELATED REQUIREMENTS

A. Section 011000 - Summary: Product requirements for Owner furnished kitchen equipment.
B. Section 016000 - Product Requirements: Procedures for Owner-supplied products.
C. Section 033000 - Cast-in-Place Concrete: Manhole bottoms.
D. Section 033000 - Cast-in-Place Concrete: Execution requirements for concrete catch basin bases.
E. Section 221005 - Plumbing Piping.
F. Section 223000 - Plumbing Equipment.
G. Section 224000 - Plumbing Fixtures.
H. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.
I. Section 330513 - Manholes and Structures.

1.03 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
B. ASME A112.6.3 - Floor and Trench Drains; 2016.
C. ASME A112.6.4 - Roof, Deck, and Balcony Drains; 2008 (Reaffirmed 2012).
D. ASSE 1011 - Performance Requirements for Hose Connection Vacuum Breakers; 2004, with Errata.
E. ASSE 1012 - Performance Requirements for Backflow Preventers with an Intermediate Atmospheric Vent; 2009.
F. ASSE 1013 - Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Principle Fire Protection Backflow Preventers; 2011.
G. ASSE 1019 - Performance Requirements for Wall Hydrant with Backflow Protection and Freeze Resistance; 2011 (Reaffirmed 2016).

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H. ASTM C478 - Standard Specification for Circular Precast Reinforced Concrete Manhole Sections; 2015a.

I. ASTM C478M - Standard Specification for Circular Precast Reinforced Concrete Manhole Sections (Metric); 2015a.

J. DIN 19580 - Drainage channels for vehicular and pedestrian areas - Durability, mass per unit area and evaluation of conformity; 2010.

K. NEMA MG 1 - Motors and Generators; 2016.

L. NSF 2 - Food Equipment; 2015.

M. NSF 61 - Drinking Water System Components - Health Effects; 2016.

N. NSF 372 - Drinking Water System Components - Lead Content; 2016.

O. PDI-WH 201 - Water Hammer Arresters; 2010.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.

C. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.

D. Certificates: Certify that grease and sand/oil interceptors meet or exceed specified requirements.

E. Manufacturer's Instructions: Indicate Manufacturer's Installation Instructions: Indicate assembly and support requirements.

F. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

G. Project Record Documents: Record actual locations of equipment, cleanouts, backflow preventers, water hammer arrestors, and shutoff valves.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept specialties on site in original factory packaging. Inspect for damage.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Specialties in Potable Water Supply Systems: Provide products that comply with NSF 61 and NSF 372 for maximum lead content.

2.02 DRAINS

A. Manufacturers:
   1. Jay R. Smith Manufacturing Company; _____
   2. Josam Company; _____
   3. Zurn Industries, LLC; _____
   4. Wade.
   5. Substitutions: See Section 016000 - Product Requirements.

B. Roof Drains:
   1. Assembly: ASME A112.6.4.
   2. Body: Lacquered cast iron with sump.
   3. Strainer: Removable polyethylene or cast metal dome.

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4. Accessories: Coordinate with roofing type, refer to Division 7._____
    a. Membrane flange and membrane clamp with integral gravel stop as appropriate for roofing type.
    b. Adjustable under deck clamp.
    c. Roof sump receiver.
    d. Waterproofing flange.
    e. Controlled flow weir.
    f. Leveling frame.
    g. Adjustable extension sleeve for roof insulation.
    h. Perforated or slotted ballast guard extension for inverted roof.
    i. Perforated stainless steel ballast guard extension.

C. Parapet Drains:
    1. Lacquered cast iron body with aluminum flashing clamp collar and nickel bronze sloping grate.

D. Canopy and Cornice Drains:
    1. Lacquered cast iron body with aluminum flashing clamp collar and nickel bronze flat strainer.

E. Roof Overflow Drains:
    1. Lacquered cast iron body and clamp collar and bottom clamp ring; flood rim to be 2 inches above flood elevation.

F. Downspout Nozzles:
    1. Bronze round with offset bottom section.

G. Area Drains:
    1. Assembly: ASME A112.6.4.
    2. Body: Lacquered cast iron with sump.
    3. Strainer: Round or square nickel-bronze.
    4. Accessories: Membrane flange and membrane clamp with integral gravel stop as appropriate for roof type, with adjustable under deck clamp, roof sump receiver, waterproofing flange, levelling frame, adjustable extension sleeve (for insulation), and perforated or slotted ballast guard extension for inverted roof.

H. Linear Drains:
    1. Body: Provide PVC or stainless-steel with sloped channel to vertical waste pipe.
    2. Clamping Ring: Stainless steel mechanism to clamp waterproof membrane to linear drain body.
    3. Strainer: Removable brushed stainless steel or tile top strainer furnished by manufacturer.
    4. Additional Components: Manufacturer's standard membrane, sealant, fasteners, and anchors.

I. Floor Drain:
    1. ASME A112.6.3; Laquered cast iron two piece body with double drainage flange, weep holes, reversible clamping collar, and square or round, adjustable nickel-bronze strainer.

J. Floor Drain:
    1. ASME A112.6.3; lacquered cast iron, two piece body with double drainage flange, weep holes, reversible clamping collar, and square or round, adjustable round nickel bronze strainer with removable perforated sediment bucket.

K. Floor Drain:
    1. ASME A112.6.3; lacquered cast iron, two piece body with double drainage flange, weep holes, reversible clamping collar, and square or round, adjustable nickel-bronze strainer with polished bronze funnel or anti-splash rim.

L. Floor Drain:
    1. ASME A112.6.3; lacquered cast iron, two piece body with double drainage flange, weep holes, reversible clamping collar, and square or round, adjustable nickel-bronze extra heavy duty strainer.

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M. Floor Drain:
   1. ASME A112.6.3; lacquered cast iron, two piece body with double drainage flange, weep holes, reversible clamping collar, and square or round, adjustable nickel-bronze extra heavy duty strainer with hinged grate and sediment bucket.

N. Prefabricated Trench Drain: Trench drain system assembled from factory fabricated, polymer concrete castings in standard lengths and variable depths, with integral joint flanges and integral grating support rails; includes joint gaskets and grating.
   1. Trench width as shown on drawings by engineer of record.
   2. Trench Section Length: 39 inches, and 19-1/2 inches.
   3. Grating Support Rail: Stainless steel.
   4. Accessories:
      a. Oval to round pipe connection.

O. Floor Sink:
   1. Porcelain coated cast iron body with dome strainer and seepage flange.
   2. Manufacturers:
      a. JR Smith.
      b. Zurn.
      c. Watts
      d. Wade
      e. Substitutions: See Section 016000 - Product Requirements.

2.03 CLEANOUTS

A. Manufacturers:
   1. Jay R. Smith Manufacturing Company; _____
   2. Josam Company; _____
   3. Zurn Industries, LLC; _____
   4. Watts
   5. Wade
   6. Substitutions: See Section 016000 - Product Requirements.

B. Cleanouts at Exterior Surfaced Areas:
   1. Round cast nickel bronze access frame and non-skid cover.

C. Cleanouts at Exterior Unsurfaced Areas:
   1. Line type with lacquered cast iron body and round epoxy coated gasketed cover.

D. Cleanouts at Interior Finished Floor Areas:
   1. Lacquered cast iron body with anchor flange, reversible clamping collar, threaded top assembly, and round gasketed scored cover in service areas and round gasketed depressed cover to accept floor finish in finished floor areas.

E. Cleanouts at Interior Finished Wall Areas:
   1. Line type with lacquered cast iron body and round epoxy coated gasketed cover, and round stainless steel access cover secured with machine screw.

F. Cleanouts at Interior Unfinished Accessible Areas: Calked or threaded type. Provide bolted stack cleanouts on vertical rainwater leaders.

2.04 HOSE BIBBS

A. Manufacturers:
   1. Jay R. Smith Manufacturing Company; _____
   2. Watts Regulator Company; _____
   3. Zurn Industries, LLC; _____
   4. Chicago;

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5. Substitutions: See Section 016000 - Product Requirements.

B. Interior Hose Bibbs:
   1. Bronze or brass with integral mounting flange, replaceable hexagonal disc, hose thread spout, chrome plated where exposed with lockshield and removable key, integral vacuum breaker in conformance with ASSE 1011.

C. Interior Mixing Type Hose Bibbs:
   1. Bronze or brass, wall mounted, double service faucet with hose thread spout, integral stops, chrome plated where exposed with removable key, and integral vacuum breaker in conformance with ASSE 1011.

2.05 HYDRANTS

A. Manufacturers:
   1. Jay R. Smith Manufacturing Company; _____
   2. Zurn Industries, LLC; _____
   3. Wade;
   4. Woodford;
   5. Substitutions: See Section 016000 - Product Requirements.

B. Wall Hydrants:
   1. ASSE 1019; freeze resistant, self-draining type with chrome plated lockable recessed box hose thread spout, lockshield and removable key, and integral vacuum breaker.

C. Floor Hydrants:
   1. ASSE 1019; polished bronze lockable recessed box, hose thread spout, lockshield and removable key, and vacuum breaker.

D. Roof Hydrants:
   1. Non-freeze roof hydrant: self draining type. Galvanized casing with adjustable flow wheel lock handle with deck flange and under deck clamp. Integral vacuum breaker.

2.06 WASHING MACHINE BOXES AND VALVES

A. Box Manufacturers:
   1. IPS Corporation/Water-Tite; _____
   2. Oatey Supply Chain Services, Inc; _____
   3. Watts,
   4. Sioux Chief
   5. Substitutions: See Section 016000 - Product Requirements.

B. Valve Manufacturers:
   1. IPS Corporation/Water-Tite; _____
   2. Zurn Industries, LLC; _____
   3. Watts;
   4. Sioux Chief;
   5. Eastman;
   6. Substitutions: See Section 016000 - Product Requirements.

C. Description: Plastic or metal preformed rough in box with brass quarter turn valves, socket for 2 inch waste, slip in finishing cover. Integral water hammer arrestors.

2.07 REFRIGERATOR VALVE AND RECESSED BOX

A. Box Manufacturers:
   1. IPS Corporation/Water-Tite; _____
   2. Oatey Supply Chain Services, Inc; _____
   3. Watts;
   4. Sioux Chief;

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5. Eastman;
6. Substitutions: See Section 016000 - Product Requirements.

B. Valve Manufacturers:
1. IPS Corporation/Water-Tite; _____
2. Zurn Industries, LLC; _____
3. Watts;
4. Sioux Chief;
5. Eastman;
6. Substitutions: See Section 016000 - Product Requirements.

C. Description: Plastic or metal preformed rough in box with brass quarter turn valves, socket for 2 inch waste, slip in finishing cover.

2.08 REDUCED PRESSURE BACKFLOW PREVENTERS:

A. Apollo RPLF-4A.

B. ASSE 1013; bronze body with bronze internal parts and stainless steel springs; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve that opens under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.

2.09 DOUBLE CHECK VALVE ASSEMBLIES

A. Apollo 4ALF-DC.

B. ASSE 1012; Bronze body with corrosion resistant internal parts and stainless steel springs; two independently operating check valves with intermediate atmospheric vent.

2.10 SPILL PROOF VACUUM BREAKER ASSEMBLY.

A. Wilkins 460 XL.

2.11 WATER HAMMER ARRESTORS

A. Manufacturers:
1. Jay R. Smith Manufacturing Company; _____
2. Watts Regulator Company, a part of Watts Water Technologies; _____
3. Zurn Industries, LLC; _____
4. Sioux Chief;
5. Substitutions: See Section 016000 - Product Requirements.

B. Water Hammer Arrestors:
1. Stainless steel construction, piston type sized in accordance with PDI-WH 201, precharged suitable for operation in temperature range 34 to 250 degrees F and maximum 250 psi working pressure.

2.12 SUMPS

A. Manufacturers:
1. Jay R. Smith Manufacturing Company; _____
2. Zurn Industries, LLC; _____
3. Zoeller;
4. Substitutions: See Section 016000 - Product Requirements.

B. Cover: 3/8 inch thick checkered steel plate with gasket seal frames and anchor bolts.

2.13 SANITARY WASTE INTERCEPTORS

A. Manufacturers:
1. Jay R. Smith Manufacturing Company; _____
2. Zurn Industries, LLC; _____

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3. Substitutions: See Section 016000 - Product Requirements.

B. Oil Interceptors:
1. Construction:
a. Material: Epoxy coated fabricated steel.
b. Rough-in: On floor.
c. Accessories: Integral deep seal trap, removable integral flow control, adjustable draw-off assembly, sediment bucket.
d. Cover: Steel, epoxy coated, non-skid with gasket, securing handle, and enzyme injection port.

C. Grease Interceptors:
1. Construction:
a. Rough-in: On floor.
b. Accessories: Multi-weir baffle assembly, integral deep seal trap, removable integral flow control, sediment bucket.
c. Cover: Steel, epoxy coated, non-skid with gasket, securing handle, and enzyme injection port.

D. Sand/Sediment Interceptors:
1. Epoxy coated cast iron. Secured cover with removable stainless steel sediment bucket.

2.14 MIXING VALVES

A. Thermostatic Mixing Valves:
1. Manufacturers:
a. Leonard Valve Company; _____
b. Powers;
c. Symmons;
d. Armstrong;
e. Substitutions: See Section 016000 - Product Requirements.
2. Valve: Chrome plated cast brass body, stainless steel or copper alloy bellows, integral temperature adjustment.
3. Accessories:
a. Check valve on inlets.
b. Volume control shut-off valve on outlet.
c. Stem thermometer on outlet.
d. Strainer stop checks on inlets.

B. Pressure Balanced Mixing Valves:
1. Manufacturers:
a. Moen
b. Bradley
c. Watts
d. Symmons
e. Substitutions: See Section 016000 - Product Requirements.
2. Valve: Chrome plated cast brass body, stainless steel cylinder, integral temperature adjustment.
3. Accessories:
a. Volume control shut-off valve on outlet.
b. Stem thermometer on outlet.
c. Strainer stop checks on inlets.

2.15 FLOOR DRAIN TRAP SEALS

A. Description: Push-fit EPDM or silicone fitting with a one-way membrane.

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PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Extend cleanouts to finished floor or wall surface. Ensure clearance at cleanout for rodding of drainage system.

C. Encase exterior cleanouts in concrete flush with grade.

D. Install directional drain fitting, as per code, to the horizontal or vertical pipe the cleanout is intended to serve.

E. Install floor cleanouts at elevation to accommodate finished floor.

F. Install approved potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibbs.

G. Pipe relief from backflow preventer to nearest drain.

H. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to dishwashers, lavatory sinks, washing machine outlets, or any fixture with quick closing valves.

END OF SECTION

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SECTION 224000
PLUMBING FIXTURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Sinks.

B. Air Admittance Valve.

1.02 RELATED REQUIREMENTS

A. Section 011000 - Summary: Owner-furnished fixtures.

B. Section 064100 - Architectural Wood Casework: Preparation of counters for sinks and lavatories.

C. Section 079200 - Joint Sealants: Sealing joints between fixtures and walls and floors.

D. Section 114000 - Foodservice Equipment: Food service sinks.

E. Section 115300 - Laboratory Equipment: Laboratory sinks.

F. Section 123600 - Countertops: Preparation of counters for sinks and lavatories.

G. Section 221005 - Plumbing Piping.

H. Section 221006 - Plumbing Piping Specialties.

I. Section 223000 - Plumbing Equipment.

J. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.

B. ASME A112.18.9 - Protectors/Insulators for Exposed Waste and Supplies on Accessible Fixtures; 2011.

C. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2013.

D. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2017.

E. ASTM C1822 - Standard Specification for Insulating Covers on Accessible Lavatory Piping; 2015.

F. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015.

G. IAPMO Z124 - Plastic Plumbing Fixtures; 2017.

H. ANSI Z358.1 - American National Standard for Emergency Eyewash and Shower Equipment; 2014.

I. ASHRAE Std 18 - Methods of Testing for Rating Drinking-Water Coolers with Self-Contained Mechanical Refrigeration; 2013.

J. ASME A112.6.1M - Supports for Off-the-Floor Plumbing Fixtures for Public Use; 1997 (Reaffirmed 2017).

K. ASME A112.18.1 - Plumbing Supply Fittings; 2012.

L. ASME A112.18.9 - Protectors/Insulators for Exposed Waste and Supplies on Accessible Fixtures; 2011.

M. ASME A112.19.1 - Enamelled Cast Iron and Enamelled Steel Plumbing Fixtures; 2013.

N. ASME A112.19.2 - Ceramic Plumbing Fixtures; 2013.

O. ASME A112.19.3 - Stainless Steel Plumbing Fixtures; 2017.

P. ASME A112.19.4M - Porcelain Enameled Formed Steel Plumbing Fixtures; 1994 (R2009).

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Q. ASME A112.19.5 - Flush Valves and Spuds for Water Closets, Urinals, and Tanks; 2017.

R. ASME A112.19.15 - Bathtub/Whirlpool Bathtubs with Pressure Sealed Doors; 2012.

S. ASSE 1014 - Performance Requirements for Backflow Prevention Devices for Hand-Held Showers; 2005.

T. ASSE 1070 - Performance Requirements for Water Temperature Limiting Devices; 2015.

U. ASTM C1822 - Standard Specification for Insulating Covers on Accessible Lavatory Piping; 2015.

V. ASTM D570 - Standard Test Method for Water Absorption of Plastics; 1998 (Reapproved 2010).

W. ASTM D638 - Standard Test Method for Tensile Properties of Plastics; 2014.

X. ASTM D696 - Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between - 30 C and 30 C with a Vitreous Silica Dilatometer; 2016.

Y. ASTM D785 - Standard Test Method for Rockwell Hardness of Plastics and Electrical Insulating Materials; 2008 (Reapproved 2015).

Z. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.

AA. IAPMO Z124 - Plastic Plumbing Fixtures; 2017.

AB. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

AC. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.

AD. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

AE. NSF 61 - Drinking Water System Components - Health Effects; 2016.

AF. NSF 372 - Drinking Water System Components - Lead Content; 2016.

AG. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.

C. Manufacturer's Instructions: Indicate installation methods and procedures.

D. Maintenance Data: Include fixture trim exploded view and replacement parts lists.

E. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

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

1.06 FIRST INSTALL

A. Provide components for installation in first install.

B. First install may remain as part of the Work.

C. Owner shall be invited to participate.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Accept fixtures on site in factory packaging. Inspect for damage.

B. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

1.08 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

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B. Provide five year manufacturer warranty for electric water cooler.

PART 2 PRODUCTS

2.01 GENERAL

A. Potable Water Systems: Provide plumbing fittings and faucets that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

2.02 REGULATORY REQUIREMENTS

A. Comply with applicable codes for installation of plumbing systems.

B. Comply with UL (DIR) requirements.

C. Perform work in accordance with local health department regulations.

D. Provide certificate of compliance from Authority Having Jurisdiction indicating approval of installation.

2.03 SINKS

A. Sink Manufacturers:
   1. Kohler Company; :
   2. Just Mfg;
   3. Elkay; No. ECTRU21179T
   4. Substitutions: See Section 016000 - Product Requirements.

B. Single Compartment Bowl
   1. ASME A112.19.3; _21__ by _17__ by _9__ inch inside bowl dimensions minimum 18 gauge Type 304 stainless steel, self rimming or undermount and undercoated, with ledge back drilled for trim. For undermount, supply sink without ledge back and mount faucet on countertop.
   2. Drain: 3-1/2 inch stainless steel strainer tailpiece.

D. Sink Faucets:
   1. Manufacturer:
      a. The Chicago Faucet Company; No. 1100-HA8-317XKABCP
      b. Kohler;
      c. T&S Brass;
      d. Moen;
      e. Substitutions: See Section 016000 - Product Requirements.
   2. Two Handled Faucet:
      a. Type: Deck-mount, wrist-blade operated faucet with mounting plate.
      b. Outlet: laminar flow.
      c. ASTM A112.18:1, ADA Standards, and NSF 61 compliant assembly.
      d. Materials: Brass body with polished chrome finish and quarter turn ceramic cartridge.

E. Accessories: Provide braided or PEX supply lines, quarter turn ball-type stop valve, slip-joint p-trap and stainless steel basket strainer.

2.04 AIR ADMITTANCE VALVE

A. Air Admittence Vavle Manufacturers:
   1. Studor : TEC-VENT
   2. Substitutions: See Section 016000 - Product Requirements.

B. Air Admittence Valve:
   1. UL 2043 listed air admittance valve with screening on the inside and outside of the valve to protect the sealing membrane from insects and debris. Valve shall also meet ANSI/ASSE1051, single fiture an branch type Air Admittence Valves, as well as ANSI/ASSE 1050 for stack type Air Admittence Valves. Valve shall be NSF Standard 14 rated for plastic piping system and components.

2. Horizontal branch sizes: 1-1/2” for a maximum of 3 DFUs, 2” for a maximum of 6 DFUs, 3” for a maximum of 20 DFUs, 4” for a maximum or 160 DFUs.
3. Stack Sizes: 1-1/2” for a maximum of 8 DFUs, and 2” for a maximum or 24 DFUs.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.
B. Verify that electric power is available and of the correct characteristics.
C. Confirm that millwork is constructed with adequate provision for the installation of counter top lavatories and sinks.

3.02 PREPARATION

A. Rough-in fixture piping connections in accordance with minimum sizes indicated in plumbing fixture schedule for particular fixtures.

3.03 INSTALLATION

A. Install each fixture with trap, easily removable for servicing and cleaning.
B. Provide 3" outlet floor drain with barrier type trap seal protection device below each emergency shower. _____
C. Provide PEX supplies to fixtures with _____stops, reducers, and escutcheons.
D. Install components level and plumb.
E. Install and secure fixtures in place with wall carriers or wall supports and bolts.

3.04 INTERFACE WITH WORK OF OTHER SECTIONS

A. Review millwork shop drawings. Confirm location and size of fixtures, carriers, wall supports, and openings before rough-in and installation.

3.05 ADJUSTING

A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.06 CLEANING

A. Clean plumbing fixtures and equipment.
B. See Section 017419 - Construction Waste Management and Disposal, for additional requirements.

3.07 PROTECTION

A. Protect installed products from damage due to subsequent construction operations.
B. Do not permit use of fixtures by construction personnel.
C. Repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

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SECTION 230100

MECHANICAL OPERATION AND MAINTENANCE MANUALS

PART 1 GENERAL **THE 230000 HAS BEEN COMPLETELY UPDATED**

1.01 SECTION INCLUDES **FEBRUARY 2023**

A. Operation and Maintenance Data.

1.02 RELATED REQUIREMENTS

A. Section 013000 - Administrative Requirements: Submittal procedures, project meetings, progress schedules and documentation, reports, coordination.

B. Section 017800 - Closeout Submittals: Project record documents, operation and maintenance (O&M) data, warranties and bonds.

1.03 SUMMARY

A. Furnish one set of bound operation and maintenance manuals and two thumb drives with electronic copies of maintenance manuals in pdf format.

1.04 PURPOSE

A. The Operation and Maintenance Manual is prepared to provide a ready reference to all important pieces of mechanical and electrical equipment installed on the project including completed start-up documentation. It is also to provide the necessary operating and maintenance data for use by service personnel. It is also to provide information required for checking equipment performance or for planning of physical plant expansion or redesign.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 ASSEMBLY OF DURABLE OPERATION AND MAINTENANCE MANUALS

A. Assemble operation and maintenance data into durable manual(s) for Owner's personnel use, with data arranged in divisions as outlined below.

B. Binders: Commercial quality, 8-1/2 by 11 inch three D side ring binders with durable plastic covers; 4 inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings. The number of binders, however, shall be based upon not filling them beyond 2 1/2 inch thickness.

C. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.

D. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.

E. Tables of Contents: List every division separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.

1. Master Table of Contents shall be (Include, in Project Operation and Maintenance Manual, only divisions used in project. Modify Table of Contents for each project manual.):
   a. Plumbing Equipment
      1) 1131 - Plumbing Air System
      2) 1132 - Water Softener
      3) 1133 - Plumbing Pressure System
      4) 1135 - Water Heater
      5) 1136 - Plumbing Pump
      6) 1138 - Plumbing Delivery System

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7) 1139 - Water Cooler
8) 113A - Grease Trap / Septic Tanks
9) 113C - Fire Sprinkling System
10) 113D - Gas Suppression System
11) 113E - Pool Treatment System
12) 113F - Lab Vacuum System
13) 113G - Backflow Preventer

b. HVAC Equipment
1) 1141 - Boilers and Boiler Accessories
2) 1143 - Thermal Storage System
3) 1144 - Steam Condensate System
4) 1145 - HVAC Piping System
5) 1146 - Heating Water Pump
6) 1147 - HVAC Expansion Tanks
7) 1148 - Terminal Heating/Cooling Units
8) 1149 - Furnace
9) 114A - Coil
10) 114B - Filter / Filter Rack
11) 114C - Damper
12) 114D - Motor Speed Controller (VFD)
13) 114F - Chiller
14) 114G - Packaged Heating/Cooling Unit
15) 114H - Humidifier / Dehumidifier
16) 114I - Cooling Tower
17) 114J - Chilled Water Pump
18) 114K - Condenser Water Pump
19) 114L - Condensing Unit
20) 114M - Air Handling Unit
21) 114N - Exhaust Fan
22) 114O - Air Control (VAV) Box
23) 114R - Heat Exchanger
24) 114S - Evaporative Cooler
25) 114T - Temperature Control System
26) 114U - HVAC Water Filter / Treatment
27) 114W - Fume Hoods
28) 114X - Dust Collector / Paint Booth
29) 114Y - HVAC Delivery System

F. Dividers: Provide tabbed dividers for each division of equipment; identify the division name on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.

G. Text: Manufacturer's printed data, or typewritten data on 20 pound paper.

H. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

I. Arrangement of Contents: Organize each volume in parts as follows:
1. Project Directory.
2. Table of Contents, of all volumes, and of current volume.
3. Operation and Maintenance Data: Arranged by division, and then by piece of equipment.
a. Source data.

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b. Outline drawings, special construction details, “as built” electrical wiring and control diagrams for all major and supplementary systems.
c. Manufacturer's test or calculated performance data and certified test curves (where applicable).
d. Installation, operating, and maintenance instructions, including a complete parts list and sectional drawing with parts identification numbers. Mark with model, size and plan number.
e. Manufacturer’s brochure marked to indicate exact equipment purchased. Brochures on component parts supplied by a manufacturer with their equipment, but not manufactured directly by them, shall also be included.
f. The serial numbers of each item of equipment installed are to be listed with the model numbers and plan symbols.
g. A copy of the approved submittals for each piece of equipment.
h. A copy of the completed equipment start up report.
i. A copy of all testing, adjusting and balancing reports.
j. Wiring diagrams, marked with model and size and plan symbol.
k. The index shall contain the name and address of the manufacturer and, if different, where replacement and repair parts may be obtained.

3.02 ORGANIZATION OF DIGITAL OPERATION AND MAINTENANCE MANUAL

A. Assemble operation and maintenance data into an electronic format for Owner's use, with data arranged in divisions.

B. Furnish two electronic copies of Mechanical Operation and Maintenance Manual to owner on a readable and downloadable thumb drive.

C. Create a directory for each division used in project. Name directories using the same format as the Master Table of Contents, shown above.

D. Compile scanned PDF files or manufacturer furnished PDF files together into a single division PDF file duplicating divisions found in the durable Operation and Maintenance Manual.

E. Populate the division directories/folders with the division PDF files.

F. No Table of Contents is required for the electronic copy of the Mechanical Operation and Maintenance Manual.

END OF SECTION

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SECTION 230523

GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Applications.
B. General requirements.
C. Ball valves.
D. Butterfly valves.
E. Check valves.
F. Flow control valves.
G. High temperature water valves

1.02 RELATED REQUIREMENTS

A. Section 078400 - Firestopping.
B. Section 083100 - Access Doors and Panels.
C. Section 230548 - Vibration and Seismic Controls for HVAC Piping and Equipment.
D. Section 230553 - Identification for HVAC Piping and Equipment.
E. Section 230716 - HVAC Equipment Insulation.
F. Section 230719 - HVAC Piping Insulation.
G. Section 232113 - Hydronic Piping.
H. Section 232213 - Steam and Steam Condensate Piping.

1.03 ABBREVIATIONS AND ACRONYMS

A. CWP: Cold working pressure.
B. EPDM: Ethylene propylene copolymer rubber.
C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
D. NRS: Nonrising stem.
E. OS&Y: Outside screw and yoke.
F. PTFE: Polytetrafluoroethylene.
G. RS: Rising stem.
H. SWP: Steam working pressure.
I. TFE: Tetrafluoroethylene.
J. WOG: Water, oil, and gas.

1.04 REFERENCE STANDARDS

A. API STD 594 - Check Valves: Flanged, Lug Wafer, and Butt-Welding; 2017.
B. ASME B1.20.1 - Pipe Threads, General Purpose (Inch); 2013.
C. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2015.
D. ASME B16.5 - Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard; 2017.
E. ASME B16.10 - Face-to-Face and End-to-End Dimensions of Valves; 2017.

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F. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2012.

G. ASME B16.34 - Valves - Flanged, Threaded and Welding End; 2017.

H. ASME B31.1 - Power Piping; 2016.

I. ASME B31.9 - Building Services Piping; 2014.

J. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing and Fusing Operators; 2017.

K. ASTM A48/A48M - Standard Specification for Gray Iron Castings; 2003 (Reapproved 2016).

L. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings; 2004 (Reapproved 2014).

M. ASTM A216/A216M - Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service; 2016.

N. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures; 1999 (Reapproved 2014).

O. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984 (Reapproved 2014).

P. ASTM A582/A582M - Standard Specification for Free-Machining Stainless Steel Bars; 2012 (Reapproved 2017).

Q. ASTM B61 - Standard Specification for Steam or Valve Bronze Castings; 2015.

R. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings; 2017.

S. AWWA C606 - Grooved and Shouldered Joints; 2015.

T. MSS SP-45 - Bypass and Drain Connections; 2003 (Reaffirmed 2008).

U. MSS SP-67 - Butterfly Valves; 2011.

V. MSS SP-68 - High Pressure Butterfly Valves with Offset Design; 2011.

W. MSS SP-70 - Cast Iron Gate Valves, Flanged and Threaded Ends; 2011.

X. MSS SP-71 - Cast Iron Swing Check Valves, Flanged and Threaded Ends; 2011.

Y. MSS SP-72 - Ball Valves with Flanged or Butt-Welding Ends for General Service; 2010.

Z. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010.

AA. MSS SP-125 - Gray Iron and Ductile Iron In-Line, Spring-Loaded, Center-Guided Check Valves; 2010.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.

C. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.

1.06 QUALITY ASSURANCE

A. Manufacturer:
   1. Obtain valves for each valve type from single manufacturer.
   2. Company must specialize in manufacturing products specified in this section, with not less than three years of documented experience.

B. Welding Materials and Procedures: Conform to ASME BPVC-IX.

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1.07 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
   1. Protect valve parts exposed to piped medium against rust and corrosion.
   2. Protect valve piping connections such as grooves, weld ends, threads, and flange faces.
   3. Adjust gate valves to the closed position to avoid clattering.
   4. Secure check valves in either the closed position or open position.
   5. Adjust butterfly valves to closed or partially closed position.

B. Use the following precautions during storage:
   1. Maintain valve end protection and protect flanges and specialties from dirt.
      a. Provide temporary inlet and outlet caps.
      b. Maintain caps in place until installation.
   2. Store valves in shipping containers and maintain in place until installation.
      a. Store valves indoors in dry environment.
      b. Store valves off the ground in watertight enclosures when indoor storage is not an option.

C. Exercise the following precautions for handling:
   1. Handle large valves with sling, modified to avoid damage to exposed parts.
   2. Avoid the use of operating handles or stems as rigging or lifting points.

PART 2 PRODUCTS

2.01 APPLICATIONS

A. See Drawings for specific valve locations.

B. Listed pipe sizes shown using nominal pipe sizes (NPS) and nominal diameter (DN).

C. Provide the following valves for the applications if not indicated on Drawings:
   1. Throttling (Hydronic): Butterfly and Ball.
   2. Isolation (Shutoff): Butterfly and Ball.
   3. Swing Check (Pump Outlet):
      a. 2 1/2 NPS and Smaller: Bronze.
      b. 3 NPS and Larger: Iron.

D. Substitutions of valves with higher CWP classes or SWP ratings for same valve types are permitted when specified CWP ratings or SWP classes are not available.

E. Required Valve End Connections for Non-Wafer Types:
   1. Steel Pipe:
      a. 2 NPS and Smaller: Threaded, mechanical compression coupling.
      b. 2-1/2 NPS and Larger: Flanged, grooved ends.
   2. Copper Tube:
      a. 2 NPS and Smaller: Threaded, mechanical compression coupling (Exception: Solder-joint valve-ends).
      b. 2-1/2 NPS and Larger: Flanged, grooved ends.
   3. Steam and Steam Condensate Pipe: Grooved ends not acceptable.

F. Chilled Water, Heating Water, and Condenser Water Valves:
   1. 2 NPS and Smaller, Brass, Bronze and Stainless Steel Valves:
      a. Ball type.
      b. Swing Check.
   2. 2-1/2 NPS and Larger, Iron Valves:
      a. Lug Wafer Butterfly.
      b. Grooved-End Butterfly.
      c. Swing Check.

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d. Center-Guided Check.

2.02 GENERAL REQUIREMENTS

A. General: Provide factory fabricated valves recommended by manufacturer for use in service indicated on drawings. Provide valves of types and pressure ratings indicated; provide proper selection as determined by installer to comply with installation requirements. Provide end connections which properly mate with pipe, tube, and equipment connections. Where more than one type is indicated, selection is Installer's choice.

B. Valve Sizes: Unless otherwise indicated, provide valves of same size as upstream pipe size.

C. Valve Operators:
   1. Gear Operator: Quarter-turn valves 6 NPS and larger; all iron grooved end butterfly valves.
   2. Handwheel: For valves with gear operators, except plug valves; fastened to valve stem.
   3. Hand Lever: Quarter-turn valves 4 NPS and smaller, except iron grooved butterfly valves..
   4. Chainwheel: Device for attachment to valve handwheel, stem, or other operator. Chainwheel shall match valve size and manufacturer. Contractor shall furnish and install a chainwheel on all gear operated and iron grooved butterfly valves mounted 8'-0" or higher, above finished floor, in mechanical rooms. Chain shall be accessible from within 4'-0" of finished floor.

D. Valves in Insulated Piping: Provide 2-inch stem extensions and the following features:
   1. Ball Valves: Extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
   2. Butterfly Valves: Extended neck.
   3. Memory Stops: Fully adjustable after insulation is installed.

E. Valve-End Connections:
   1. Threaded End Valves: ASME B1.20.1.
   2. Flanges on Iron Valves: ASME B16.1 for flanges on iron valves.
   3. Pipe Flanges and Flanged Fittings 1/2 NPS through 24 NPS: ASME B16.5.
   4. Solder Joint Connections: ASME B16.18.
   5. Grooved End Connections: AWWA C606.
   6. Mechanical Press Connections: ASME B16.51.

F. General ASME Compliance:
   1. Ferrous Valve Dimensions and Design Criteria: ASME B16.10 and ASME B16.34.
   2. Power Piping Valves: ASME B31.1.
   3. Building Services Piping Valves: ASME B31.9.

G. Bronze Valves:
   1. Fabricate from dezincification resistant material.
   2. Copper alloys containing more than 15 percent zinc are not permitted.

H. Valve Bypass and Drain Connections: MSS SP-45.

I. Source Limitations: Obtain each valve type from a single manufacturer.

2.03 BRONZE OR BRASS BALL VALVES

A. Two Piece, Full Port with Stainless Steel Trim:
   1. Comply with MSS SP-110.
   2. SWP Rating: 150 psig.
   3. CWP Rating: 600 psig.
   4. Body: Forged bronze or brass.
   5. Ends: Threaded, Grooved, or Mechanical press.
   6. Seats: PTFE.
   7. Stem: Stainless Steel.

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8. Ball: Stainless Steel.
9. Manufacturers:
    a. Milwaukee;_____
    b. Apollo;
    c. Hammond;
    d. Nibco;
    e. Watts;
    f. Substitutions: See Section 016000 - Product Requirements.

B. Three Piece, Full Port with Stainless Steel Trim:
1. Comply with MSS SP-110.
2. SWP Rating: 150 psig.
3. CWP Rating: 600 psig.
4. Body: Forged brass.
5. Ends: Threaded, Grooved, or Propress.
6. Seats: PTFE or TFE.
7. Stem: Stainless steel.
8. Ball: Stainless steel, vented.
9. Manufacturers:
    a. Milwaukee;_____
    b. Apollo;
    c. Hammond;
    d. Nibco;
    e. Watts;
    f. Substitutions: See Section 016000 - Product Requirements.

2.04 IRON, GROOVED-END BALL VALVES

A. Class 125:
1. Body: Ductile iron; ASTM A536, Grade 65-45-12.
2. Ends: Grooved.
3. Seats: Teflon.
4. Stem: Stainless steel.
5. Ball: Stainless steel.
6. Manufacturers:
    a. Anvil International;Gruvlock.
    b. Victaulic;
    c. Grinnell;
    d. Substitutions: See Section 016000 - Product Requirements.

2.05 IRON, LUG WAFER BUTTERFLY VALVES

A. Lug type: Bi-directional dead end service without downstream flange.
1. Comply with MSS SP-67, Type I.
2. CWP Rating: 150 psig, and 200 psig.
3. Body Material: ASTM A126 cast iron.
4. Stem: One or two-piece stainless steel.
5. Seat: EPDM.
6. Disc: Stainless steel.
7. Manufacturers:
    a. Hammond;
    b. Milwaukee;
    c. Keystone;

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d. Nibco;
e. Substitutions: See Section 016000 - Product Requirements.

2.06 IRON, GROOVED-END BUTTERFLY VALVES

A. CWP Rating: 175 psig (1200 kPa).
1. Comply with MSS SP-67, Type I.
2. Body: Coated ductile iron.
3. Stem: Stainless steel.
4. Disc: Stainless steel.
5. Disc Seat and Seal: EPDM.
6. Operator: Gear type with handwheel.
7. Manufacturers:
a. Anvil International;Gruvlock.
b. Victaulic;
c. Grinnell;
d. Substitutions: See Section 016000 - Product Requirements.

2.07 BRONZE SWING CHECK VALVES

A. Class 125: CWP Rating: 200 psig (1380 kPa).
1. Comply with MSS SP-80, Type 3.
2. Body Design: Horizontal flow.
3. Body Material: Bronze, ASTM B62.
4. Ends: Threaded.
5. Disc: Bronze, Brass, or PTFE.

B. Manufacturers:
1. Apollo;_____
2. Nibco;
3. Crane;
4. Milwaukee;
5. Substitutions: See Section 016000 - Product Requirements.

2.08 IRON, FLANGED END SWING CHECK VALVES

A. Class 125: CWP Rating: 200 psig (1380 kPa) with Metal Seats.
1. Comply with MSS SP-71, Type I.
2. Design: Clear or full waterway with flanged ends.
3. Body: Gray iron with bolted bonnet in accordance with ASTM A126.
4. Trim: Bronze.
5. Disc Holder: Bronze.
6. Disc: Cast iron or bronze.
7. Gasket: Asbestos free.

B. Manufacturers:
1. Milwaukee;_____
2. Apollo;
3. Nibco;
4. Crane;
5. Mueller;
6. Substitutions: See Section 016000 - Product Requirements.

2.09 IRON, GROOVED-END SWING CHECK VALVES

A. 300 CWP:

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1. Body Material: ASTM A536, Grade 65-45-12 ductile iron.
2. Seal: EPDM or Nitrile.
3. Disc: Ductile iron.
4. Coating: Black, non-lead paint.

B. Manufacturers:
1. Grinnell;_____
2. Anvil International; Gruvlock.
3. Victaulic;
4. Substitutions: See Section 016000 - Product Requirements.

2.10 IRON, CENTER-GUIDED CHECK VALVES

A. Class 125, Compact-Wafer:
1. Comply with MSS SP-125.
2. 2-1/2 NPS to 12 NPS, CWP Rating: 200 psig.
3. 14 NPS to 24 NPS, CWP Rating: 150 psig.
4. Body Material: ASTM A126, cast iron.
5. Seat: Stainless steel.
6. Seat Rings: EPDM or Nitrile (BUNA-N).
7. Spring and Stem: Stainless steel.
8. Disc: Aluminum bronze.
9. Manufacturers:
   a. Apollo Valves;
   b. Metraflex;_____
   c. Milliken, a Mueller brand;
   d. Substitutions: See Section 016000 - Product Requirements.

B. Class 125, Globe Style:
1. Comply with MSS SP-125.
2. 2-1/2 NPS to 12 NPS, CWP Rating: 200 psig.
3. 14 NPS to 24 NPS, CWP Rating: 150 psig.
4. Body Material: ASTM A126, cast iron.
5. Seat: Stainless steel.
6. Seat Rings: EPDM or Nitrile (BUNA-N).
7. Spring and Stem: Stainless steel.
8. Disc: Aluminum bronze.
9. Manufacturers:
   a. Metraflex;_____
   b. Milliken, a Mueller brand;
   c. Substitutions: See Section 016000 - Product Requirements.

2.11 MANUAL BALANCING VALVES

A. 2 NPS and Smaller:
1. Brass or bronze body with union, venturi with temperature and pressure test plug on inlet and outlet, and threaded or sweat end connections.
2. Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 psi.
3. Provide schedule showing pressure drop and flow rate of each valve.

B. 2-1/2 NPS and Larger:
1. ASTM A216 or A120 carbon steel venturi body with extended temperature and pressure test plugs on inlet and outlet of venturi, flanged inlet and outlet, lug type butterfly valve for throttling.

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2. Butterfly valve: Ductile iron or cast iron body (ASTM A536), aluminum-bronze or stainless steel disc, stainless steel stem, EPDM seat and gasket, memory stop handle.
3. Calibration: Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 psi.
4. Provide schedule showing pressure drop and flow rate of each valve.

C. If improperly sized balance valves are found during the test and balance work, the improperly sized balance valves shall be replaced by the installing contractor at no additional cost to the Owner or project.

D. Manufacturers:
1. ITT Bell & Gossett;
2. Taco, Inc.;
3. IMI Flow Design;
4. Gerund;
5. Nexus;

2.12 HIGH TEMPERATURE WATER VALVES

A. See specification section 232113.50.

PART 3 EXECUTION

3.01 EXAMINATION

A. Discard all packing materials and verify that valve interior, including threads and flanges are completely clean without signs of damage or degradation that could result in leakage.

B. Verify valve parts to be fully operational in all positions from closed to fully open.

C. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.

D. Should valve be determined to be defective, replace with new valve.

3.02 INSTALLATION

A. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.

B. Where valve support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.

C. Chainwheel: Contractor shall furnish and install a chainwheel on all gear operated and iron grooved butterfly valves mounted 8'-0" or higher, above finished floor, in mechanical rooms. Chain shall be accessible from within 4'-0" of finished floor.

D. Install check valves where necessary to maintain direction of flow as follows:
1. Swing Check: Install horizontal maintaining hinge pin level.
2. Orient center-guided into horizontal or vertical position, between flanges.

END OF SECTION

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SECTION 230529

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. See specification section 220529 for requirements for this section.

END OF SECTION

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SECTION 230548

VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Match specification section 220548 for requirements for vibration isolation requirements.

B. Match specification section 220548 for requirements for seismic control requirements.

C. Match specification section 220548 for requirements for equipment support bases.

D. Match specification section 220548 for requirements for vibration isolators.

E. Match specification section 220548 for requirements for seismic restraints for suspended components and equipment.

F. Seismic snubber assemblies.

G. Roof curbs.

1.02 RELATED REQUIREMENTS

A. Section 014533 - Code-Required Special Inspections.

B. Section 033000 - Cast-in-Place Concrete.

C. Section 220548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.

1.03 DEFINITIONS

A. HVAC Component: Where referenced in this section in regards to seismic controls, applies to any portion of the HVAC system subject to seismic evaluation in accordance with applicable codes, including distributed systems (e.g., ductwork, piping).

B. Seismic Restraint: Structural members or assemblies of members or manufactured elements specifically designed and applied for transmitting seismic forces between components and the seismic force-resisting system of the structure.

1.04 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; 2010, with 2013 Supplements and Errata.

B. ASCE 19 - Structural Applications of Steel Cables for Buildings; 2016.

C. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications; 2015.

D. ICC (IBC) - International Building Code (current adopted version)

E. ICC-ES AC156 - Acceptance Criteria for Seismic Certification by Shake-Table Testing of Nonstructural Components; 2010, with Editorial Revision (2015).

F. MFMA-4 - Metal Framing Standards Publication; 2004.

G. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel; 2017.

H. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems; Sheet Metal and Air Conditioning Contractors' National Association; 2008.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.

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C. Seismic Design Data:
   1. Compile information on project-specific characteristics of actual installed HVAC components necessary for determining seismic design forces required to design appropriate seismic controls.
      a. Component operating weight and center of gravity.
      b. Component elevation in the building in relation to the roof elevation (z/h).
      c. Component importance factor (Ip).
      d. For distributed systems, component materials and connection methods.
      e. Component amplification factor (ap) and component response modification factor (Rp), determined in accordance with ASCE 7 tables.
   2. Include structural calculations, stamped or sealed by seismic controls designer, demonstrating suitability of seismic controls for seismic design forces.

D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

E. Field quality control test reports.

1.06 QUALITY ASSURANCE

A. Comply with applicable building code.

B. Seismic Controls Designer Qualifications: Registered professional engineer licensed in Utah and with minimum five years' experience designing seismic restraints for nonstructural components.
   1. Designer may be employed by the manufacturer of the seismic restraint products.

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

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 SEISMIC SNUBBER ASSEMBLIES

A. Manufacturers:
   1. External Seismic Snubber Assemblies:
      a. Kinetics Noise Control, Inc; _____: www.kineticsnoise.com
      b. Mason Industries; _____: www.mason-ind.com
      c. Substitutions: See Section 016000 - Product Requirements.
   2. Source Limitations: Furnish external seismic snubber assemblies and associated accessories produced by the same manufacturer as the vibration isolators and obtained from a single supplier.

B. Description: Steel snubbing assemblies designed for external attachment to both equipment and supporting structure that, as part of a complete system, restrain equipment motion in all directions during a seismic event while maintaining vibration isolation during normal operation.

C. Seismic Snubbing Elements:
   1. Air Gap: Between 0.125 inches and 0.25 inches unless otherwise indicated.
   2. Points of Contact: Cushioned with resilient material, minimum 0.25 inch thick; capable of being visually inspected for damage and replaced.

2.02 ROOF CURBS

A. Seismic Type Non-Isolated Curb and Fabricated Equipment Piers:
   1. Location: Between structure and rooftop equipment.

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2. Construction: Steel.
3. Weather exposed components consist of corrosion resistant materials.
4. Stamped seismic curb design and installation as per curb manufacturer or curb supplier.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that mounting surfaces are ready to receive vibration isolation and/or seismic control components and associated attachments.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Secure fasteners according to manufacturer's recommended torque settings.

3.03 INSTALLATION - SEISMIC

A. Comply with:
   1. ASHRAE (HVACA) Handbook - HVAC Applications.
   2. SMACNA (SRM).

B. Seismic Snubbers:
   1. Provide on all isolated equipment, piping and ductwork.
   2. Provide minimum of four seismic snubbers located close to isolators.
   3. Snub all other equipment between 0.15 inch and 0.25 inch clearance.

C. Floor and Base-Mounted Equipment, Vibration Isolated Equipment and associated Vibration and Seismic Controls for Connections:
   1. Install equipment anchorage items designed to resist seismic design force in any direction.
   2. Install vibration and seismic controls designed to include base and isolator requirements.
   3. Provide flexible connections between equipment and interconnected piping.
   4. Provide isolators and restraints designed for amplified code forces per ASCE 7 and with demonstrated ability to resist required forces including gravity, operational and seismic forces.
   5. Where equipment is not designed to be point loaded, provide base capable of transferring gravity and seismic demands from equipment to isolator base plate anchorage.
   6. Where concrete floor thickness is less than required for expansion anchor installation, install through bolt in lieu of expansion anchor.

D. Suspended Mechanical Equipment:
   1. Provide supports and bracing to resist seismic design force in any direction.
   2. Provide flexible connections between equipment and interconnected piping.
   3. Brace equipment hung from spring mounts using cable or other bracing that will not transmit vibration to the structure.
   4. Use of proprietary restraint systems with a certificate of compliance, verified and listed by an accredited inspection body is acceptable (pending shop drawing approval), as an alternative to project specific seismic bracing design.

E. Wall mounted Mechanical Equipment:
   1. Provide support and bracing to resist seismic design force in any direction.
   2. Install backing plates or blocking as required to deliver load to primary wall framing members.
   3. Anchoring to gypsum wallboard, plaster or other wall finish that has not been engineered to resist imposed loads is not permitted.

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F. Ductwork:
   1. Provide seismic bracing for ducts with cross sectional area greater than 6 sq ft (independent of duct contents).
   2. Provide seismic bracing for all ducts containing hazardous materials.
   3. Provide supports, braces, and anchors to resist gravity and seismic design forces.
   4. Install ducts and duct risers designed to accommodate interstory drift.
   5. Independently support in-line devices weighing more than 20 pounds.
   6. Independently support and brace all in-line devices weighing more than 75 pounds.
   7. Provide unbraced piping attached to braced in-line equipment with adequate flexibility to accommodate differential displacements.
   8. Positively attach dampers, louvers, diffusers and similar appurtenances to ductwork with mechanical fasteners.
   9. Install duct supports designed to resist not less than 150 percent of the duct weight.
   10. The use of power driven fasteners is prohibited in the hanging of ducts weighing over 10 pounds per lineal foot for seismic design categories D, E, and F.
   11. Use of proprietary restraint systems with a certificate of compliance, verified and listed by an IAS AC172 accredited inspection body or otherwise accepted by applicable codes is acceptable (pending shop drawing approval), as an alternative to project specific seismic bracing design.

G. Tanks:
   1. Install tank anchorage, tank legs and/or supporting structure designed to resist design force.
   2. Provide flexible connections between tank and interconnected piping.

3.04 FIELD QUALITY CONTROL

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

B. Inspect vibration isolation and/or seismic control components for damage and defects.

C. Seismic Controls:
   1. Verify snubbing element air gaps.

D. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.

E. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.05 SCHEDULE - AS SPECIFIED ON DRAWINGS.

END OF SECTION

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SECTION 230553

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Pipe markers.

1.02 RELATED REQUIREMENTS

A. Section 099123 - Interior Painting: Identification painting.

1.03 REFERENCE STANDARDS

A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2015.

B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2017.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.

C. Product Data: Provide manufacturers catalog literature for each product required.

D. Manufacturer's Installation Instructions: Indicate special procedures, and installation.

E. Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS

2.01 IDENTIFICATION APPLICATIONS

A. Scheduled Equipment: Nameplates.

B. Air Handling Units: Nameplates.

C. Air Terminal Units: Adhesive label or legible hand-written permanent marker.

D. Automatic Control Sensors, Relays, Actuators: Adhesive label or legible hand-written permanent marker at closest junction box.

E. Control Panels: Nameplates.

F. Dampers: Adhesive label or legible hand-written permanent marker at closest junction box.

G. Heat Transfer Equipment: Nameplates.

H. Piping: Pipe markers.

I. Pumps: Nameplates.

J. Tanks: Nameplates.

K. Valves: Tags.

L. Water Treatment Devices: Nameplates.

2.02 NAMEPLATES

A. Manufacturers:

1. Advanced Graphic Engraving, LLC; _____
2. Brimar Industries, Inc; _____: www.pipemarker.com
3. Craftmark Pipe Markers; _____
4. Kolbi Pipe Marker Co; _____

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5. Seton Identification Products, a Tricor Direct Company; _____
6. Substitutions: See Section 016000 - Product Requirements.

B. Letter Color: White.
C. Letter Height: 1/4 inch.
D. Background Color: Black.
E. Plastic: Comply with ASTM D709.

2.03 TAGS

A. Manufacturers:
1. Advanced Graphic Engraving; _____: www.advancedgraphicengraving.com
2. Brady Corporation; _____
3. Brimar Industries, Inc; _____
4. Craftmark Pipe Markers; _____
5. Kolbi Pipe Marker Co; _____
6. Seton Identification Products, a Tricor Company; _____
7. Substitutions: See Section 016000 - Product Requirements.

B. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.

C. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.

2.04 PIPE MARKERS

A. Manufacturers:
1. Brady Corporation; _____
2. Brimar Industries, Inc; _____
3. Craftmark Pipe Markers; _____
4. Kolbi Pipe Marker Co; _____
5. Seton Identification Products, a Tricor Company; _____
6. Substitutions: See Section 016000 - Product Requirements.

B. Color: Comply with ASME A13.1.

C. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

D. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

E. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

PART 3 EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.02 INSTALLATION

A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion.

B. Install tags with corrosion resistant chain.

C. Install plastic pipe markers in accordance with manufacturer's instructions.

D. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

END OF SECTION

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SECTION 230593

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL **UPDATED FULL SECTION**

1.01 GENERAL CONDITIONS **FEBRUARY 2023**

A. Mechanical Contractor shall be responsible to verify if a Commissioning Agent is retained by Owner for the current project. If no Commissioning Agent is hired, then it shall be the responsibility of the Mechanical Contractor to provide commissioning services as per specification section 230800.

B. The Testing, Adjusting, and Balancing (TAB) Contractor is responsible for all work in this section in coordination with BYU Construction Project Manager.

C. Work of this section shall be subject to the requirements of the General Conditions of this contract, the General Mechanical Requirements, General Electrical Requirements and other sections where this work shares a responsibility.

D. Startup of mechanical systems shall be the responsibility of the Mechanical Contractor and his subcontractors with the participation of the Electrical Contractor related to electrical work and the General Contractor related to general construction items.

E. Testing and balancing shall be the responsibility of the Mechanical Contractor under the direction of the General Contractor with the full participation of all the mechanical and electrical trades employed on the project and shall include the participation of an independent testing and balance contractor to coordinate all elements of the TAB work and to perform special technical services outlined herein.

F. TAB Contractor shall coordinate all work with BYU Construction Project Manager. BYU Construction Project Manager shall coordinate work with BYU Commissioning representatives, BYU Air Conditioning Shop representatives, BYU Mechanical Shop representatives, and Owner contracted Digital Controls Supplier and Programmer.

1.02 SECTION INCLUDES

A. Testing, Adjustment, and Balancing of:
   1. Air conditioning equipment including air distribution devices, supply ducts, air handling units, condensing units, fans, coils, and related equipment.
   2. Hydronic systems including pumps, water distributions systems, chillers, boilers, heat exchangers, coils and related equipment.

B. System Commissioning - Extent of Work:
   1. The work required by this section includes, but is not necessarily limited to the following:
      a. The pre-startup inspection of all systems and subsequent correction of any incorrect items. (PFAT)
      b. The initial first run inspections. (FAT)
      c. System operations inspections.
   2. The intent of this work is to provide for proper installation, startup, service and operation of the mechanical systems in preparation for system balance.
   3. Repair, replacement or adjustment of each item shall be performed by the installing contractor.
   4. Involves all new construction and those elements of existing construction which are affected by this project.

C. Testing and Balancing - Extent of Work:
   1. This work incorporates a confirming checkout of construction work, an individual component activation and an overall system activation into one work program which shall serve as the transition period from Contractor's job to Owner's facility.
   2. The TAB Contractor shall be skilled in the operation and manipulation of systems and in the direction of parties involved in the work.

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3. Conduct and participate in the startup and verification of all mechanical systems installed and modified in the contract; test, adjust and balance these systems to obtain optimum performance at a level which minimizes the required energy input, prepare and submit at completion a report of work done and the final system condition obtained, participate in the instruction of Owner's personnel in the proper operation of systems and equipment.
4. Involves all new construction and those elements of existing construction which are affected by this project.

1.03 RELATED REQUIREMENTS

A. Section 012100 - Allowances: Inspection and testing allowances.

B. Section 014000 - Quality Requirements: Employment of testing agency and payment for services.

C. Section 019113 - General Commissioning Requirements: Commissioning requirements that apply to all types of work.

D. Section 250500 - Common Work Results for Integrated Automation.

1.04 REFERENCE STANDARDS

A. Testing, Adjusting, and Balancing Bureau (TABB) - International Standards for Environmental Systems Balance.

B. AABC (NSTSB) - AABC National Standards for Total System Balance, 7th Edition; 2016.

C. ASHRAE Std 110 - Methods of Testing Performance of Laboratory Fume Hoods; 2016.

D. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems; 2008.

E. NEBB (TAB) - Procedural Standards for Testing Adjusting and Balancing of Environmental Systems; 2015, with Errata (2017).

F. SMACNA (TAB) - HVAC Systems Testing, Adjusting and Balancing; 2002.

1.05 DEFINITIONS

A. Adjusting: Varying of system flow by modifying settings of dampers and valves, in combination with varying speeds to obtain optimum operating conditions for the entire system.

B. Balancing: Proportioning of air and hydronic flows through system mains, branches, and terminal devices using standardized procedures to obtain specified air or hydronic flow while imposing the least amount of restriction on the HVAC system.

C. Testing: Use of specialized and calibrated instruments to measure temperatures, pressures, rotational speeds, electrical characteristics, air and hydronic flow in velocities or quantities used in evaluating the performance of a HVAC system.

1.06 QUALITY ASSURANCE

A. Representatives of the General Contractor, Mechanical Contractor, etc., and the Electrical Contractor shall be available on a daily basis through the commissioning and adjustment period. These representatives shall be experienced journeymen with prior experience in system operation and with specific experience on the construction project.

B. Qualifications of Test and Balance Firm:
1. Testing and Balancing shall be performed by a testing agency who specializes in testing, adjusting and balancing of heating, ventilating, air-moving equipment, air-conditioning systems and hydronic systems and have a minimum of one year of experience.
2. Testing agency shall have successfully completed a minimum of five projects of similar size and scope.
3. Testing agency shall be a certified member to TABB, AABC, and/or NEBB.

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4. Test and Balance Firm shall provide documentation of items 1 - 3 prior to start of project.
5. Balance agencies approved for this work:
    a. Payson Sheet Metal, Payson, UT. (801) 465-3018, office@paysonsheetmetal.com
    b. Substitutions: See Section 012500. Alternate contractors require owner approval. See Mechanical Bid Breakdown form.

C. Certifications:
1. TAB technician shall be certified by a nationally recognized certifying agency.

D. Perform total system balance in accordance with Testing, Adjusting and Balancing Bureau (TABB) – Quality Assurance Program for Environmental Systems Balance, AABC National Standards for Field Measurements and Instrumentation and/or Total System Balance and/or NEBB Quality Assurance Program – Conformance Certification.

E. The balancing work including air and hydronic portions shall be performed by the same firm having total responsibility for the final testing, adjusting and balancing of the entire system.

F. The independent testing and balancing firm shall furnish all necessary tools, scaffolding and ladders that are required and shall provide all required instruments, take all readings and make all necessary adjustments.

G. After all tests and adjustments are made, a detailed written report shall be prepared and submitted for review, and shall bear the signature of the professional supervising the work. Final acceptance of this project will not be made until a complete and satisfactory report is received. Furnish two (2) copies of the report.

H. Testing of laboratory fume hoods **(when fume hoods are included in project)**:
1. Product Data sheets for all equipment proposed for use in on-site as-installed testing.
2. Sample Test Report.
3. List of laboratory fume hoods to be tested. Submit a minimum of one week prior to commencement of testing.
4. Test data demonstrating that each type of fume hood provided for the project has been successfully tested in the factory as per requirements of Section 115313.

1.07 PROJECT CONDITIONS

A. Testing, adjusting and balancing shall commence after HVAC systems installation is complete and in working order. Associated areas of general construction shall be in place including interior and exterior doors, windows, walls and ceilings.

1.08 SPECIAL WARRANTY

A. Provide warranty for period of 120 days following submission of completed report, during which time, Owner may request a recheck of up to 10% of total number of terminals, or resetting of any outlet, coil, or device listed in the report.

B. Warranty shall meet the requirements of the following program(s):
1. TABB – International Quality Assurance Program
2. AABC - National Project Performance Guarantee
3. NEBB - Conformance Certification

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PFAT (PRE-FUNCTIONAL ACCEPTANCE TESTING)

A. If a Commissioning Agent other than the balance firm is employed on the project, the PFAT requirements shall be performed by the commissioning firm. Otherwise the requirements shall be performed by the balance firm.

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B. Prior to the commencing of testing, adjusting and balancing of environmental system(s), verify the following conditions:
   1. Removal of shipping stops.
   2. Vibration isolators properly aligned and adjusted.
   3. Flexible connections properly aligned.
   4. Belts properly adjusted.
   5. Belts guards and safety shields in place.
   6. Systems are started and operating in a safe and normal condition.
   7. Thermal overload protection is in place for fans, pumps, chillers, and other equipment.
   8. Safety controls, safety valves and high or low limits in operation.
   9. All systems properly filled.
   10. Pumps are rotating correctly.
   11. Start-up/construction strainers have been removed and all pertinent strainers are clean and in place.
   12. Gauges and/or test ports are properly located for balancing.
   13. Service and balance valves are fully open.
   14. Hydronic systems are pressure tested, flushed, filled, and properly vented.
   15. Leak testing on duct system has been performed in accordance with SMACNA standards or as specified.
   16. Air coil fins are cleaned and combed.
   17. Access doors are closed and duct end caps are in place.
   18. Air outlets are installed and connected.
   19. Fans and motors are rotating correctly.
   20. Duct and fan systems are clean.
   21. Final filters are clean and properly installed.
   22. Automatic and manual dampers are installed correctly, operable and fully open.
   23. Fire and volume dampers are in place and open.
   24. Temperature control systems are installed, complete and operable.
   25. Voltages match nameplate.
   26. All interlocks are wired and verified.
   27. All other items necessary to provide for proper startup.
      a. If deficiencies are evident, submit Deficiency Report to Engineer/Architect. Do not begin testing, adjusting and balancing of environmental systems until deficiencies have been remedied.

3.02 FIRST RUN INSPECTION

A. If a Commissioning Agent other than the balance firm is employed on the project, the first run inspection requirements shall be performed by the commissioning firm. Otherwise the requirements shall be performed by the balance firm.

B. Verify that Prestartup Inspection has been successfully completed to ensure proper operation.

C. Check for the following items:
   1. All specified air and water filters installed.
   2. Excessive vibration or noise.
   3. Loose components.
   4. Initial control settings.
   5. Motor amperages.
   6. Heat buildup in motors, bearings, etc.
   7. Control system is properly calibrated and functioning as required.

D. Correct all items which are not operating properly.

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3.03 FAT (FUNCTIONAL ACCEPTANCE TESTING)

A. If a Commissioning Agent other than the balance firm is employed on the project, the FAT requirements shall be performed by the commissioning firm. Otherwise the requirements shall be performed by the balance firm.

B. Observe mechanical systems under operating conditions for up to six months' time (one seasonal change) to insure proper operation under varying conditions, such as day-night and heating-cooling.
   1. Check the following items:
      a. Visual checks to air flow for "best guess" settings for preparation for system air balancing under section applying.
      b. Control operation, on-off sequences, system cycling, etc.
      c. Visual checks of water flow, seals, packing safety valves, operation pressures and temperature.
      d. Cleaning of excessive oil or grease.
      e. Dampers close tightly.
      f. Valves close tightly.
      g. System leaks.
      h. All other items pertaining to the proper operation of the mechanical system whether specifically listed or not.

3.04 TOTAL MECHANICAL SYSTEM BALANCE

A. The mechanical systems balance involves elements of the work of the General Contractor, the Electrical Contractor, the Mechanical Contractor, the Sheet Metal Contractor and the Controls Contractor. Total system balance requires all elements be not only individually correct, but also correct as a composite system. Therefore, participation of all parties shall be required in the test and balance procedure.

B. Prior to the beginning of the work, a written description of the balance methods, equivalent to be used, and procedures of action shall be submitted to the Engineer/Owner for review and comment.

C. The testing and balance specialist shall review the contract drawings during the bid period and shall advise the Engineer of any modifications to the layout which may be needed to facilitate the balance procedure. Modifications will be incorporated into the contract by Addendum during the bidding period.

D. The test and balance specialist shall visit the project at 50%, 80% and 90% completion, making a thorough inspection of those items which will affect his subsequent work and provide a report. Mechanical Contractor shall coordinate progress visits with test and balance specialist and BYU Project Manager. Test and balance specialist shall advise the Contractor in writing, with a copy to the Engineer/Architect, of any work required by the contract which is not being performed adequately. This is in addition to the regular inspection efforts of the Architect and Engineer. Particularly note the needed valves, dampers, access doors, thermometers, pressure gauges, belts and drives, diffuser styles, strainers and filters, etc.

3.05 MAJOR EQUIPMENT

A. The Testing and Balancing Contractor shall work with the Controls Contractor, and Electrician in placing heat exchangers, pumps, fans and other major equipment in operation. The factory representative of the equipment manufacturer shall also participate in a team effort to place the system(s) in operation, adapt to all anticipated operating modes and make adjustments as required to obtain correct operation. The Design Engineer and the Owner's Representative shall witness the final operating sequences.

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3.06 CONTROL SYSTEMS

A. The Testing and Balancing Contractor shall go through the entire control system with the Controls Contractor, verifying proper operation of each and every device and the proper function of each system. Certify such effort in the report.

3.07 ON SITE FUME HOOD TESTING (WHEN FUME HOODS ARE INCLUDED IN PROJECT)

A. General: Test fume hoods as installed to assess airflow velocity, airflow visualization, and level of containment. Perform tests with static mode (set sash position) conditions. Conduct testing as outlined below for 100% of the hoods provided in the Project.

B. Preparation: Visit the project site to confirm that construction activities related to the fume hood system(s) and equipment are complete. Review design documents and Contractor's submittals. Verify that mechanical ventilation systems serving the space are functioning and operating in the normal mode. Notify Owner in writing, if conditions exist which preclude proper fume hood testing. Starting of testing constitutes acceptance of site conditions.

C. Testing Requirements:
   1. Perform the following tests, in order:
      a. Airflow Velocity Test.
      b. Airflow Visualization Test.
      c. Tracer Gas Containment Test (Where lab safety level requires, as per BYU Risk Management).
   2. If more than one test procedure is selected, proceed to the next test only if any unsafe condition discovered during current test has been successfully rectified.
   3. Airflow Velocity Test: Comply with Section 9 of NEBB (FHT) Fume Hood Testing Standard - current edition.
   4. Airflow Visualization Test: Comply with Section 10 of NEBB (FHT) Fume Hood Testing Standard - current edition.
   5. Tracer Gas Containment Test (Where lab safety level requires, as per BYU Risk Management):
      a. Conduct a static mode test of the hood and laboratory configuration. Conduct testing in accordance with ASHRAE Std 110, except as modified herein:
         1) Test hood with simulated scientific apparatus set-up within the hood. Apparatus to consist of: two (2) each 1 gal. round paint cans, one (1) 1' by 1' by 1' cardboard box, and three (3) each 6" by 6" by 12" high cardboard boxes. Position these items from 6 to 10 inches behind the sash, randomly distributed, and supported off of the work surface by 2 inch by 2 inch by 2 inch block of any material.
         2) 6 liters per minute release rate for tracer gas.
         3) Conduct only at the center position for the manikin.
         4) Each tracer gas test duration to be 5 minutes.
         5) Acceptable test results will be 0.05 PPM or better.
         6) At the conclusion of each 5-minute test there will be three rapid walk-by at 1' behind the manikin. Each walk-by to be spaced 30 seconds apart. If a rise in test gas concentration occurs, it cannot exceed 0.10 ppm and must return to 0.05 ppm within 15 seconds.
         7) There must be a minimum of three and a maximum of five people in the space in which the fume hood is located during the test procedure.
         8) Representatives of the Architect, Engineer, Owner, and Contractor must witness the tests.
         9) Test of Alarm: Shut off the fume hood exhaust and verify that the individual fume hood alarm activates.
         10) Test individual controls: Test any controls that are provided at the fume hood such as unoccupied cycle override, alarm override, etc.

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6. Reporting Requirements: Organize and include, at a minimum, the following information:
    a. Report Title.
    b. Report Certification.
    c. Table of Contents.
    d. Report Summary/ Remarks.
    e. Appropriate Forms.
    f. Instrument Calibration.
    g. List of Abbreviations Used.
    h. A room layout drawing for each tested item. Identify: walls; doors; fume hood(s); other present environmental enclosures (e.g. biological safety cabinet(s), laminar flow hood(s), canopy hood(s), etc.); location and airflow pattern of all air supply, return, and exhaust grilles, registers and diffusers.

3.08 AIR SYSTEM BALANCE

A. Before any adjustments are made, check the systems for such items as dirty filters, duct leakage, filter leakage, damper leakage, equipment vibrations, correct damper operations, etc. Adjust all fan systems major duct sections, registers, diffusers, etc., to deliver design air quantities within ±5%. Individual air outlets, when one of three or more serve a space may have a tolerance of ±10% of the average.

B. Adjust supply, exhaust and recirculation air systems toward air quantities shown on drawings. Establish a proper relationship between supply and exhaust. Follow proportional balance procedures outlined by AABC, SMACNA and/or TABB for such work.

C. All thermal boxes, air flow measuring stations, and other devices shall be calibrated and verified for proper function.

D. Distribution system shall be further adjusted to obtain uniform space temperatures free from objectionable drafts and noise within the capabilities of the system. Any changes to the design are to be submitted for approval and fully documented.

E. Exchange sheaves and/or belts as needed to adjust the RPM of all fans so they handle specified air quantity.

F. All balance procedures shall follow allowed procedure from the REFERENCE STANDARDS section (1.04 above).

G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

3.09 HYDRONIC SYSTEMS

A. Before adjustments are made, clean strainers, check temperature control valve operations, check pump rotation, adjust pressure reducing valves, as required by sections, 3.01, 3.02, 3.03 of this specification section. Assure that system water treatment has been inspected and approved by Owner water treatment specialist.

B. Using system flow meters, pressure gauges, and/or contact pyrometer, adjust the quantity of fluid handled by each pump and supplied to each coil, heat exchanger, etc., to meet design requirements. Adjust hydronic systems to provide ±10% of required design quantities.
    1. Remove and trim pump impellers where throttling, and/or speed control exceeds 10% of adequate flow.

C. Verify all hydronic system controls for proper function for coils, heat exchangers, and all other equipment with control valves.

D. Use proportional balance techniques so that in every case, at least one terminal valve is set for full flow at wide open, and at least one branch is wide open at full flow, other equivalent.

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3.10 MISCELLANEOUS

A. Observe and note all furnished thermal overload protection in the data sheets. If thermal overload protection is incorrect, the trade which furnished the overload devices shall furnish and install the correct size overload protection devices. It shall be the responsibility of the balancing firm to confirm that proper overload protection has been installed at the completion of the job.

B. Measure and set any special conditions such as minimum air quantities; coordinate outside air, return air and relief air damper operation; check and adjust outside and return air intakes so that the system will deliver substantially the same volume on either; make tests and record data as required in "REPORT" below.

C. Permanently mark setting of valves, dampers, and other adjustment devices allowing for settings to be restored. Set and lock memory stops.

D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

E. Upon request, based on perceived need, make 24-hour space temperature recordings. Any required re-balance of the system shall be performed without additional cost to the project.

F. Upon request, a representative of the balancing firm performing the work shall demonstrate fluid flow quantities shown in the report by reading back outlets or terminals selected specifically or at random by the Design Engineer, or the Owner. It is understood that the operating mode of the system shall be the same for read-back as it was during balancing. If any system is found to be outside the specified balance requirements, the balancing agency shall re-balance the entire system and resubmit a new balance report at no cost to the Owner.

3.11 REPORT

A. Provide (1) one bound report and (1) one searchable electronic pdf copy containing a general information sheet listing instruments used, method of balancing, altitude correction, and manufacturer's grille, register and diffuser data.

B. Electric Motors:
   1. Manufacturer.
   2. Model/Frame.
   3. HP/BHP.
   4. Phase, voltage, amperage; nameplate, actual, no load.
   5. RPM.
   6. Service factor.
   7. Starter size, rating, heater elements.
   8. Sheave Make/Size/Bore.

C. Belt Drives:
   1. Identification/location.
   2. Required driven RPM.
   3. Drive and sheave on fan or other device, record bore size, outside diameter of sheave or pitch diameter or make and model of sheave, and RPM
   4. Belt, manufacturer, size and quantity.
   5. Motor sheave, record bore size, outside diameter of sheave or pitch diameter or make and model of sheave, and RPM
   6. Center to center distance, maximum, minimum, and actual.
   7. Rotational direction, recorded on motor and drive side of fan

D. Pumps:
   1. Identification/number.

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2. Location, clearly identified on the balance reports, and clearly shown on a set of 11”x17” mechanical plans.
3. Manufacturer.
4. Size/model.
5. Impeller.
6. Service.
7. Design flow rate, pressure drop.
8. Actual flow rate, pressure drop.
9. Discharge pressure.
10. Suction pressure.
11. Total operating head pressure.
12. Shut off, discharge and suction pressures.
13. Shut off, total head pressure.

E. Combustion Equipment:
1. Boiler manufacturer.
2. Location, clearly identified on the balance reports, and clearly shown on a set of 11”x17” mechanical plans.
3. Model number.
4. Serial number.
5. Water flow, design and actual.
6. Heat output, design and actual entering and leaving water temperatures with calculated heat output.

F. Air Cooled Condensers:
1. Identification/number.
2. Location, clearly identified on the balance reports, and clearly shown on a set of 11”x17” mechanical plans.
3. Manufacturer.
4. Model number.
5. Serial number.
6. Entering DB air temperature, design and actual.
7. Leaving DB air temperature, design and actual.
8. Number of compressors, refrigerant suction/discharge pressures.
9. Refrigerant type.

G. Chillers:
1. Identification/number.
2. Location, clearly identified on the balance reports, and clearly shown on a set of 11”x17” mechanical plans.
3. Manufacturer.
4. Capacity.
5. Model number.
6. Serial number.
7. Evaporator entering water temperature, design and actual.
8. Evaporator leaving water temperature, design and actual.
9. Evaporator pressure drop, design and actual.
10. Evaporator water flow rate, design and actual.
11. Condenser entering water temperature.
12. Condenser pressure drop, design and actual.
13. Condenser water flow rate, design and actual.

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14. Number of compressors, refrigerant suction/discharge pressures.
15. Refrigerant type.

H. Cooling Tower:
1. Tower identification/number.
2. Location, clearly identified on the balance reports, and clearly shown on a set of 11”x17” mechanical plans.
3. Manufacturer.
4. Model number.
5. Serial number.
6. Rated capacity.
7. Entering air WB temperature, specified and actual.
8. Leaving air WB temperature, specified and actual.
9. Ambient air DB temperature.
10. Condenser water entering temperature.
11. Condenser water leaving temperature.
12. Condenser water flow rate.
13. Fan RPM.

I. Heat Exchangers:
1. Identification/number.
2. Location, clearly identified on the balance reports, and clearly shown on a set of 11”x17” mechanical plans.
3. Service.
4. Manufacturer.
5. Model number.
6. Serial number.
7. Primary water entering temperature, design and actual.
8. Primary water leaving temperature, design and actual.
9. Primary water flow, design and actual.
10. Primary water pressure drop, design and actual.
11. Secondary water leaving temperature, design and actual.
12. Secondary water flow, design and actual.
13. Secondary water pressure drop, design and actual.

J. Cooling Coils:
1. Identification/number.
2. Location, clearly identified on the balance reports, and clearly shown on a set of 11”x17” mechanical plans.
3. Service.
4. Manufacturer.
5. Water flow, design and actual.

K. Heating Coils and ATU Reheat Coils:
1. Identification/number.
2. Location, clearly identified on the balance reports, and clearly shown on a set of 11”x17” mechanical plans.
3. Service.
4. Manufacturer.
5. Water flow, design and actual.

L. Electric Duct Heaters and ATU Reheat :
1. Manufacturer.

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2. Identification/number.
3. Location, clearly identified on the balance reports, and clearly shown on a set of 11”x17” mechanical plans.
4. Model number.
5. Design kW.
6. Number of stages, control type.
7. Phase, voltage, amperage.
8. Test voltage (each phase).
9. Test amperage (each phase).
10. Air flow, specified and actual.
11. Temperature rise, specified and actual.

M. Air Moving Equipment:
1. Location, clearly identified on the balance reports, and clearly shown on a set of 11”x17” mechanical plans.
2. Manufacturer.
3. Model number.
4. Serial number.
5. Arrangement/Class/Discharge.
6. Air flow, specified and actual.
7. Return air flow, specified and actual.
8. Outside air flow, specified and actual.
9. Static pressure profile across each component.
10. Total static pressure (total external), specified and actual.
11. Inlet pressure.
12. Discharge pressure.
13. Filter type, MERV rating, sizes and quantity.
14. Filter differential pressure.

N. Return Air/Outside Air:
1. Identification/location, clearly identified on the balance reports, and clearly shown on a set of 11”x17” mechanical plans.
2. Design air flow.
3. Actual air flow.
4. Design return air flow.
5. Actual return air flow.
6. Design outside air flow.
7. Actual outside air flow.
8. Return air temperature.
9. Outside air temperature.
10. Mixed air temperature.
11. Design outside/return air ratio.
12. Actual outside/return air ratio.

O. Exhaust/Relief Air Fans:
1. Identification/location, clearly identified on the balance reports, and clearly shown on a set of 11”x17” mechanical plans.
2. Manufacturer.
3. Model number.
4. Serial number.

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5. Air flow, specified and actual, equipment data sheet shall show inlet totals and a fan flow rate measured nearest possible to fan to quantify leakage rate for exhaust fans.
6. Total static pressure (total external), specified and actual.
7. Inlet pressure.
8. Discharge pressure.
9. Fan RPM.

P. Duct Traverses:
1. System zone/branch.
2. Duct size.
3. Area.
4. Design air flow.
5. Test velocity.
6. Test air flow.
7. Duct static pressure.
8. Air temperature.
9. Air correction factor, if required, by necessary device..

Q. Duct Leak Tests:
1. Description of ductwork under test.
2. Duct design operating pressure.
3. Duct design test static pressure.
4. Duct capacity, air flow.
5. Maximum allowable leakage duct capacity times leak factor.
6. Test apparatus:
   a. Blower.
   b. Orifice, tube size.
   c. Orifice size.
   d. Calibrated.
7. Test static pressure.
8. Test orifice differential pressure.
9. Leakage.

R. Air Flow Measuring Stations:
1. Identification/location, clearly identified on the balance reports, and clearly shown on a set of 11”x17” mechanical plans.
2. System.
3. Size.
4. Area.
5. Calibration factor, and method used for calibration.
6. Design air flow.
7. Test velocity.
8. Test air flow.

S. Room Pressure Monitors:
1. Identification/location, clearly identified on the balance reports, and clearly shown on a set of 11”x17” mechanical plans.
2. Manufacturer.
3. Model number.
4. Design differential pressure/setpoint.
5. Actual differential pressure.
6. Supply air CFM.

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7. Return/exhaust air CFM.

T. Air Terminal Unit Data:
   1. Manufacturer.
   2. Type, constant, variable, cooling only, dual duct.
   3. Identification/number.
   4. Location, clearly identified on the balance reports, and clearly shown on a set of 11”x17” mechanical plans.
   5. Inlet size.
   6. K-factor
   7. Minimum design air flow.
   8. Maximum cooling design air flow.
   9. Maximum cooling actual air flow.
   10. Maximum heating design air flow.
   11. Maximum heating actual air flow.
   12. Unoccupied design air flow.
   13. Unoccupied actual air flow.

U. Air Distribution Tests:
   1. Air terminal number
      a. This number is to correlate to a set of 11”x17” mechanical plans with the numbers clearly identified, and in which it is easy to see supply, return, and exhaust air ducts, see section above.
   2. Room number/location, the room numbers shown on the report are to correlate to a set of 11”x17” mechanical plans with the numbers clearly identified, and in which it is easy to see supply, return, and exhaust air inlets and outlets.
   3. Terminal type.
   4. Terminal size.
   5. Area factor, when used for balancing, all units for area shall be clearly identified and shall all be recorded on the report using the same units. If different units are used on the report, then the report will be rejected, and the balance report will be changed such that only one unit of area is shown on the reports.
   6. Design air flow.
   7. Test (final) air flow.
   8. Percent of design air flow.

V. Water Flow Measuring Stations:
   1. Identification/number.
   2. Location, clearly identified on the balance reports, and clearly shown on a set of 11”x17” mechanical plans.
   3. Size.
   4. Manufacturer.
   5. Model number.
   6. Serial number.
   7. Design flow rate.
   8. Design pressure drop.
   9. Actual/final pressure drop.
   10. Actual/final flow rate.
   11. Calibration factor, and method used for calibration.

W. Water Flow Balancing Valves:

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1. Identification/location, the numbers on the report are to correlate to a set of 11”x17” mechanical plans with the numbers clearly identified, and in which it is easy to see supply and return; and the difference between chilled water and heating water
2. Manufacturer.
3. Design flow rate.
4. Actual inlet and outlet pressure.
5. Actual flow rate (GPM), all pressure dependent valves with fixed or changing orifice type valves shall have recorded flow rates. For systems that have automatic or pressure independent control valves, the actual flows shall not be recorded unless there is a measuring device in the piping. Pressure readings that show the valve has the required pressures to function is all that is required. For valves that have flow setpoints that need to be set, the reports shall clearly show the final setpoints on these types of valves.
6. Setpoint identification/number.

X. Balancing data sheets shall indicate the required and actual CFM of all supply, return and exhaust outlets or inlets, and be totaled and summarized by systems.

Y. Hydronic balancing data sheets shall list required temperature or pressure differentials used for balancing coils, radiators, condensers, etc. Sheets shall show in comparison final as-balanced versus design values.

Z. Include a reduced set of contract drawings with inlets, and outlets marked for easy identification using the same identification method used in the data sheets.

AA. Note any abnormal or notable conditions not covered in the above.

AB. Keep a daily log of all work performed, with a list of work scheduled for each day and the workers on the job.

END OF SECTION

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SECTION 230713
DUCT INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Duct insulation.
B. Duct liner.
C. Insulation jackets.

1.02 RELATED REQUIREMENTS

A. Section 078400 - Firestopping.
B. Section 099113 - Exterior Painting: Painting insulation jackets.
C. Section 099123 - Interior Painting: Painting insulation jackets.
D. Section 220553 - Identification for Plumbing Piping and Equipment.
E. Section 230553 - Identification for HVAC Piping and Equipment.
F. Section 233100 - HVAC Ducts and Casings: Glass fiber ducts.

1.03 REFERENCE STANDARDS

A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.
C. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2013.
D. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2017.
E. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2016.
F. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013.
G. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014.
H. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2013).
I. ASTM C916 - Standard Specification for Adhesives for Duct Thermal Insulation; 2014.
J. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material); 2016.
K. ASTM C1290 - Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts; 2016.
L. ASTM C1410 - Standard Specification for Cellular Melamine Thermal and Sound-Absorbing Insulation; 2014.
M. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.
N. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.
O. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015.

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P. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Rev. 2009).

Q. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

C. Manufacturer's Instructions: Indicate installation procedures necessary to ensure acceptable workmanship and that installation standards will be achieved.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section with not less than three years of documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified in this section, with minimum three years of experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

C. Materials not protected will be rejected and replaced at installers expense.

1.07 FIELD CONDITIONS

A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER, FLEXIBLE

A. Manufacturer:
   1. CertainTeed Corporation; _____: www.certainteed.com
   2. Johns Manville; _____
   3. Knauf Insulation;
   4. Owens Corning Corporation; _____
   5. Substitutions: See Section 016000 - Product Requirements.

B. Insulation: ASTM C553; flexible, noncombustible blanket.
   1. 'K' value: 0.36 at 75 degrees F, when tested in accordance with ASTM C518.
   2. Maximum Service Temperature: 250 degrees F.
   3. Maximum Water Vapor Absorption: 5.0 percent by weight.

C. Vapor Barrier Jacket:
   1. 0.0032 inch vinyl or Kraft paper with glass fiber yarn and bonded to aluminum film.
   2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.

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3. Secure with staples, bands, wires, pressure sensitive tape, anchors, corner angles and similar accessories as recommended by insulation manufacturer.

D. Vapor Barrier Tape:
1. Vinyl or kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

E. Outdoor Vapor Barrier Mastic:
1. Manufacturers:
a. Carlisle HVAC Products;_____
b. Childers;_____
c. Henry Co.;
d. W. R. Meadows;
e. Substitutions: See Section 016000 - Product Requirements.
2. Single component, liquid applied, elastomeric polymer based vapor barrier and insulation adhesive.

F. Tie Wire: Stainless steel, 16 gage, 0.0508 inch diameter.

2.03 GLASS FIBER, RIGID

A. Manufacturer:
1. CertainTeed Corporation; _____: www.certainteed.com
2. Johns Manville; _____
3. Knauf Insulation; _____
4. Owens Corning Corporation;
5. Substitutions: See Section 016000 - Product Requirements.

B. Insulation: ASTM C612; rigid, noncombustible blanket.
1. 'K' Value: 0.24 at 75 degrees F, when tested in accordance with ASTM C518.
2. Maximum Service Temperature: 250 degrees F.
3. Maximum Water Vapor Absorption: 5.0 percent.
4. Maximum Density: 10 lb./cu ft.

C. Indoor Vapor Barrier Jacket:
1. Vinyl or Kraft paper with glass fiber yarn and bonded to aluminized film.
2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
3. Secure with pressure sensitive tape.

D. Vapor Barrier Tape:
1. Vinyl or Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.
2. Vapor barrier tape shall be compatible with vapor barrier.

E. Indoor Vapor Barrier Finish:
1. Vinyl emulsion type acrylic, compatible with insulation, white color.

F. Exterior Vapor Barrier Finish:
1. Manufacturers:
a. Carlisle HVAC Products, Hard cast;
b. Childers;
c. Henry Co.;
d. W. R. Meadows;
2. Single component, liquid applied, elastomeric polymer based vapor barrier and insulation adhesive.

G. Insulation Fastening:

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1. Stick pins: Galvanized steel, welded with integral or press-on head or mastic applied.
2. Tie Wire: Stainless steel, 16 gage, 0.0508 inch diameter.

2.04 JACKETS

A. Aluminum Jacket: ASTM B209 (ASTM B209M). Use only where specified on drawings.
   1. Thickness: 0.016 inch sheet.
   2. Finish: Smooth.
   3. Joining: Longitudinal slip joints and 2 inch laps.
   4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
   5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

2.05 DUCT LINER

A. Manufacturers:
   1. CertainTeed Corporation; _____: www.certainteed.com
   2. Johns Manville; _____
   3. Knauf Insulation; _____
   4. Owens Corning Corporation;
   5. Substitutions: See Section 016000 - Product Requirements.

B. Glass Fiber Insulation: Non-corrosive, incombustible glass fiber complying with ASTM C1071; flexible blanket; impregnated surface and edges coated with poly vinyl acetate polymer, acrylic polymer, or black composite.
   1. Fungal Resistance: No growth when tested according to ASTM G21.
   2. Apparent Thermal Conductivity: Maximum of 0.31 at 75 degrees F.
   3. Service Temperature: Up to 250 degrees F.
   4. Rated Velocity on Coated Air Side for Air Erosion: 5,000 fpm, minimum.
   5. Minimum Noise Reduction Coefficients:
      a. 1/2 inch Thickness: 0.30.
      b. 1 inch Thickness: 0.45.
      c. 1-1/2 inches Thickness: 0.60.
      d. 2 inch Thickness: 0.70.

C. Adhesive: Waterproof, fire-retardant type, ASTM C916.

D. Liner Fasteners: Galvanized steel, welded with integral or press-on head.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that ducts have been tested before applying insulation materials.

B. Verify that surfaces are clean, foreign material removed, and dry.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. Insulated ducts conveying air below ambient temperature:
   1. Provide insulation with vapor barrier jackets.
   2. Insulate all unlined ductwork with 1” thick flexible glass fiber insulation, unless otherwise noted on drawings.
   3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
   4. Insulate entire system including fittings, joints, and flanges. Finish with tape.

D. Insulated ducts conveying air above ambient temperature:
   1. Provide with or without standard vapor barrier jacket.

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2. Insulate all unlined ductwork with 1” thick flexible glass fiber insulation, unless otherwise noted on drawings.
3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
4. Insulate entire system including fittings, joints, and flanges. Finish with tape.

E. Lined Ductwork:
1. Except as otherwise indicated, omit external insulation on ductwork where internal insulation or sound absorbing linings have been installed.
2. Line all supply air ductwork mains with 1” thick acoustic lining, unless otherwise noted on drawings.

F. External Duct Insulation Application:
1. All external ductwork shall have a fluid applied vapor barrier adhesive applied directly to ductwork.
2. Insulate all ductwork with 2" thick rigid glass fiber insulation.
3. Secure insulation to ductwork with wires and seal insulation joints with vapor barrier adhesive or tape.
4. Cover insulated ductwork with aluminum jacket with seams and drain holes located on bottom side of horizontal ductwork.

G. Duct Liner Application:
1. Adhere insulation with adhesive for 90 percent coverage.
2. Secure insulation with mechanical liner fasteners. Refer to SMACNA (DCS) for spacing.
3. Seal and smooth joints. Seal and coat transverse joints.
4. Seal liner surface penetrations with adhesive.
5. Duct dimensions indicated are net inside dimensions required for air flow. Increase duct size to allow for insulation thickness.

END OF SECTION

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SECTION 230719
HVAC PIPING INSULATION

PART 1 GENERAL UPDATED FEB 2024.

1.01 SECTION INCLUDES

A. Refrigeration piping insulation.

B. Flexible removable and reusable blanket insulation.

C. Jackets and accessories.

1.02 RELATED REQUIREMENTS

A. Section 078400 - Firestopping.

B. Section 099123 - Interior Painting: Painting insulation jacket.

C. Section 232113 - Hydronic Piping: Placement of hangers and hanger inserts.

D. Section 232300 - Refrigerant Piping: Placement of inserts.

1.03 REFERENCE STANDARDS

A. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2013).

B. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement; 2007 (Reapproved 2013).

C. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2017.

D. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation; 2013.

E. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2016.

F. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2017.

G. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation; 2016a.

H. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013.

I. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2016.

J. ASTM C585 - Standard Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing; 2010 (Reapproved 2016).

K. ASTM C591 - Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation; 2017.

L. ASTM C610 - Standard Specification for Molded Expanded Perlite Block and Pipe Thermal Insulation; 2016.

M. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2013).

N. ASTM C1410 - Standard Specification for Cellular Melamine Thermal and Sound-Absorbing Insulation; 2014.

O. ASTM C1695 - Standard Specification for Fabrication of Flexible Removable and Reusable Blanket Insulation for Hot Service; 2010 (Reapproved 2015).

P. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2016.

Q. ASTM D570 - Standard Test Method for Water Absorption of Plastics; 1998 (Reapproved 2010).

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R. ASTM D1056 - Standard Specification for Flexible Cellular Materials--Sponge or Expanded Rubber; 2014.

S. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics; 2012.

T. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.

U. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.

V. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

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.

B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum three years of experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

C. Materials not protected will be rejected and replaced at installers expense.

1.07 FIELD CONDITIONS

A. Maintain ambient conditions required by manufacturers of each product.

B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

B. Insulation shall have a ‘K’ value that meets the minimum requirements of the latest International Energy Conservation Code (IECC).

2.02 GLASS FIBER

A. Manufacturers:
   1. CertainTeed Corporation
   2. Johns Manville Corporation
   3. Knauf Insulation;
   4. Owens Corning Corporation;
   5. Armstrong World Industries;
   6. Substitutions: See Section 016000 - Product Requirements.

B. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.
   1. 'K' Value: ASTM C177, 0.24 at 75 degrees F.
   2. Maximum Service Temperature: 850 degrees F.

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3. Maximum Moisture Absorption: 0.2 percent by volume.

C. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible, with wicking material to transport condensed water to the outside of the system for evaporation to the atmosphere.
   1. 'K' Value: ASTM C177, 0.23 at 75 degrees F.
   2. Maximum Service Temperature: 220 degrees F.
   3. Maximum Moisture Absorption: 0.2 percent by volume.

D. Insulation: ASTM C547 and ASTM C795; semi-rigid, noncombustible, end grain adhered to jacket.
   1. 'K' Value: ASTM C177, 0.24 at 75 degrees F.
   2. Maximum Service Temperature: 650 degrees F.
   3. Maximum Moisture Absorption: 0.2 percent by volume.

E. Vapor Barrier Jacket: White kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches.

F. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

G. Vapor Barrier Lap Adhesive: Compatible with insulation.

H. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

I. Fibrous Glass Fabric:
   1. Cloth: Untreated; 9 oz/sq yd weight.
   2. Blanket: 1.0 lb/cu ft density.
   3. Weave: 5 by 5.

J. Indoor Vapor Barrier Finish:
   1. Cloth: Untreated; 9 oz/sq yd weight.
   2. Vinyl emulsion type acrylic, compatible with insulation, black or white color.

K. Outdoor Vapor Barrier Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

L. Outdoor Breather Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

M. Insulating Cement: ASTM C449.

2.03 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Manufacturers:
   1. Aeroflex USA, Inc; Aerocel Stay-Seal with Protape (SSPT):
   2. Armacell LLC; AP Armaflex:
   3. K-Flex USA LLC; K-Flex Titan:
   4. Substitutions: See Section 016000 - Product Requirements.

B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1; use molded tubular material wherever possible.
   1. Minimum Service Temperature: Minus 40 degrees F.
   2. Maximum Service Temperature: 180 degrees F.
   3. Connection: Waterproof vapor barrier adhesive.

C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

2.04 JACKETS

A. PVC Plastic.
   1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
      a. Minimum Service Temperature: 0 degrees F.
      b. Maximum Service Temperature: 150 degrees F.
      c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.

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d. Thickness: 10 mil.
e. Connections: Brush on welding adhesive.

2. Covering Adhesive Mastic: Compatible with insulation.

B. ABS Plastic:

1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
   a. Minimum Service Temperature: Minus 40 degrees F.
   b. Maximum Service Temperature: 180 degrees F.
   c. Moisture Vapor Permeability: 0.012 perm inch, when tested in accordance with ASTM E96/E96M.
   d. Thickness: 30 mil.
   e. Connections: Brush on welding adhesive.

C. Aluminum Jacket: ASTM B209 (ASTM B209M) formed aluminum sheet.

1. Thickness: 0.016 inch sheet.
2. Finish: Embossed.
3. Joining: Longitudinal slip joints and 2 inch laps.
4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

D. Stainless Steel Jacket: ASTM A666, Type 304 stainless steel.

1. Thickness: 0.010 inch.
2. Finish: Smooth.
3. Metal Jacket Bands: 3/8 inch wide; 0.010 inch thick stainless steel.

2.05 ACCESSORIES

A. General Requirements:

1. Provide required accessories in accordance with and subject to the recommendations of the insulation manufacturer.
2. Furnish compatible materials which do not contribute to corrosion, soften, or otherwise attack surfaces to which applied, in either the wet or dry state.
3. Comply with ASTM C795 requirements for materials to be used on stainless steel surfaces.
4. Supply materials that are asbestos free.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that piping has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. Exposed Piping: Locate insulation and cover seams in least visible locations.

D. Insulated pipes conveying fluids below ambient temperature; insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, in-line pump bodies, and expansion joints.

E. Orient all insulation and jacketing seams on bottom of pipe.

F. Glass fiber insulated pipes conveying fluids below ambient temperature:

1. Provide vapor barrier jackets, factory-applied or field-applied; secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.

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G. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

H. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.

I. For fan coil unit and VAV reheat coil piping, conveying fluids over 140 degrees F, do not insulate (valve train) shut-off valves, strainers, control valve, air bleeds, circuit setters, and unions at equipment. Insulate pipe from last fitting to coil if 12" long or greater. Bevel and seal ends of insulation.

J. Glass fiber insulated pipes conveying fluids above ambient temperature.
   1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.
   2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.

K. Inserts and Shields:
   1. Application: Piping 1-1/2 inches diameter or larger.
   2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
   3. Insert location: Between support shield and piping and under the finish jacket.
   4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
   5. Insert Material: Hydrous calcium silicate insulation, for 2-1/2" pipe or larger, or other heavy density insulating material suitable for the planned temperature range.

L. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Section 078400.

M. **Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish exposed pipe in Mechanical Equipment Rooms with PVC jacket and fitting covers. Finish exposed pipe in Finished Spaces with paper and foil scrim suitable for application of paint or PVC jacket and fitting covers. Coordinate with Owner**. _____.
Updated Feb 2024

N. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping. Provide two coats of UV resistant finish for flexible elastomeric cellular insulation without jacketing.

O. Heat Traced Piping: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size insulation large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

P. **Black Steel Chilled Water Piping:**
   1. **After fabrication assemble and installation of piping, scrape and brush piping free of scale, dirt, and loose material and wipe clean with solvent moistened cloth.**
   2. **Using brush or roller, coat entire piping surfaces with primer and finish coats of water based vinyl acrylic system of RustOleum "RustOCrylic" 5700 system or equivalent by Sherwin Williams. Coating system includes red primer (5769), grey coat (5781), black finish coat (5779). Final film thickness shall be 4-6 mils.**
   3. **Allow coating to dry and harden thoroughly before applying insulation.**
      Updated Feb 2024

3.03 PIPING INSULATION SCHEDULE

A. Condensate and Equipment Drain Water below 60 Deg F:
   1. All Pipe Sizes: Insulation shall be one of the following:
      a. Flexible elastomeric:

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1) 1/2 inch thick.
b. Glass fiber:
1) 1/2 inch thick.

B. Chilled Water, above 40 Deg F:
1. All pipe sizes: Insulation shall be one of the following:
a. Flexible elastomeric:
1) 1 1/2 inch thick.
b. Glass fiber:
1) 1 1/2 inch thick.

C. Heating Hot Water Supply and Return, 200 Deg F and below:
1. 1 1/2 inch and smaller:
a. Glass fiber:
1) 1 1/2 inch thick.
2. 2 inch and larger:
a. Glass fiber:
1) 2 inch thick.

D. Refrigerant Suction and Hot Gas Piping:
1. All pipe sizes:
a. Flexible elastomeric:
1) 1 inch thick.

3.04 INDOOR FIELD APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory applied jacket, install the field applied jacket over the factory applied jacket

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping:
1. PVC:
a. White: 30 mils thick.

3.05 OUTDOOR FIELD APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory applied jacket, install the field applied jacket over the factory applied jacket

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, exposed:
1. Aluminum, Embossed:
a. 0.016 inch thick.

END OF SECTION

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SECTION 230800

COMMISSIONING OF HVAC

PART 1 GENERAL

1.01 SUMMARY

A. See Section 019113 - General Commissioning Requirements for overall objectives; comply with the requirements of Section 019113.

B. This section covers the Contractor's responsibilities for commissioning; each subcontractor or installer responsible for the installation of a particular system or equipment item to be commissioned is responsible for the commissioning activities relating to that system or equipment item.

C. The Commissioning Authority (CxA) will be employed by the owner and directs and coordinates all commissioning activities and provides Prefunctional Checklists and Functional Test Procedures for Contractor's use.

D. The entire HVAC system is to be commissioned, including commissioning activities for the following specific items:
   1. Control system.
   2. Major and minor equipment items.
   3. Piping systems and equipment.
   4. Ductwork and accessories.
   5. Terminal units.
   6. Sound control devices.
   7. Vibration control devices.
   8. Variable frequency drives.
   9. Special Ventilation:
      a. Fume hoods.
      b. Laboratory pressurization.
      c. Specialty fans.
      d. Egress pressurization.
   10. Other equipment and systems explicitly identified elsewhere in Contract Documents as requiring commissioning.

E. The Prefunctional Checklist and Functional Test requirements specified in this section are in addition to, not a substitute for, inspection or testing specified in other sections.

1.02 RELATED REQUIREMENTS

A. Section 017800 - Closeout Submittals: Scope and procedures for operation and maintenance manuals and project record documents.

B. Section 017900 - Demonstration and Training: Scope and procedures for Owner personnel training.

C. Section 019113 - General Commissioning Requirements: Commissioning requirements that apply to all types of work.

D. Section 230923 - Direct-Digital Control System for HVAC.

E. Section 230913 - Instruments and Control Elements.

F. Section 230993 - Sequence of Operations for HVAC Controls.

G. Section 230593 - Testing, Adjusting, and Balancing for HVAC.

1.03 REFERENCE STANDARDS

A. ASHRAE Guideline 1.1 - The HVAC&R Technical Requirements for the Commissioning Process; 2007 (Errata 2012).

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1.04 SUBMITTALS

A. Updated Submittals: Keep the Commissioning Authority informed of all changes to control system documentation made during programming and setup; revise and resubmit when substantial changes are made.

B. Prefunctional Checklists and Functional Test Procedures for Control System: Detailed written plan indicating the procedures to be followed to test, checkout and adjust the control system prior to full system Functional Testing; include at least the following for each type of equipment controlled:
   1. System name.
   2. List of devices.
   3. Step-by-step procedures for testing each controller after installation, including:
      a. Process of verifying proper hardware and wiring installation.
      b. Process of downloading programs to local controllers and verifying that they are addressed correctly.
      c. Process of performing operational checks of each controlled component.
      d. Plan and process for calibrating valve and damper actuators and all sensors.
      e. Description of the expected field adjustments for transmitters, controllers and control actuators should control responses fall outside of expected values.
   4. Copy of proposed log and field checkout sheets to be used to document the process; include space for initial and final read values during calibration of each point and space to specifically indicate when a sensor or controller has “passed” and is operating within the contract parameters.
   5. Description of the instrumentation required for testing.
   6. Indicate what tests on what systems should be completed prior to TAB using the control system for TAB work. Coordinate with the Commissioning Authority and TAB contractor for this determination.

C. Startup Reports, Prefunctional Checklists, and Trend Logs: Submit for approval of Commissioning Authority.

D. HVAC Control System O&M Manual Requirements. In addition to documentation specified elsewhere, compile and organize at minimum the following data on the control system:
   1. Specific step-by-step instructions on how to perform and apply all functions, features, modes, etc. mentioned in the controls training sections of this specification and other features of this system. Provide an index and clear table of contents. Include the detailed technical manual for programming and customizing control loops and algorithms.
   2. Full as-built set of control drawings.
   3. Full as-built sequence of operations for each piece of equipment.
   4. Full points list; in addition to the information on the original points list submittal, include a listing of all rooms with the following information for each room:
      a. Floor.
      b. Room number.
      c. Room name.
      d. Air handler unit ID.
      e. Reference drawing number.
      f. Air terminal unit tag ID.
      g. Heating and/or cooling valve tag ID.
      h. Minimum air flow rate.
      i. Maximum air flow rate.
   5. Full print out of all schedules and set points after testing and acceptance of the system.
   6. Full as-built print out of software program.
   7. Electronic copy on disk of the entire program for this facility.

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8. Marking of all system sensors and thermostats on the as-built floor plan and HVAC drawings with their control system designations.
9. Maintenance instructions, including sensor calibration requirements and methods by sensor type, etc.
10. Control equipment component submittals, parts lists, etc.
11. Warranty requirements.
12. Copies of all checkout tests and calibrations performed by the Contractor (not commissioning tests).
13. Organize and subdivide the manual with permanently labeled tabs for each of the following data in the given order:
    a. Sequences of operation.
    b. Control drawings.
    c. Points lists.
    d. Controller and/or module data.
    e. Thermostats and timers.
    f. Sensors and DP switches.
    g. Valves and valve actuators.
    h. Dampers and damper actuators.
    i. Program setups (software program printouts).

E. Project Record Documents: See Section 017800 for additional requirements.
1. Submit updated version of control system documentation, for inclusion with operation and maintenance data.
2. Show actual locations of all static and differential pressure sensors (air, water and building pressure) and air-flow stations on project record drawings.

F. Training Plan: In addition to requirements specified in Section 017900, include:
1. Follow the recommendations of ASHRAE Guideline 1.1.
2. Control system manufacturer's recommended training.
3. Demonstration and instruction on function and overrides of any local packaged controls not controlled by the HVAC control system.

G. Training Manuals: See Section 017900 for additional requirements.
1. Provide a USB drive with one electronic copy of the controls training manuals in a separate manual from the O&M manuals.

PART 2 PRODUCTS

2.01 TEST EQUIPMENT

A. CxA shall provide all standard testing equipment required to verify startup and initial checkout and required functional performance testing; unless otherwise noted such testing equipment will NOT become the property of Owner.

B. Equipment-Specific Tools: Where special testing equipment, tools and instruments are specific to a piece of equipment, are only available from the vendor, and are required in order to accomplish startup or Functional Testing, provide such equipment, tools, and instruments as part of the work at no extra cost to Owner; such equipment, tools, and instruments are to become the property of Owner.

PART 3 EXECUTION

3.01 PREPARATION

A. Cooperate with the Commissioning Authority in development of the Prefunctional Checklists and Functional Test Procedures.

B. Furnish additional information requested by the Commissioning Authority.

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C. Prepare a preliminary schedule for HVAC pipe and duct system testing, flushing and cleaning, equipment start-up and testing, adjusting, and balancing start and completion for use by the Commissioning Authority; update the schedule as appropriate.

D. Notify the Owner's representative at least 48 hours before pipe and duct system testing, flushing, cleaning, startup of each piece of equipment and testing, adjusting, and balancing will occur; when commissioning activities not yet performed or not yet scheduled will delay construction, notify at least 48 hours ahead of time and be proactive in seeing that the Owner's representative has the scheduling information needed to efficiently execute the commissioning process.

E. Upon approval from the Owner's representative, put all HVAC equipment and systems into operation and continue operation during each working day of testing, adjusting, and balancing and commissioning, as required.
   1. Include cost of sheaves and belts that may be required for testing, adjusting, and balancing.

F. Provide test holes in ducts and plenums to allow air measurements and air balancing; close with an approved plug.

G. Provide temperature and pressure taps in accordance with Contract Documents.

3.02 INSPECTING AND TESTING - GENERAL

A. CxA shall submit startup plans, startup reports, and Prefunctional Checklists for each item of equipment or other assembly to be commissioned.

B. CxA shall perform the Functional Tests for each item of equipment or other assembly to be commissioned.

C. Valve stroke, damper stroke, and VFD speed setup and check (CxA to coordinate this work with the control contractor through Owner's representative. Control contractor to initiate commands and adjustment of devices. CxA to verify.) :
   1. For all valve/damper actuator positions and VFD speeds checked, verify the actual position or speed against the control system readout.
   2. Set pump/fan to normal operating mode.
   3. If valve/damper: command closed; visually verify that valve/damper is closed and adjust output zero signal as required. If VFD: command to minimum speed; visually verify VFD at minimum speed and adjust output zero signal as required.
   4. If valve/damper: command open; visually verify that valve/damper is open and adjust output signal as required. If VFD: command to maximum speed if conditions allow (if unable to run equipment at full speed test VFD with load disconnected); visually verify VFD at maximum speed and adjust output signal as required.
   5. Command valve/damper or VFD speed to a few intermediate positions. Verify position/signal.
   6. If actual valve/damper position or VFD speed does not reasonably correspond, replace actuator, signal conditioner, or add pilot positioner (for pneumatics).

D. Coil Valve Leak Through Check:
   1. Air Handler and FCU Coil Drain Down: Not for 3-way valves.
      a. Put systems in normal mode.
      b. If cooling coil valve, remove all call for cooling; if heating coil valve, put system in full cooling.
      c. Close isolation valve on supply side of coil, open air bleed cap, open drain-down cock and drain water from coil.
      d. If water does not stop draining, there may be a leak through the control valve.
      e. Return all to normal when done.

E. Deficiencies: Correct deficiencies and re-inspect or re-test, as applicable, at no extra cost to Owner.

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3.03 TAB COORDINATION

A. TAB: Testing, adjusting, and balancing of HVAC.

B. Coordinate commissioning schedule with TAB schedule through the Owner's representative.

3.04 CONTROL SYSTEM FUNCTIONAL TESTING

A. Prefunctional Checklists for control system components will require a signed and dated certification that all system programming is complete as required to accomplish the requirements of Contract Documents and the detailed Sequences of Operation documentation submittal.

B. Do not start Functional Testing until all controlled components have themselves been successfully Functionally Tested in accordance with Contract Documents.

C. Using a skilled technician who is familiar with this building, execute the Functional Testing of the control system as required by the Commissioning Authority.

D. Functional Testing of the control system constitutes demonstration and trend logging of control points monitored by the control system.
   1. Perform all trend logging specified in Prefunctional Checklists and Functional Test procedures.

E. Functionally Test integral or stand-alone controls in conjunction with the Functional Tests of the equipment they are attached to, including any interlocks with other equipment or systems; further testing during control system Functional Test is not required unless specifically indicated below.

F. Demonstrate the following to the Commissioning Authority during testing of controlled equipment; coordinate with commissioning of equipment.
   1. Setpoint changing features and functions.
   2. Sensor calibrations.

G. Demonstrate to the Commissioning Authority:
   1. That all specified functions and features are set up, debugged and fully operable.
   2. That scheduling features are fully functional and setup, including holidays.
   3. That all graphic screens and value readouts are completed.
   4. Correct date and time setting in central computer.
   5. That field panels read the same time as the central computer; sample 10 percent of field panels; if any of those fail, sample another 10 percent; if any of those fail test all remaining units at no extra cost to Owner.
   6. Functionality of field panels using local operator keypads and local ports (plug-ins) using portable computer/keypad; demonstrate 100 percent of panels and 10 percent of ports; if any ports fail, sample another 10 percent; if any of those fail, test all remaining units at no extra cost to Owner.
   7. Power failure and battery backup and power-up restart functions.
   8. Global commands features.
   9. Security and access codes.
   10. Occupant over-rides (manual, telephone, key, keypad, etc.).
   11. O&M schedules and alarms.
   12. Occupancy sensors and controls.
   13. All control strategies and sequences not tested during controlled equipment testing.

H. If the control system, integral control components, or related equipment do not respond to changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice, under any of the conditions, sequences, or modes tested, correct all systems, equipment, components, and software required at no additional cost to Owner.

3.05 OPERATION AND MAINTENANCE MANUALS

A. See Section 017800 for additional requirements.

B. Add design intent documentation furnished by Architect to manuals prior to submission to Owner.

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C. Submit manuals related to items that were commissioned to Commissioning Authority for review; make changes recommended by Commissioning Authority.

D. Commissioning Authority will add commissioning records to manuals after submission to Owner.

3.06 DEMONSTRATION AND TRAINING

A. See Section 017900 for additional requirements.

B. Demonstrate operation and maintenance of HVAC system to Owner's personnel; if during any demonstration, the system fails to perform in accordance with the information included in the O&M manual, stop demonstration, repair or adjust, and repeat demonstration. Demonstrations may be combined with training sessions if appropriate.

C. These demonstrations are in addition to, and not a substitute for, Prefunctional Checklists and demonstrations to the Commissioning Authority during Functional Testing.

D. Provide hands-on training of Owner's designated personnel on operation and maintenance of the HVAC system, control system, and all equipment items indicated to be commissioned. Provide durations of training as sufficient or as needed.

E. TAB Review: Instruct Owner's personnel during and concurrent with TAB, on the following:
   1. Review final TAB report, explaining the layout and meanings of each data type.
   2. Discuss any outstanding deficient items in control, ducting or design that may affect the proper delivery of air or water.
   3. Identify and discuss any terminal units, duct runs, diffusers, coils, fans and pumps that are close to or are not meeting their design capacity.
   4. Discuss any temporary settings and steps to finalize them for any areas that are not finished.
   5. Other salient information that may be useful for facility operations, relative to TAB.

F. Provide the services of manufacturer representatives to assist where necessary.

END OF SECTION

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SECTION 230913

INSTRUMENTS AND CONTROL ELEMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Air Supply System:
   1. Compressor and receivers.
   2. Pressure regulators.
   3. Particle filters.
   4. Combination filter/regulators.
   5. Airborne oil filters.
   6. Pressure relief valves.
   7. Control and instrumentation tubing.
   8. Refrigerated air dryers.

B. Control panels.

C. Control Valves:
   1. Ball valves.
   2. Globe valves.
   3. Butterfly valves.
   4. Pneumatic actuators (high-temp valves only).
   5. Electronic actuators.

D. Dampers. See Section 233300

E. Damper Actuators:
   1. Pneumatic actuators.
   2. Electric actuators.

F. Humidistats:
   1. Room humidistats.
   2. Limit duct humidistats.

G. Input/Output Sensors:
   1. Temperature sensors.
   2. Humidity sensors.
   3. Static pressure (air pressure) sensors.
   4. Equipment operation (current) sensors.
   5. Digital to pneumatic transducers.
   6. Damper position indicators.
   7. Nitrogen dioxide sensors.
   8. Carbon monoxide sensors.
   9. Carbon dioxide sensors.

H. Thermostats:
   1. Direct Digital Control (DDC) thermostat.
   2. Low-limit temperature cutout switch (freezestat).
   3. Line voltage thermostats.
   4. Room thermostat accessories.

I. Time switches.

J. Transmitters:
   1. Air pressure transmitters.

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2. Air differential pressure transmitters.
3. Liquid pressure transmitters.
4. Liquid differential pressure transmitters.
5. Temperature transmitters.
6. Humidity transmitters.

K. Energy Metering: Refer to section 230519.

L. Flow Sensors:
1. Airflow measurement array (AFMA).
2. Orifice plates.
3. Ultrasonic flow meters.
4. Insertion turbine meters.
5. Insertion magnetic flow meters.
6. Flow switches.

M. Level Instruments:
1. Ultrasonic liquid level transmitter.

N. Level Switches:
1. Ultrasonic level switch.
2. Conductivity Sensors:
   a. Dual point level switch.
   b. Conductivity controller.
   c. Conductivity level probe.
3. Float Sensors:
   a. Float switch.
   b. Boiler water level control.
   c. Multi-level switch kit.
   d. Free-floating/cable float level switch.

1.02 RELATED REQUIREMENTS

A. Section 230519 - Meters and Gages for HVAC Piping: Thermometer sockets, gage taps.

B. Section 230548 - Vibration and Seismic Controls for HVAC Piping and Equipment.

C. Section 230923 - Direct-Digital Control System for HVAC.

D. Section 230943 - Pneumatic Control System for HVAC.

E. Section 232113 - Hydronic Piping: Installation of control valves, flow switches, temperature sensor sockets, gage taps.

F. Section 232114 - Hydronic Specialties.

G. Section 232213 - Steam and Steam Condensate Piping: Installation of control valves, flow switches, temperature sensor sockets, gage taps.

H. Section 233300 - Air Duct Accessories: Installation of automatic dampers.

I. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.

J. Section 262725 - Wiring Devices: Elevation of exposed components.

1.03 REFERENCE STANDARDS

A. AMCA 500-D - Laboratory Methods of Testing Dampers for Rating; 2012.

B. ANSI/FCI 70-2 - Control Valve Seat Leakage; 2013.

C. ASME B1.20.1 - Pipe Threads, General Purpose (Inch); 2013.

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D. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2013.

E. ASTM B32 - Standard Specification for Solder Metal; 2008 (Reapproved 2014).

F. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2011-AMD 1.

G. IEC 60529 - Degrees of Protection Provided by Enclosures (IP Code); 2013-08, with 2015 Corrigendum.

H. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.

I. NEMA DC 3 - Residential Controls - Electrical Wall-Mounted Room Thermostats; 2013.

J. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2015.

K. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Mechanical controls and components shall be furnished by the owner and contractor installed.

B. Start-up / programming / commissioning shall be by owner.

C. Preinstallation Meeting: Conduct a preinstallation meeting at least one week before starting work of this section; require attendance by all affected installers.

D. Scheduling:
   1. Coordination:
      a. Coordinate planning and installation of equipment with parties specified to be involved in the BMS including but not limited to:
         1) Representative from Control Commissioning Specialist/Firm.
         2) Electrical Subcontractor.
         3) Mechanical Contractor.
         4) Owner.
         5) Architect and Consultants.
         6) Balancing Contractor.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide a description and engineering data for each control system component. Include sizing as requested. Provide data for each system component and software module. The description shall include drawings indicating instrument/valve size, trim, flow inserts, and location for each item. The submittal shall correspond to flow and instrumentation requirements indicated in drawings and other specifications.

C. Shop Drawings: Indicate complete operating data, system drawings, wiring diagrams, and a written detailed operational description of sequences. Submit schedule of valves indicating size, flow, trim package, flow control inserts, control signal type, and pressure drop for each valve. For automatic dampers indicate arrangement, velocities, and static pressure drops for each system.

D. Manufacturer's Instructions: Provide for all manufactured components.

E. Operation and Maintenance Data: Include inspection period, cleaning methods, recommended cleaning materials, and calibration tolerances.

F. Project Record Documents: Indicate actual installed locations of control components, including panels, transformers, thermostats, duct pressure sensors, water pressure sensors, building static sensors, etc.
   1. Revise shop drawings to reflect actual installation and operating sequences.

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G. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

H. 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. Designer Qualifications: Design system subject to review of a Professional Engineer experienced in design of this work and licensed in Utah.

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 with minimum three years' experience.

D. Products Requiring Electrical Connection: Listed and classified by testing firm acceptable to the Authority Having Jurisdiction as suitable for the purpose specified and indicated.

1.07 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Correct defective work for a period of two years after Substantial Completion.

C. Provide five year manufacturer's warranty for control air compressors.

PART 2 PRODUCTS

2.01 EQUIPMENT - GENERAL

A. Products Requiring Electrical Connection: Listed and classified by testing firm acceptable to the Authority Having Jurisdiction as suitable for the purpose specified and indicated.

2.02 AIR SUPPLY SYSTEM

A. Compressor and Receivers:
   1. Manufacturers:
      a. Quincy.
      b. Ingersoll Rand.
      c. Substitutions: See Section 016000 - Product Requirements.
   2. Simplex belt driven air compressor and tank unit with belt guard, silencers, flexible connections, air filter, automatic and manual drain assemblies, oil and particle filter for minimum 0.5 micron particles, pressure reducing valves, and pressure relief valves.
   3. Size compressor and storage tank to limit compressor starts to maximum 6 per hour and 30 percent running time.
   4. Pressure Control: Zinc or aluminum castings, rated for service with elastomeric diaphragm, adjustable electric contacts.
      a. Set to start and stop compressor at 80 and 90 psig.

B. Pressure Regulators:
   1. Zinc or aluminum castings, rated for service with elastomeric diaphragm, balanced construction to automatically prevent pressure build up, and producing flat, reduced pressure curve for system capacity demand.

C. Particle Filters:
   1. Zinc or aluminum castings with filtration efficiency at rated air flow of 97 percent, rated for service with threaded connections, quick-disconnect service devices, aluminum bowl or plastic bowl with metal guard equipped with manual drain cock, to separate liquid and solid particles.

D. Combination Filter/Regulators:

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E. Zinc or aluminum castings, rated for service with elastomeric diaphragm, balanced construction to automatically prevent pressure build up, and producing flat, reduced pressure curve for system capacity demand; with threaded pipe connections, quick-disconnect service devices, aluminum bowl or plastic bowl with metal guard equipped with manual drain cock to separate liquid and solid particles.

F. Airborne Oil Filters:
   1. Rated for service with filtration efficiencies of 99.9 percent for particles of 0.025 micron or larger particles of airborne lubricating oil.

G. Pressure Relief Valves:
   1. ASME Code Rated and labeled for high pressure side and sized for installed capacity of pressure regulators at low pressure. Set at maximum 20 percent above low pressure.

H. Control and Instrumentation Tubing:
   1. Copper Tube: ASTM B819 Type K, or ASTM B88 (ASTM B88M) Type K (A), seamless, H or O temper (drawn or annealed).
   2. Polyethylene Tubing: Black, flame retardant, virgin polyethylene, resistant to environmental stress-cracking when tested in accordance with ASTM D1693.

I. Refrigerated Air Dryers:
   1. Manufacturers:
      a. Hankison.
      b. Johnson Controls International, PLC; www.johnsoncontrols.com.
      c. Substitutions: See Section 016000 - Product Requirements.
   2. General Assembly: Self-contained, commercial quality, refrigerated, compressed air dryer complete with heat exchangers, moisture separator, and internal wiring and piping. Provide air inlet and outlet connections connected through manual by-pass valve.
   3. Heat Exchangers: Air to refrigerant coils. Provide centrifugal type moisture separator located at discharge of compressed air complete with automatic trap assembly. Provide automatic control system to bypass refrigeration system on low or no load conditions.
   4. Refrigeration Unit: Hermetically sealed, operating to maintain dew point of 0 degrees F at 100 psig. House in steel cabinet with access door and panel.
   5. Accessories: Air inlet temperature gage, air inlet pressure gage, on/off switch, high temperature light, power on light, refrigerant gage on back, air outlet temperature gage, air outlet pressure gage.

2.03 CONTROL PANELS

A. Unitized cabinet type for each system under automatic control with relays and controls mounted in cabinet and temperature indicators, pressure gages, pilot lights, push buttons and switches flush on cabinet panel face. Furnish stamped steel with hinged door to protect and conceal all control devices. Arrange components neatly to provide adequate maintenance opportunity and proper device function. Label all components, numerically code all piping and wiring. Terminate all wiring at terminal blocks. Provide engraved plastic labels for all panel face devices.
   1. Provide external enclosure for transformers, 120/24 VAC, with maximum 80% VA to operate control system.
      a. Provide with surge suppressor - one per panel.
      b. Provide with circuit protection.
   2. Provide control system service connection for “Laptop” computer access.
   3. Communication wire shall avoid common conduit with AC voltage or inductive loads. All in accordance with National Electric Code, conductors in conduit (3/4" minimum).

B. NEMA 250, general purpose utility enclosures with enameled finished face panel.

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C. Provide common keying for all panels if not located in a controlled area (e.g. a mechanical room behind a locked door).

2.04 CONTROL VALVES

A. Ball Valves and Actuators:
   1. Manufacturers:
      a. Belimo Aircontrols (USA), Inc; _____: www.belimo.com
      b. Johnson Controls International, PLC; _____: www.johnsoncontrols.com
      c. Substitutions: See Section 016000 - Product Requirements.
   2. Service: Use for chilled water, hot water, steam at 15 to 25 psig (104.4 to 172.4), or brine (40 percent glycol).
   3. Flow Characteristic: Include 2-way, 3-way diverting, and 3-way mixing operation configured to fail as indicated on drawings.
   4. Rangeability: 500 to 1.
   5. ANSI Rating: As indicated on drawings.
   6. Leakage: Class IV (0.1 percent of rated capacity) per ANSI/FCI 70-2.
   7. Body Size:
      a. 2-1/2 inches and under:
         1) Connection: NPT.
         2) Materials:
            (a) Body: Brass.
            (b) Ball: 300 series stainless steel.
            (c) Stem: 300 series stainless steel.
            (d) Seat: Graphite-reinforced PTFE with EPDM O-Ring backing.
            (e) Stem Seal: EPDM O-Rings.
            (f) Flow Control Disk: Thermoplastic synthetic-resin.
      b. Service Temperature:
         1) Fluid Side: 0 to 284 degrees F liquid or 25 psig steam.
         2) Ambient Side: From minus 4 to 122 degrees F.
   8. Actuator Requirements:
      a. Assembly: Factory-mounted.
      b. Input: 0-10 VDC, 2-10 VDC, 4-20 mA, 24 VAC, or 120 VAC configured as indicated on drawings.
      c. Accessories: Provide with valve position indicator and manual override.

B. Globe Pattern:
   1. Manufacturers:
      a. Belimo;_____.
      b. Siemens;_____.
      c. Johnson Controls International, PLC; www.johnsoncontrols.com
      d. Substitutions: See Section 016000 - Product Requirements.
   2. Up to 2 inches: Bronze body, stainless steel trim, rising stem, renewable composition disc, screwed ends with backseating capacity repackable under pressure.
   3. Over 2 inches: Iron body, stainless steel trim, rising stem, plug-type disc, flanged ends, renewable seat and disc.
   4. Hydronic Systems:
      a. Rate for service pressure of 150 psig at 250 degrees F.
      b. Replaceable plugs and seats of stainless steel.
      c. Size for 3-5 psig maximum pressure drop at design flow rate.

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d. Two-way valves shall have equal percentage characteristics, three way valves linear characteristics. Size two-way valve operators to close valves against pump shut off head.

C. Butterfly Pattern:
1. Manufacturers:
a. Belimo.
b. Johnson Controls International, PLC; www.johnsoncontrols.com
c. Substitutions: See Section 016000 - Product Requirements.
2. Iron body, stainless steel disc, stainless steel trim, resilient replaceable seat for service to 180 degrees F lug ends, extended neck.
3. Hydronic Systems:
a. Rate for service pressure of 150 psig at 250 degrees F.
b. Size for less than 1 psig maximum pressure drop for isolation valves.
c. Size for 3-5 psig maximum pressure drop at 60% open for modulating control.

D. Pressure Independent Patern:
1. Manufacturers:
a. Belimo, PIQCV or PICCV.
b. Griswold, Pinnacle or PIC-V.
c. Substitutions: See Section 016000 - Product Requirements.
2. Pressure Independent Control Valves shall maintain the required flow rate regardless of pressure changes.
3. Brass body, stainless steel trim, EPDM, Teflon packing material
4. Valves shall spring return to normal position as indicated on freeze, fire, or temperature protection. All other valves shall be fail in place.
5. Select operator for full shut off at maximum pump differential pressure.
6. In locations that utilize pressure independent valves balance valve is not required.

E. Electronic Actuators:
1. Manufacturers:
a. Belimo;_____.
b. Johnson Controls International, PLC; www.johnsoncontrols.com
c. Seimens;
d. Substitutions: See Section 016000 - Product Requirements.
2. Valves shall spring return to normal position as indicated on freeze, fire, or temperature protection.
3. Select actuator for full shut off at maximum pump differential pressure.

2.05 DAMPERS - SEE SECTION 233300

2.06 DAMPER ACTUATORS

A. General: Provide smooth proportional control with sufficient power for air velocities 20 percent greater than maximum design velocity and to provide tight seal against maximum system pressures. Provide spring return for two position control and for fail safe operation.
1. Provide sufficient number of actuators to achieve unrestricted movement throughout damper range.
2. Provide one actuator for maximum 24 sq ft damper section. Size actuator for at least 7 in-lb. per square foot.

B. Pneumatic Actuators:
1. Manufacturers:
a. Flowserve.
b. Siemens.

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c. Johnson Controls International, PLC; www.johnsoncontrols.com
d. Substitutions: See Section 016000 - Product Requirements.
2. Rolling diaphragm piston type with adjustable stops.
3. Pilot Positioners: Starting point adjustable from 3 to 15 psig.

C. Electric Actuators:
1. Manufacturers:
a. Siemens_____.
b. Belimo_____.
c. Honeywell.
d. Johnson Controls International, PLC; www.johnsoncontrols.com
e. Substitutions: See Section 016000 - Product Requirements.
2. Adjustable stroke motor with optional auxiliary end switch and spring return, where required.
3. 0-10 VDC, 2-10 VDC, or 4-20 mA signals for modulating control actuators. 120 or 24 VAC signal for two-position actuators.
4. Actuators shall be powered by 24 VAC or by 120 VAC when coordinated with division 26.

2.07 HUMIDISTATS

A. Limit Duct Humidistats:
1. Insertion, two position type.
2. Throttling Range: Adjustable 2 percent relative humidity.
3. Operating Range: 20 to 80 percent.
4. Maximum Temperature: 150 degrees F.

2.08 INPUT/OUTPUT SENSORS

A. Temperature Sensors:
1. Manufacturers:
a. Veris Industries; _____: www.veris.com
b. Delta; _____.
c. Siemens; _____.
d. Johnson Controls International, PLC; www.johnsoncontrols.com
e. Pyromation;
f. Substitutions: See Section 016000 - Product Requirements.
2. Use thermistor or RTD type temperature sensing elements with characteristics resistant to moisture, vibration, and other conditions consistent with the application without affecting accuracy and life expectancy.
3. Construct RTD of nickel or platinum with base resistance of 1000 ohms at 70 degrees F.
4. 100 ohm platinum RTD is acceptable for hot water applications and if used with project DDC controllers.
5. Temperature Sensing Device: Compatible with project DDC controllers.
6. Performance Characteristics:
a. RTD:
1) 1000 ohm nickel (Johnson Controls International, PLC)
2) Room Sensor Accuracy: Plus/minus 0.50 degrees F minimum.
3) Duct Averaging Accuracy: Plus/minus 0.50 degrees F minimum.
4) Chilled Water Accuracy: Plus/minus 0.50 degrees F minimum.
5) Range according to application.
b. Thermistor:
1) Type II 10k (Siemens) or type III 10k (Delta)
2) Accuracy (All): Plus/minus 0.54 degrees F minimum.
3) Range according to application.

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c. Temperature Transmitter:
   1) Accuracy: 0.10 degree F minimum or plus/minus 0.20 percent of span.
   2) Output: 4 to 20 mA.
d. Sensing Range:
   1) Provide limited range sensors if required to sense the range expected for a respective point.
   2) Use RTD type sensors for extended ranges beyond minus 30 degrees F to 230 degrees F.
   3) Use temperature transmitters in conjunction with RTD's when RTD's are incompatible with DDC controller direct temperature input or distances exceed 10 ft.
e. Wire Resistance:
   1) Use appropriate wire size to limit temperature offset due to wire resistance to 1.0 degree F or use temperature transmitter when offset is greater than 1.0 degree F due to wire resistance.
   2) Compensate for wire resistance in software input definition when feature is available in the DDC controller.
f. Outside Air Sensors: Watertight and airtight inlet fitting, shielded from direct rays of the sun.
g. Immersion Temperature Sensors: A sensor encased in a corrosion-resistant probe inserted into a 4-inch or 6-inch well.
h. Tamper Proof Sensors: Stainless steel cover plate with insulated back.
i. Room Temperature Sensors:
   1) Construct for surface or wall box mounting.
   2) Provide the following:
      (a) Room temperature setpoint reset with adjustable temperature range as required.
      (b) Momentary override request for activation of after-hours operation as required.
      (c) Temperature display as required.
j. Temperature Averaging Elements:
   1) Use averaging elements where prone to stratification with sensor length 8 ft, 16 ft, or 24 ft on all cooling coil, heating coil, and discharge sensors.
   2) Provide for all mixed air sensors regardless of duct size.
k. Insertion Elements:
   1) Use in ducts not affected by temperature stratification or inaccessible for averaging sensors.
   2) Provide dry type, insertion elements for liquids, installed in immersion wells, with minimum insertion length of 2.5 inches.

B. Humidity Sensors:
1. Manufacturers:
   a. Veris Industries; _____: www.veris.com
   b. Dwyer.
   c. Siemens.
   d. Johnson Controls International, PLC; www.johnsoncontrols.com
   e. Substitutions: See Section 016000 - Product Requirements.
2. Duct Mounted Sensor: Voltage type encased in a die-cast metal, weather-proof housing.
   a. Input Power, Voltage Type: Class 2; 12-30 VDC/24 VAC, 15mA max.
   b. Input Power, mA Type: Class 2; Loop powered 12-30 VDC only, 30 mA max.
   c. Output Voltage Type: 3-wire observed polarity.
   d. Output mA Type: 2-wire, not polarity sensitive (clipped and capped).
   e. Humidity:
      1) HS Element: Digitally profiled thin-film capacitive.

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2) Accuracy 2 percent at 10 to 90 percent relative humidity at 77 degrees F.
3) Scaling: 0 to 100 percent RH.

f. Temperature Effect:
1) Duct Mounted: Less than 0.06 percent per degree F. 4 to 20mA or 0-10 VDC.
2) Outdoor Mounted: 4 to 20mA or 0-10 VDC.

g. Hysteresis: 1.5 percent typical.

h. Stability: Plus/minus 1 percent at 68 degrees F (20 degrees C) annually, for two years.

i. Temperature Monitoring:
1) Temperature Transmitter Output: Digital, 4 to 20mA (clipped and capped) or 0-5V/0-10V output.
(a) HO Transmitter Accuracy: Plus/minus 2.3 degrees F.
(b) HD Transmitter Accuracy: Plus/minus 1.0 degree F.

j. Operating Environment:
1) Operating Humidity Range: 0 to 100 percent RH noncondensing.
2) Operating Temperature Range: Minus 40 degrees F to 122 degrees F.

3. Wall Mounted Sensor: Voltage type encased in a plastic housing.

C. Static Pressure (Air Pressure) Sensors:
1. Manufacturers:
a. Veris Industries; _____: www.veris.com
b. Dwyer.
c. Siemens.
d. Setra.
e. Johnson Controls International, PLC; www.johnsoncontrols.com
f. Substitutions: See Section 016000 - Product Requirements.
2. Unidirectional with ranges not exceeding 150 percent of maximum expected input.
3. Temperature compensate with typical thermal error or 0.06 percent of full scale in temperature range of 40 to 100 degrees F.
4. Accuracy: One percent of full scale with repeatability 0.3 percent.
5. Output: 0 to 5 vdc, 0 to 10 vdc, or 4 to 20 mA.
6. Input Power: 24 VAC.

D. Equipment Operation Sensors:
1. Manufacturers:
a. Veris.
b. Johnson Controls International, PLC; www.johnsoncontrols.com
c. Substitutions: See Section 016000 - Product Requirements.
2. Status Inputs for Fans: Differential pressure switch with adjustable range of 0 to 5 inches wg.
3. Status Inputs for Pumps: Differential pressure switch piped across pump with adjustable pressure differential range of 8 to 60 psi.
4. Status Inputs for Electric Motors: Current sensing relay with current transformers, adjustable and set to 175 percent of rated motor current.

E. Nitrogen Dioxide Sensors, for Single-Gang Electrical Box Mounting:
1. Manufacturers:
a. Veris Industries; _____: www.veris.com
b. Senva.
c. Honeywell.
d. Substitutions: See Section 016000 - Product Requirements.
2. General:
a. Provide gas platform, wired to the building controller, with replaceable sensor.

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b. Input Power: Class 2; 15 to 30 VDC, plus/minus 20 percent, 50/60 Hz.
c. Relay Ratings: 1A/30VAC/DC, normally open.
d. Operating Temperature Range: Minus 4 degrees F to 122 degrees F.
e. Operating Humidity Range: 0 to 90 percent RH non-condensing.
f. Protection Class: IP20 in accordance with IEC 60529.
g. Communication: BACnet.

3. Sensor:
a. Sensor Type: Electrochemical.
b. Measurement Range: 0-10 ppm.
c. Accuracy: Plus/minus 5 percent of range at 25 degrees F.
d. Resolution: 0.1 ppm.
e. Sensor Warranty: 2 years from manufacture date minimum.
f. Low Setpoint Value: 1 ppm (fixed).
g. High Setpoint Value: 180 ppm (fixed).
h. Operating Temperature Range: Minus 4 degrees F to 122 degrees F.
i. Operating Humidity Range: 0 to 90 percent RH non-condensing.

F. Carbon Monoxide Sensors, for Single-Gang Electrical Box Mounting:
1. Manufacturers:
a. Veris Industries; _____: www.veris.com
b. Senva.
c. Honeywell.
d. Substitutions: See Section 016000 - Product Requirements.

2. General:
a. Provide gas platform, wired to the building controller, with replaceable sensor.
b. Input Power: Class 2; 15 to 30 VDC/24 VAC plus/minus 20 percent, 50/60 Hz.
c. Relay Ratings: 1A/30VAC/DC, normally open.
d. Operating Temperature Range: Minus 4 degrees F to 122 degrees F.
e. Operating Humidity Range: 0 to 90 percent RH non-condensing.
f. Protection Class: IP20 in accordance with IEC 60529.
g. Communication: BACnet.

3. Sensor:
a. Sensor Type: Electrochemical.
b. Measurement Range: 0 to 200 ppm.
c. Accuracy: Plus/minus 5 percent of range.
d. Resolution: 1 ppm.
e. Sensor Warranty: 2 years from manufacture date.
f. Low Setpoint Value: 25 ppm field adjustable.
g. Operating Temperature Range: Minus 4 degrees F to 122 degrees F.
h. Operating Humidity Range: 0 to 90 percent RH non-condensing.

G. Carbon Dioxide Sensors, Duct and Wall:
1. Manufacturers:
a. Veris Industries; _____: www.veris.com
b. Delta.
c. Siemens.
d. Substitutions: See Section 016000 - Product Requirements.

2. General: Provide non-dispersive infrared (NDIR), diffusion sampling CO2 sensors with integral transducers and linear output.
3. Air Temperature: Range of 32 to 122 degrees F.
4. Relative Humidity: Range of 0 to 95 percent (non-condensing).

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5. Power Input: Class 2; 12 to 30VDC or 24VAC 60 Hz; 100mA max.
6. Calibration Characteristics:
   a. Automatically compensating algorithm for sensor drift due to sensor degradation.
   b. Maximum Drift: 2 percent.
   c. User calibratable with a minimum calibration interval of 5 years.
7. Construction:
   a. Sensor Chamber: Non-corrosive material for neutral effect on carbon dioxide sample.
   b. Provide duct mounted sensors with duct probe designed to protect sensing element from dust accumulation and mechanical damage.
   c. Housing: High impact plastic.
8. Optional Equipment
   a. Temperature Sensor:
      1) Solid state, integrated circuit; Accuracy: Plus/minus 2 degrees F; Resolution: 0.2 degrees F; Output Range: 50 to 95 degrees F.

2.09 THERMOSTATS

A. Electric Room Thermostats:
   1. Manufacturers:
      a. Honeywell.
      b. Carrier.
      c. Johnson Controls International, PLC;
      d. Trane.
      e. Substitutions: See Section 016000 - Product Requirements.
   2. Type: NEMA DC 3, 24 volts, with setback/setup temperature control.
   3. Service: Cooling and heating.
   4. Covers: Locking with set point adjustment, with thermometer.

B. Low-Limit Temperature Cutout Switch (low-limit thermostat or freezestat):
   1. Manufacturers:
      a. Johnson Controls International, PLC; _____:
      b. Siemens Industry, Inc; _____:
      c. Substitutions: See Section 016000 - Product Requirements.
   2. Configuration: Vapor-filled capillary.
   3. Sensing Length: 20 feet.
   4. Setpoint Adjust: Screw, concealed.
   5. Switch Type: SPDT, snap-action, form C in dust-protected enclosure.
   6. Sensing Range: 35-45 degrees F.
   7. Mounting: Locate as indicated on drawings.
   8. Field Interface: Connect as indicated on drawings.
   9. Electrical Rating: Pilot duty, 125 VA at 125 to 600 VAC.
   10. Where three or more freezestats are required, provide a panel to display status of each sensor and a single pushbutton point of reset.

C. Line Voltage Thermostats:
   1. Manufacturers:
      a. Honeywell.
      b. Carrier.
      c. Johnson Controls International, PLC; www.johnsoncontrols.com
      d. Substitutions: See Section 016000 - Product Requirements.
   2. Integral manual On/Off/Auto selector switch, single or two pole as required.
   3. Dead Band: Maximum 2 degrees F.

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4. Cover: Locking with set point adjustment_____.
5. Rating: Motor load.

D. Room Thermostat Accessories:
1. Insulating Bases: For thermostats located on exterior walls.

2.10 TIME SWITCHES

A. Input Voltage: 120 or 208-277 VAC.

B. Enclosure: lockable hasp

C. Manufacturers:
1. Tork.
2. Substitutions: See Section 016000 - Product Requirements.

D. Electromechanical Time Clocks
1. General: Heavy duty synchronous, self-starting high torque timing motor, 24 hour Automatic ON/OFF daily control, manual override until the next regularly scheduled ON or OFF setting.

E. Digital Time Switch
1. General: Day combinations for 7-5-2 speed programming, scheduling, manual daylight saving switch, manual override until the next regularly scheduled ON or OFF, am/pm clock format, battery backup.

2.11 TRANSMITTERS

A. Air Pressure Transmitters:
1. Manufacturers:
a. Veris Industries; _____: www.veris.com
b. Siemens.
c. Setra.
d. Dwyer.
e. Honeywell.
f. Johnson Controls International, PLC; www.johnsoncontrols.com
g. Rosemount.
h. Substitutions: See Section 016000 - Product Requirements.
2. General: Provide dry media differential pressure transducers to monitor duct, room, and building pressure.
a. Media Compatibility: Dry air.
b. Input Power: Class 2; 12 to 30 VDC; 2-wire: 20 mA max.
c. Output: Field selectable, 0-10 VDC or 4-20 mA.
d. Pressure Ranges: By application, field selectable.
e. Accuracy: Plus/minus 1 percent f.s. (full scale) of selected range (combined linearity & hysteresis).
f. Operating Environment:
1) 32 degrees F to 140 degrees F.
2) 0 to 90 percent RH noncondensing.

B. Water Pressure Transmitters (Liquid Differential Pressure Transmitters):
1. Manufacturers:
a. Veris Industries; _____: www.veris.com
b. Siemens.
c. Setra.
d. Dwyer.
e. Honeywell.

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f. Johnson Controls International, PLC; www.johnsoncontrols.com
g. Rosemount.
h. Substitutions: See Section 016000 - Product Requirements.

2. General: Provide wet media differential pressure transducers with 6 ft (1.83 m) armored cable, to allow remote pressure sensing capability using existing plumbing runs.
   a. Input Power: Class 2; 15 to 30 VDC, 24VAC nominal, 60 Hz.
   b. Output: 3-wire transmitter; user-selectable, 4 to 20 mA (0 to 5V/0 to 10V).
   c. Operating Conditions:
      1) Sensor Operating Range: Minus 4 degrees F to 185 degrees F.
      2) Operating Environment: 14 degrees F to 122 degrees F; 10 to 90 percent RH noncondensing.
   d. Enclosure: NEMA 250, type as per application.

C. Temperature Transmitters:
1. Manufacturers:
   a. Minco.
   b. Substitutions: See Section 016000 - Product Requirements.
2. Output: 4 to 20 mA over specified range, linear with temperature.
3. Calibration accuracy: ±0.1% of span.
4. Linearity: Referenced to actual sensor temperature.
5. Adjustments: Zero and span, ±5% of span. Factory set.
6. Ambient temperature effects: ±0.013% of span per °C (±0.025% of span per °C for spans less than 55°C.)
7. Supply voltage: 8.5 to 35 VDC. Voltage effect ±0.001% of span per volt. Reverse polarity protected.
8. Warmup drift: ±0.1% of span max., with V_supply = 24 VDC and R_loop = 250 Ohms. Stable within 30 minutes.
9. Minimum span: 50°F.

2.12 ENERGY METERING

A. Hydronic BTU (J) Meters: See section 230519

2.13 FLOW SENSORS

A. Airflow Measurement Array (AFMA):
1. Manufacturers:
   a. Ebtron.
   b. Substitutions: See Section 016000 - Product Requirements.
2. Airflow Straighteners:
   a. Provide AFMA's with an airflow straightener if required by the AFMA manufacturer's published installation instructions.
   b. Straightener: Contained inside a flanged sheet metal casing, with the AFMA located as specified according to the published recommendations of the AFMA manufacturer.
   c. Construction to consist of 0.125 inch aluminum honeycomb with the straightener depth not less than 1.5 inches.
3. Air Temperature: AFMA shall be certified by the manufacturer to be accurate as specified over a temperature range of minus 20 degrees F to 140 degrees F.
4. Sensor Probes: Distribute the sensing elements across the duct section in the pattern and quantity specified or as recommended by the installation instructions of the AMFA manufacturer.
5. Accuracy: Plus/minus 5 percent over a range of 300 fpm to 5,000 fpm.

B. Orifice Plates:

1. Fabricate orifice plate of austenitic stainless steel sheet of 0.125 inches nominal thickness with an accuracy of plus/minus 1 percent of full flow.
2. Configuration: Flat plate within 0.002 inches.
3. Orifice Surface Roughness: Not-to-exceed 20 micro-inches.
4. Orifice Cylindrical Face Thickness: Not-to-exceed 2 percent of the pipe inside diameter or 12.5 percent of the orifice diameter, whichever is smaller.
5. Upstream Edge of the Orifice Plate: Utilize in all applications except steam flow measurement in horizontal pipelines.

C. Ultrasonic Flow Meters:
1. Provide ultrasonic flow meters complete with matched transducers, self-aligning installation hardware, and transducer cables.
2. Optimize ultrasonic transducers for the specific pipe and process conditions for the application.
3. Flow Meter Accuracy: Plus/minus 1 percent of rate from 0.98 fps to 40 fps.
4. Include dry contact outputs, 4 to 20 mA, 0 to 10 VDC.

D. Insertion Turbine Flow Meters:
1. Manufacturers:
   a. Onicon.
   b. Substitutions: See Section 016000 - Product Requirements.
2. Furnish dual axial turbine flowmeter with all installation hardware required to enable insertion and removal of the meter without system shutdown.
3. All Parts: Meet or exceed the pressure classification of the piping system installed in.
4. Accuracy for the Insertion Turbine Flow Meter: Plus/minus 0.5 percent of the rate at calibrated velocity, within plus/minus of the rate over a 10 to 1 turn down and within plus/minus 2 percent of the rate over a 50 to 1 turn down.
5. Repeatability: Plus/minus 0.25 percent of reading.
6. The meter flow sensing element to operate over a range suitable for the installed location with a pressure loss limited to 1 percent of operating pressure at maximum flow rate.
7. Include dry contact, 4 to 20 mA, or 0 to 10 VDC output.
8. Fabricate the turbine rotor assembly of Series 300 stainless steel and use Teflon seats.
9. Ambient temperature range: -5 to 160 degrees F.

E. Insertion Magnetic Flow Meters:
1. Manufacturers:
   a. Onicon.
   b. Substitutions: See Section 016000 - Product Requirements.
2. Provide insertion type magnetic flow meters with all installation hardware necessary to enable the insertion and removal of the meter without system shutdown.
3. All Parts: Meet or exceed the pressure classification of the piping system installed in.
4. Accuracy: +/- 1 percent of the reading from 2 fps to 20 fps.
5. Fabricate wetted material parts from 300 series stainless steel.
6. Include 4 to 20 mA, dry contact pulse output, 0 to 10 VDC.

F. Flow Switches:
1. Manufacturers:
   a. Siemens
   b. Honeywell.
   c. Penn.
   d. Substitutions: See Section 016000 - Product Requirements.
2. Repetitive Accuracy: Plus/minus 10 percent of actual flow setting.
3. Provide Form C snap-action contacts, rated for the application.

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2.14 LEVEL INSTRUMENTS

A. Compact Visual Level Indicators:
   1. Provide for high-visibility level indication in tight spaces.
   2. Housing:
      a. Material: Stainless steel.
   3. Mounting Type: Provide mounting type best suited for the application with an indication length of 12 inches, minimum.
   4. Incorporate a pressure tight housing with internal float that magnetically activates external level indication flags, switches, or transmitter.
   5. Service: Clean, low viscosity liquids.
   6. Pressure/Temperature Limits:
      a. Greater than or equal to 300 degrees F, 400 psi.
   7. Switch Modules:
      a. Clamp on to the level indicator, SPST, rated 0.17 A at 120 VAC.
      b. Maximum temperature of 450 degrees F, 316 stainless steel with 1/2 inch male NPT conduit connection.

B. Ultrasonic Liquid Level Transmitter:
   1. Manufacturers:
      a. Flowline:
      b. Substitutions: See Section 016000 - Product Requirements.
   2. Characteristics: Non-contact liquid level sensor intrinsically safe for use in hazardous locations and provides continuous level measurement up to 18 feet. LCD display, NEMA 4X enclosure, simple push button calibration for all user set points, adjustable dead band and range filters.
   3. Range: 6 inches to 18 feet.
   4. Accuracy: plus/minus 0.25% of range
   5. Resolution: 0.125"
   6. Dead band: 6"
   7. Beam width: 8" conical
   8. Configuration: Push button
   9. Memory: Non-volatile
   10. Display type: LCD, 4-digit
   11. Display units: inches or cm
   12. Supply voltage: 12 - 32 VDC
   13. Signal output: 4-20 mA, two wire
   14. Signal fail-safe: Reverts to safe state during echo loss
   15. Process temp.: -4 degrees to 140 degrees F
   16. Pressure: 30 psi @ 25 degrees C
   17. Approvals: CSA: Class I, Groups A, B, C, D; Class II, Groups E, F, G; Class III; T3C

2.15 LEVEL SWITCHES

A. Manufacturers:
   1. Flowline.
   2. Emerson.
   3. Walchem.
   4. Substitutions: See Section 016000 - Product Requirements.

B. Conductivity Sensors:
   1. Conductivity Controller:
   2. Conductivity Level Probe:

C. Float Sensors:

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1. Side Mounted-Chamber Type Level Control:
    a. Wetted Materials:
        1) Body: Carbon steel.
        2) Float and Trim: 303 stainless steel.
    b. Temperature Limits:
        1) Ambient Temperature: 212 degrees F.
    c. Pressure Limits:
        1) 800 psi at 100 degrees F.
    d. Enclosure Rating: NEMA 250 general purpose.
    e. Switch Type: SPDT snap switch.
    f. Agency Approvals: UL, none on HM switch.
2. Level Switches - Horizontal:
    a. Service: Compatible liquids.
    b. Wetted Materials: Polypropylene.
    c. Temperature Limit:
        1) 14 degrees F to 176 degrees F.
    d. Pressure Limit: 218 psi.
    e. Enclosure Rating: General purpose.
    f. Switch Type: Hermetically sealed reed switch, reversible for NO or NC.
    g. Agency Approvals: CEA.
3. Free-Floating Level Switch:
    a. Wetted Materials:
        1) Enclosure: Polypropylene.
        2) Cable: PVC.
    b. Operating Temperature: 32 degrees F (0 degrees C) to 122 degrees F (50 degrees C).
    c. Pressure Limits: 29 psi.
    d. Enclosure Rating: IP68 in accordance with IEC 60529.
    e. Switch Type: Normally Open (SPST) Emptying Function.
    f. Electrical Rating: 10 A at 250 VAC.
    g. Mounting Orientation: Vertical.
    h. Agency Approval: UL or CE or CSA.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that systems are ready to receive work.

C. Sequence work to ensure installation of components is complementary to installation of similar components in other systems.

D. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install owner furnished control system(s) as indicated on the project documents, point list, interoperability tables, drawings and as described in these specifications. Installation shall be for a complete and working mechanical control system. Provide all required installation materials, installation labor, start-up, training, and final project documentation and warranty. The work shall include all labor, materials, special tools, equipment, enclosures, power supplies, project specific software configurations, graphics, programming, sequencing, and database entries, interfaces, wiring,

tubing, installation, labeling, calibration, documentation, submittals, testing, verification, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, warranty, specified services, and any other items required for a complete and fully functional Controls System unless otherwise indicated by owner.

C. Control wiring:
   1. In concealed locations above lay-in ceilings low voltage conductor may be installed without conduit. Low voltage conductor shall be UL listed Article 725 Plenum Cable. Install the cable parallel to building walls.
   2. In all other building areas, i.e.., electrical rooms, mechanical rooms, boiler rooms, high temperature water rooms, above “hard” ceilings, within walls, etc., all control wiring shall be installed in conduit per National Electric Code. Installation shall be square with the walls of the buildings.
   3. Installer shall identify and label all sensors, actuators, and wiring as shown on control drawings.
   4. Installer shall document all power and communication wire routing, transformer locations, network manager & router locations, as well as all remote system sensors (i.e. building static, duct static, etc.) on "as-built" control plans.

D. Mount compressor and tank unit on vibration isolation as specified in Section 220531. Isolate air supply with wire-braid reinforced rubber hose or polyethylene tubing. Pipe manual and automatic drains to nearest floor drain.

E. Supply instrument air from compressor units through filter, pressure reducing valve, pressure relief valve, with pressure gauges, and shutoff and bypass valves.

F. Install pressure reducing stations consisting of pressure reducing valve, particle filter, valve bypass, pressure gauge on inlet and outlet, and pressure relief valve.

G. Locate refrigerated air dryer in discharge air line from tank. Mount dryer on wall on rubber in shear mounts. Install pressure regulator downstream of dryer. Pipe automatic drain to nearest floor drain.

H. Use copper tubing in mechanical rooms, where subject to damage or temperatures in excess of 200 degrees F, where adjacent to heating pipes passing through common sleeve, and where not readily accessible.

I. Conceal tubing. Run exposed only in mechanical rooms, storage rooms and like, in neat manner and properly supported.

J. Purge tubing with dry, oil-free compressed air before connecting control instruments.

K. Check and verify location of thermostats and exposed control sensors with plans and room details before installation. Locate 42 inches above floor. Align with lighting switches. Refer to Section 262725.

L. Mount freeze protection thermostats using flanges and element holders.

M. Mount outdoor reset thermostats and outdoor sensors indoors, with sensing elements outdoors with sun shield.

N. Provide mixing dampers of parallel blade construction arranged to mix streams. _____.

O. Provide isolation (two position) dampers of parallel blade construction.

P. Install damper motors on outside of duct in warm areas. Do not install motors in locations at outdoor temperatures.

Q. Mount control panels adjacent to associated equipment on vibration free walls or free standing angle iron supports. One cabinet may accommodate more than one system in same equipment room. Provide engraved plastic nameplates for instruments and controls inside cabinet and engraved plastic nameplates on cabinet face.

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R. Install "hand/off/auto" selector switches to override automatic interlock controls when switch is in "hand" position.

3.03 MAINTENANCE

A. All maintenance shall be provided by owner.

END OF SECTION

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SECTION 230923

DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

A. System description.
B. Operator interface.
C. Controllers.
D. Power supplies and line filtering.
E. System software.
F. Controller software.
G. HVAC control programs.
H. Chiller control programs.

1.02 RELATED REQUIREMENTS

A. Section 230913 - Instruments and Control Elements.
B. Section 230993 - Sequence of Operations for HVAC Controls.
C. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.
D. Section 284600 - Fire Detection and Alarm.

1.03 REFERENCE STANDARDS

A. ASHRAE Std 135 - BACnet - A Data Communication Protocol for Building Automation and Control Networks; 2017.
B. ASHRAE Std 147 - Reducing the Release of Halogenated Refrigerants From Refrigerating and Air-Conditioning Equipment and Systems; 2013.
C. Bluetooth CS - Bluetooth Core Specification; 2016, Addendum 2017.
D. IEEE 802.11 - IEEE Standard for Information Technology--Telecommunications and Information Exchange Between Systems Local and Metropolitan Area Networks--Specific Requirements - Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications ; 2016, with Errata (2017).
E. IEEE 802.15.4 - IEEE Standard for Low-Rate Wireless Networks; 2015.
F. LonMark Interoperability Guide - LonMark Application-Layer Interoperability Guide and LonMark Layer 1-6 Interoperability Guide; Version 3.4; 2005.
G. LonMark SCPT List - LonMark SCPT Master List; Version 15; 2014.
H. LonMark SNVT List - LonMark SNVT Master List; Version 15; 2014.
I. Modbus (PS) - The Modbus Organization Communications Protocol; Latest Update.
J. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting prior to the start of the work of this section; require attendance by all affected installers.
B. Mechanical controls and components shall be furnished by the owner and contractor installed.

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1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data for each system component and software module.

C. Shop Drawings:
   1. Indicate communication trunk cable schematic showing programmable control unit locations and connected unit addressing.
   2. List connected data points, including connected control unit and input device.
   3. Coordinate graphics design to ensure implementation of current owner's standard.
   4. Show system configuration with peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
   5. Indicate description and sequence of operation of operating, user, and application software.

D. Manufacturer's Instructions: Indicate manufacturer's installation instructions for all manufactured components.

E. Project Record Documents: Record actual locations of control components, including control units, thermostats, transformers, routing devices, and system sensors.
   1. Revise shop drawings to reflect actual installation and operating sequences.

F. Operation and Maintenance Data:
   1. Include interconnection wiring diagrams complete field installed systems with identified and numbered, system components and devices.
   2. Include inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.

G. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner s name and registered with manufacturer with a copy returned to the Owner.

1.06 QUALITY ASSURANCE

A. Perform work in accordance with NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.

C. Installer Qualifications: Company specializing in performing work of the type specified and with minimum five years of documented experience.

D. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for purpose specified and indicated.

1.07 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Correct defective Work within a one year period after Substantial Completion.

C. Provide a minimum one year manufacturer's warranty for all control devices and components after Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Delta Controls; _____: www.deltacontrols.com

B. Honeywell International, Inc; _____: www.honeywell.com

C. Johnson Controls, Inc; _____: www.johnsoncontrols.com

D. Siemens AG, Building Technologies Division; _____: www.siemens.com

E. Substitutions: See Section 016000 - Product Requirements.

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2.02 SYSTEM DESCRIPTION

A. Automatic temperature control field monitoring and control system using field programmable micro-processor based units with communications to the Owner furnished Building Management System.

B. Base system on distributed system of fully intelligent, stand-alone controllers, operating in a multi-tasking, multi-user environment network, with central and remote hardware, software, and interconnecting wire and conduit.

C. Include computer software and hardware, operator input/output devices, control units, local area networks (LAN), routers, sensors, control devices, actuators.

D. Controls for variable air volume terminals, radiation, reheat coils, unit heaters, fan coils, and the like when directly connected to the control units. Individual terminal unit control is specified in Section 230913.

E. Provide control systems consisting of thermostats, control valves, dampers and operators, indicating devices, interface equipment and other apparatus and accessories required to operate mechanical systems, and to perform functions specified.

F. Include installation and calibration, supervision, adjustments, and fine tuning necessary for complete and fully operational system for both heating and cooling seasons.

2.03 CONTROLLERS

A. BUILDING CONTROLLERS

1. General:
   a. Manage global strategies by one or more, independent, standalone, microprocessor based controllers.
   b. Provide sufficient memory to support controller's operating system, database, and programming requirements. Memory requirements shall not exceed 60% of capacity for application, system, and network controllers at turnover to Owner.
   c. Share data between networked controllers.
   d. Controller operating system manages input and output communication signals allowing distributed controllers to share real and virtual object information and allowing for central monitoring and alarms.
   e. Utilize real-time clock for all time related functions.
   f. Controller may assume predetermined failure mode and generate alarm notification upon detection of abnormal operation.
   g. Communication with other network devices to be based on assigned protocol.
2. Communication:
   a. Controller to reside on a BACnet network using ISO 8802-3 (ETHERNET) Data Link/Physical layer protocol. LonWorks, Modbus, or other communication protocols may be use upon approval of Owner.
   b. Perform routing when connected to a network of custom application and application specific controllers.
   c. Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.
3. External Input-Output (I-O) Data Bus:
   a. Variable frequency drives (VFD's).
   b. Specific wired and wireless data integration modules.
   c. Multiple Input Output (I-O) Module:
      1) IAQ: Temperature, humidity, and CO2.
      2) Occupancy: Light and thermal sensing with multi-colored LED feedback.
      3) Basis of Design: Delta Controls; Sensor Hub: www.deltacontrols.com
4. Anticipated Environmental Ambient Conditions:

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a. Outdoors and/or in Wet Ambient Conditions:
1) Mount within waterproof, non-condensing enclosures.
2) Rated for operation at 32 to 130 degrees F.
b. Conditioned Space:
1) Mount within dustproof, non-condensing enclosures.
2) Rated for operation at 32 to 130 degrees F.

5. Provisions for Serviceability:
a. Diagnostic LEDs for power, communication, and processor.
b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.

6. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.

7. Power and Noise Immunity:
a. Maintain operation at 90 to 110 percent of nominal voltage rating.
b. Perform orderly shutdown below 80 percent of nominal voltage.
c. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W. at 3 feet.

B. CUSTOM APPLICATION CONTROLLERS

1. General:
a. Provide sufficient memory to support controller's operating system, database, and programming requirements. Memory requirements shall not exceed 60% of capacity for application, system, and network controllers at turnover to Owner.
b. Share data between networked, microprocessor based controllers.
c. Controller operating system manages input and output communication signals allowing distributed controllers to share real and virtual object information and allowing for central monitoring and alarms.
d. Utilize real-time clock for all time related functions.
e. Controller may assume predetermined failure mode and generate alarm notification upon detection of abnormal operation.
f. Communication with other network devices to be based on assigned protocol.

2. Communication:
a. Controller to reside on a BACnet network using MS/TP Data Link/Physical layer protocol. LonWorks, Modbus, or other communication protocols may be use upon approval of Owner.
b. Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.

3. Anticipated Environmental Ambient Conditions:
a. Outdoors and/or in Wet Ambient Conditions:
1) Mount within waterproof, non-condensing enclosures.
2) Rated for operation at 32 to 130 degrees F..
b. Conditioned Space:
1) Mount within dustproof, non-condensing enclosures.
2) Rated for operation at 32 to 130 degrees F.

4. Provisions for Serviceability:
a. Diagnostic LED's for power, communication, and processor.
b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.

5. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.

6. Power and Noise Immunity:

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a. Maintain operation at 90 to 110 percent of nominal voltage rating.
b. Perform orderly shutdown below 80 percent of nominal voltage.
c. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W. at 3 feet.

C. APPLICATION SPECIFIC CONTROLLERS
1. General:
a. Not fully user programmable, microprocessor based controllers dedicated to control specific equipment.
b. Customized for operation within the confines of equipment served.
c. Communication with other network devices to be based on assigned protocol.
2. Communication:
a. Controller to reside on a BACnet network using MS/TP Data Link/Physical layer protocol. LonWorks, Modbus, or other communication protocols may be use upon approval of Owner.
b. Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.
3. Anticipated Environmental Ambient Conditions:
a. Outdoors and/or in Wet Ambient Conditions:
1) Mount within waterproof, non-condensing enclosures.
2) Rated for operation at 32 to 130 degrees F..
b. Conditioned Space:
1) Mount within dustproof, non-condensing enclosures.
2) Rated for operation at 32 to 130 degrees F.
4. Provisions for Serviceability:
a. Diagnostic LEDs for power, communication, and processor.
b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.
5. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.
6. Power and Noise Immunity:
a. Maintain operation at 90 to 110 percent of nominal voltage rating.
b. Perform orderly shutdown below 80 percent of nominal voltage.
c. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 3 feet.
7. Smart Sensor (SS):
a. Manufacturers:
1) Delta Controls: www.deltacontrols.com
2) JCI.
3) Siemens.
4) Substitutions: See Section 016000 - Product Requirements.
b. Features: Built-in display and cool-warm adjust slider or knob as indicated on plans.
c. Inputs: 3-universal (configurable).
d. Output: 4-externally power binary.
e. Occupancy Feedback: Alphanumeric display with changeable background color.
f. Temperature Sensor: Platinum, 1,000 ohms RTD element inside insulated thermoplastic enclosure.
g. Combined Senor Monitoring Range:
1) Humidity: 0 to 100 percent (non-condensing).
2) CO2 (Carbon Dioxide): 0 to 2,000 ppm.
h. Communications Protocol: BACnet MS/TP per ASHRAE Std 135.

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i. Certification: BACnet Testing Laboratory (BTL) certified device listed under the BACnet Smart Sensor (B-SS) device profile in compliance with ASHRAE Std 135.

D. INPUT/OUTPUT INTERFACE
1. Hardwired inputs and outputs tie into the DDC system through building, custom application, or application specific controllers.
2. All Input/Output Points:
a. Protect controller from damage resulting from any point short-circuiting or grounding and from voltage up to 24 volts of any duration.
b. Provide universal type for building and custom application controllers where input or output is software designated as either binary or analog type with appropriate properties.
3. Binary Inputs:
a. Allow monitoring of On/Off signals from remote devices.
b. Provide wetting current of 12 mA minimum, compatible with commonly available control devices and protected against the effects of contact bounce and noise.
c. Sense dry contact closure with power provided only by the controller.
4. Pulse Accumulation Input Objects: Conform to all requirements of binary input objects and accept up to 10 pulses per second.
5. Analog Inputs:
a. Allow for monitoring of low voltage 0 to 10 VDC, 4 to 20 mA current, or resistance signals (thermistor, RTD).
b. Compatible with and field configurable to commonly available sensing devices.
6. Binary Outputs:
a. Used for On/Off operation or a pulsed low-voltage signal for pulse width modulation control.
b. Outputs provided with three position (On/Off/Auto) override switches.
c. Status lights for building and custom application controllers to be selectable for normally open or normally closed operation.
7. Analog Outputs:
a. Monitoring signal provides a 0 to 10 VDC or a 4 to 20 mA output signal for end device control.
b. Provide status lights and two position (AUTO/MANUAL) switch for building and custom application controllers with manually adjustable potentiometer for manual override on building and custom application controllers.
c. Drift to not exceed 0.4 percent of range per year.
8. Tri State Outputs:
a. Coordinate two binary outputs to control three point, floating type, electronic actuators without feedback.
b. Limit the use of three point, floating devices to the following zone and terminal unit control applications:
1) VAV terminal units.
2) Zone dampers.
c. Control algorithms run the zone actuator to one end of its stroke once every 24 hours for verification of operator tracking.

2.04 POWER SUPPLIES AND LINE FILTERING

A. Power Supplies:
1. Provide UL listed control transformers with Class 2 current limiting type or over-current protection in both primary and secondary circuits for Class 2 service as required by the NEC.
2. Limit connected loads to 80 percent of rated capacity.
3. Match DC power supply to current output and voltage requirements.
4. Unit to be full wave rectifier type with output ripple of 5.0 mV maximum peak to peak.

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5. Provide over-voltage and over-current protection to withstand a 150 percent current overload for 3 seconds minimum without trip-out or failure.
6. Operational Ambient Conditions: 32 to 120 degrees F.
7. Line voltage units UL recognized and CSA approved.
8. Provide ventilation for any enclosed power supplies.

B. Power Line Filtering:
1. Provide 120 volt transient voltage and surge suppression component for each powered control panel.

2.05 SYSTEM SOFTWARE

A. System Features:
1. HTML5 and Java-enabled user interface (UI), and includes a JavaScript data interface library (BajaScript).
2. Supports an unlimited number of users over the internet/intranet with a standard web browser (depending on the host PC resources).
3. Optional enterprise-level data archival using SQL, MySQL or Oracle databases, and HTTP/HTML/XML, CSV or text formats.
4. Audit Trail" of database changes, database storage and backup, global time functions, calendar, central scheduling, control and energy management routines.
5. Sophisticated alarm processing and routing, including email alarm acknowledging.
6. Access to alarms, logs, graphics, schedules and configuration data with a standard web browser.
7. Follows industry best practices for cyber security, with support for features such as strong, hashed passwords, TLS for secure communications and certificate management tools for authentication.
8. A built-in Security Dashboard provides a comprehensive and actionable view of the security posture of your Niagara deployment HTML-based help system that includes comprehensive online system documentation.
9. Supports multiple Niagara-based stations connected to a local Ethernet network or the internet.
10. Provides online/offline use of the Niagara Framework® Workbench graphical configuration tool and a comprehensive Java Object Library.
11. Direct Ethernet-based driver support for most Open IP field bus protocols (see supported drivers document).
12. Utilize tags to quickly navigate to buildings, systems and equipment when diagnosing operational problems or emergencies.
13. FIPS 140-2 Level 1 conformance.
14. Integrate with other applications, such as work order management, analytics, etc.
15. Graphics:
    a. Graphic package shall conform to Owner's current custom graphics layout.

B. Workstation System Applications:
1. Automatic System Database Save and Restore Functions:
    a. Current database copy of each Building Controller is automatically stored on hard disk.
    b. Automatic update occurs upon change in any system panel.
    c. In the event of database loss in any system panel, the first workstation to detect the loss automatically restores the database for that panel unless disabled by the operator.
2. Manual System Database Save and Restore Functions by Operator with Password Clearance:
    a. Save database from any system panel.
    b. Clear a panel database.
    c. Initiate a download of a specified database to any system panel.
3. Software provided allows system configuration and future changes or additions by operators under proper password protection.

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4. On-line Help:
    a. Context-sensitive system assists operator in operation and editing.
    b. Available for all applications.
    c. Relevant screen data provided for particular screen display.
    d. Additional help available via hypertext.
5. Security:
    a. Operator log-on requires user name and password to view, edit, add, or delete data.
    b. System security selectable for each operator.
    c. System supervisor sets passwords and security levels for all other operators.
    d. Operator passwords to restrict functions accessible to viewing and/or changing system applications, editor, and object.
    e. Automatic, operator log-off results from keyboard or mouse inactivity during user-adjustable, time period.
    f. All system security data stored in encrypted format.
6. System Diagnostics:
    a. Operations Automatically Monitored:
        1) Workstations.
        2) Network connections.
        3) Building management panels.
        4) Controllers.
    b. Device failure is annunciated to the operator.
7. Alarm Processing:
    a. All system objects are configurable to "alarm in" and "alarm out" of normal state.
    b. Configurable Objects:
        1) Alarm limits.
        2) Alarm limit differentials.
        3) States.
        4) Reactions for each object.
8. Alarm Messages:
    a. Descriptor: English language.
    b. Recognizable Features:
        1) Source.
        2) Location.
        3) Nature.
9. Configurable Alarm Reactions by Workstation and Time of Day:
    a. Logging.
    b. Starting programs.
    c. Displaying messages.
    d. Dialing out to remote locations.
    e. Texting and emailing.
    f. Providing audible annunciation.
    g. Displaying specific system graphics.
10. Custom Trend Logs:
    a. Definable for any data object in the system including interval, start time, and stop time.
    b. Trend Data:
        1) Sampled and stored on the building controller panel.
        2) Archivable on hard disk.
        3) Retrievable for use in reports, spreadsheets and standard database programs.

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4) Archival on LAN accessible storage media including hard disk, Raid array drive, and virtual cloud environment.

11. Alarm and Event Log:
    a. View all system alarms and change of states from any system location.
    b. Events listed chronologically.
    c. Operator with proper security acknowledges and clears alarms.
    d. Alarms not cleared by operator are archived to the workstation hard disk.
12. Object, Property Status and Control:
    a. Provide a method to view, edit if applicable, the status of any object and property in the system.
    b. Status Available by the Following Methods:
        1) Property sheet.
        2) Slot sheet.
        3) Wire sheet.
        4) Relation sheet.
        5) Category sheet.
        6) Graphics.
        7) Custom Programs.
13. Reports and Logs:
    a. Reporting Package:
        1) Allows operator to select, modify, or create reports.
        2) Definable as to data content, format, interval, and date.
        3) Exportable.
    b. Real-time logs available by type or status such as alarm, lockout, normal, etc.
    c. Stored on hard disk and readily accessible by standard software applications, including spreadsheets and word processing.
    d. Set to be printed on operator command or specific time(s).
14. Reports:
    a. Standard:
        1) Objects with current values.
        2) Current alarms not locked out.
        3) Disabled and overridden objects, points and SNVTs.
        4) Objects in manual or automatic alarm lockout.
        5) Objects in alarm lockout currently in alarm.
        6) Logs:
            (a) Alarm History.
            (b) System messages.
            (c) System events.
            (d) Trends.
    b. Custom:
        1) Daily.
        2) Weekly.
        3) Monthly.
        4) Annual.
        5) Time and date stamped.
        6) Title.
        7) Facility name.

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2.06 CONTROLLER SOFTWARE

A. All applications should reside and operate in the system controllers where standalone control is necessary and available. System level programming to be used when multiple controllers are needed for sequence implementation.

B. System Security:
   1. User access secured via user passwords and user names.
   2. Passwords restrict user to the objects, applications, and system functions as assigned by the system manager.
   3. User Log On/Log Off attempts are recorded.
   4. Automatic Log Off occurs following the last keystroke after a user defined delay time.

C. Object or Object Group Scheduling:
   1. Weekly Schedules Based on Separate, Daily Schedules:
      a. Schedule is fully customizable (Boolean, float, enumerated, etc.).
      b. Start/stop times adjustable for each group object.
      c. All terminal devices (VAVs, FCUs, UHs, etc.) shall have the capability to be scheduled at Owner's direction.

D. Provide standard application for equipment coordination and grouping based on function and location to be used for scheduling and other applications.

E. Alarms:
   1. Binary object is set to alarm based on the operator specified state.
   2. Analog object to have high/low alarm limits.
   3. All alarming is capable of being automatically and manually disabled.
   4. Alarm Reporting:
      a. Operator determines action to be taken for alarm event.
      b. Alarms to be routed to appropriate email or text message.

F. Maintenance Management: System can monitor equipment status and generates maintenance messages based upon user-designated run-time limits.

G. Sequencing: Application software based upon specified sequences of operation in Section 230993.

H. PID Control Characteristics:
   1. Direct or reverse action.
   2. Anti-windup.
   3. Calculated, time-varying, analog value, positions an output or stages a series of outputs.
   4. User selectable controlled variable, set-point, and PID gains.

2.07 HVAC CONTROL PROGRAMS

A. General:
   1. Support Inch-pounds and SI (metric) units of measurement.
   2. Identify each HVAC Control system.

B. Optimal Run Time:
   1. Base on occupancy schedules, outside air temperature, seasonal requirements, and interior room mass temperature.
   2. Control Summary:
      a. Heating/cooling mode status.
      b. Start/Stop times.
      c. Occupancy and vacancy times.
   3. Mass temperature summary:
      a. Mass temperature point type and ID.

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b. Desired and current mass temperature values.

4. HVAC point summary:
   a. Control system identifier and status.
   b. Point ID and status.
   c. Outside air temperature point ID and status.

C. Supply Air Reset:
1. Monitor heating and cooling loads in building spaces, terminal reheat systems, both hot deck and cold deck temperatures on dual duct and multizone systems, single zone unit discharge temperatures.
2. Adjust discharge temperatures to most energy efficient levels satisfying measured load by:
   a. Raising cooling temperatures to highest possible value.
   b. Reducing heating temperatures to lowest possible level.
3. Control summary:
   a. Supply air reset system status.
   b. Heating and cooling loop.
   c. High/low limits.
4. Space load summary:
   a. HVAC system status.
   b. Heating/cooling loop status.
   c. Space load point ID.
   d. Current space load point value.
   e. Calculated reset values.
   f. Fan status point ID and status.
   g. Control discharge temperature point ID and status.

D. Enthalpy Switchover:
1. Calculate outside and return air enthalpy using measured temperature and relative humidity; determine energy expended and control outside and return air dampers.
2. Operator commands:
   a. Define discharge controller parameters.
3. Control summary:
   a. Enthalpy switchover optimal system status.
   b. Current return air enthalpy.
   c. Current outside air enthalpy.
   d. Enthalpy switchover dead band.
   e. Status of damper mode switch.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that conditioned power supply is available to the control units and to the operator work station. Verify that field end devices, wiring, and pneumatic tubing is installed prior to installation proceeding.

3.02 INSTALLATION

A. Install control units and other hardware in position on permanent walls where not subject to excessive vibration.

B. Install software in control units and in operator work station. Implement all features of programs to specified requirements and appropriate to sequence of operation. Refer to Section 230993.

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C. Provide conduit and electrical wiring in accordance with Section 260583. Electrical material and installation shall be in accordance with appropriate requirements of .

3.03 MANUFACTURER'S FIELD SERVICES

A. Start and commission systems. Allow sufficient time for start-up and commissioning prior to placing control systems in permanent operation.

B. Provide basic operator training on sequence of operations, data display, alarm and status descriptors, requesting data, execution of commands and request of logs. Provide training on site.

3.04 DEMONSTRATION AND INSTRUCTIONS

A. Demonstrate complete operating system to Owner.

3.05 MAINTENANCE

A. See Section 017000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.

B. Provide service and maintenance of energy management and control systems for one year from Date of Substantial Completion.

END OF SECTION

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SECTION 230993
SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This section defines the manner and method by which controls function. Requirements for each type of control system operation are specified. Equipment, devices, and system components required for control systems are specified in other sections.

B. Sequence of operation for:
   1. Air terminal units.

1.02 RELATED REQUIREMENTS

A. Section 019113 - General Commissioning Requirements: Commissioning requirements that apply to all types of work.

B. Section 230913 - Instruments and Control Elements.

C. Section 230923 - Direct-Digital Control System for HVAC.

D. Section 262816.13 - Enclosed Circuit Breakers.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Sequence of Operation Documentation: Submit written sequence of operation for entire HVAC system and each piece of equipment.
   1. Preface: 1 or 2 paragraph overview narrative of the system describing its purpose, components and function.
   2. State each sequence in small segments and give each segment a unique number for referencing in Functional Test procedures; provide a complete description regardless of the completeness and clarity of the sequences specified in Contract Documents.

1.04 GENERAL INFORMATION

A. Power Failure - Except for the equipment noted below, all supply, return, relief, exhaust, pumps, etc. shall stop on power failure. When power has been restored to normal for a minimum of two minutes, the mechanical equipment shall restart at 30-second intervals (adjustable) in a predetermined sequence.

B. Schedule - Although specific set points, time periods and reset values are listed in the sequence of operation, all values shall be changeable through the Facility Management System console or portable operators' terminal. The initial occupied/unoccupied schedules shall be as designated by the owners representative.

C. Point Database - Inputs and outputs required to meet the sequence of operation shall be provided, whether they are listed in the Input/Output schedule or not. All points listed in the Input/Output schedule shall also be provided.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 AIR HANDLING UNITS

3.02 AIR TERMINAL UNITS

A. VAV General Items
   1. Multiple Zone Control: Where a VAV box serves multiple zones, each zone should have a temperature sensor that can be used to average the temperatures of zones being served. This

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average temperature will be considered the zone temperature for control purposes. Unoccupied areas (e.g. hallways, bathrooms, closets, etc.) served by the same box may be excluded from the requirement of temperature averaging. The controller shall monitor and report the temperature of each zone served with the value displayed on the graphical floor plan.

2. Analytics: All VAV controllers should employ Atkinson Modular Analytics (AMA) software as a means of performing ongoing VAV controller and equipment automated functional testing. A summary screen shall be included in the graphics package which lists the AMA testing results for all VAVs. This data shall be grouped by areas (e.g. area A, floor 2 South, etc.) where large numbers of VAV exist and not in one large list. Additionally, each VAV controller should incorporate a tagging structure (e.g. room, floor, air handler, transformer, etc.) in the BMS software to allow for higher level filtering and analysis.
3. Temperature & Pressure Reset: All VAV DDC controllers shall have the ability to be included or excluded from system Discharge Air Temperature and Pressure resets for energy optimization.
4. Zone Setpoints: The minimum dead band between occupied heating and cooling setpoints shall be 2 degF. The zone Heating and Cooling temperature setpoints as well as setpoint offset ranges should be set according to the following table:

	IOS	OH	OC	OMM	UO	DB	UH	UC
Classroom	72	70	74	68 / 76	+/- 2	4	68	78
Office & General Work	72	71	73	68 / 76	+/- 3	2	68	78
Lab	72	70	74	68 / 76	+/- 2	4	68	78
Lobby, Hall, Public	72	70	74	70 / 74	0	4	68	78
Auditorium	70	69	71	67 / 73	+/- 2	2	67	75
Critical	72	71	73	66 / 78	+/- 5	2	68	78

abbreviation	description
IOS	Initial Occupied Setpoint
OH	Occupied Heat Setpoint
OC	Occupied Cool Setpoint
OMM	Occupied Min / Max
UO	User Offset
DB	Deadband
UH	Unoccupied Heat Setpoint
UC	Unoccupied Cool Setpoint

5. Scheduling: Multiple BMS schedule options should be made available for VAV controllers using BYU's custom template. If a zone is occupied 24/7 it should resynchronize the primary and auxiliary dampers at least once per week.
6. Deadband Mode: When occupied and the zone temperature is between the heating and cooling zone temperature setpoints, or when unoccupied and the zone temperature is between the unoccupied heating and unoccupied cooling zone temperature setpoints, the box shall be in Deadband mode.
7. Cooling Mode: When occupied and the zone temperature is above the occupied zone cooling temperature setpoint, or when unoccupied and the zone temperature is above the unoccupied zone cooling temperature setpoint, the box shall be in Cooling mode.
8. Heating Mode: When occupied and the zone temperature is below the occupied zone heating temperature setpoint, or when unoccupied and the zone temperature is below the unoccupied zone heating temperature setpoint, the box shall be in Heating mode.
9. Start-up: When power is restored the VAV DDC controller should synchronize the primary and auxiliary dampers.

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10. Warm-up: Morning Warm Up (MWU) mode should be enabled for the 1st hour of occupancy (adj) when OSA temperature is below 50 degF (adj) and the Return Air Temperature (RAT) of the AHU unit serving the zones is below 67 degF (adj) with a 2 degF (adj) deadband. During MWU the OSA dampers of the AHU should be shut and the AHU should provide as warm of air as possible up to 75 degF (adj). During MWU all VAV boxes which have zone temperature (or average temperature) below the Heating setpoint should modulate the primary damper open to its cooling maximum ventilation setpoint (primary air is warm).
11. Occupancy Sensor: If the BMS system is occupied and a local occupancy sensor is used in conjunction with the BMS scheduling, the DDC controller should go into a Standby mode when motion is not detected. During Standby and in either Deadband or Heating modes, the local DDC controller shall modulate the primary damper to a fully closed position. During standby and in Cooling mode, follow the occupied cooling mode sequence of control. When occupancy is detected, the DDC controller will revert to the occupied mode. Where available standby setpoints should provide a wider deadband and be a minimum of +/- 1 (adj) degF offset from the occupied heating and cooling setpoints.
12. CO2 Sensors: In zones where occupancy has high variability (e.g. conference room, classrooms, etc.) a CO2 sensor shall be used. The VAV controller shall compare the zone CO2 sensor to the CO2 set point (800 ppm – adj). When the CO2 rises above the CO2 set point the controller shall reset the minimum air flow ventilation set point up until it reaches that of the maximum cooling CFM. As the space CO2 falls below the CO2 set point the controller shall return the adjusted air flow set point to the original minimum air flow ventilation setting. The VAV controller shall modulate the damper to maintain the adjusted minimum air flow set point. The controller shall monitor and report the CO2 level of each zone served with the value displayed on the graphical floor plan.
13. VOC Sensors: In zones where VOC concentrations may be elevated, a VOC sensor should be used. The DDC controller shall compare the zone VOC sensor to the VOC set point (40% – adj). When the VOC rises above the VOC set point the controller shall reset the minimum air flow ventilation set point up until it reaches that of the maximum cooling CFM. As the space VOC falls below the VOC set point the controller shall return the adjusted air flow set point to the original minimum air flow ventilation setting. The VAV controller shall modulate the damper to maintain the adjusted minimum air flow set point. The controller shall monitor and report the VOC level of each zone served with the value displayed on the graphical floor plan.
14. Capacity control: The local VAV controller shall modulate the primary damper, auxiliary damper, reheat valve and / or auxiliary fan to a fully closed or off position if a load shed signal is received from the BMS system.
15. Power outage: A VAV controller should be on normal power and not on emergency backup power unless called for by the specifying engineer. When power is lost all dampers should fail in place, the hot water valve should close, and the auxiliary fan should stop.
16. Software Alarms & Histories:

	PT	HT	CI	LCL	SCL	AL	SN
Zone Air Temp	AI	Interval	10	3	36		SpcTemp
Zone Air Temp Setpoint	AV	Interval	10	3	36		SpcTempSp
Zone Occupancy Mode	MV	Interval	10	3	36		Occ
Air Damper Command	AV / AO	Interval	10	3	36		DmprPos
Discharge Air Flow	AI	Interval	10	3	36		DaFlow
Discharge Air Flow SP	AV	Interval	10	3	36		DaFlowSp
Hot Water Valve Command	AV / AO	Interval	10	3	36		HwVlvPos
Aux Air Damper Command	AV / AO	Interval	10	3	36		AuxDmprPos
Aux Discharge Air Flow	AI	Interval	10	3	36		AuxDaFlow

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Aux Discharge Air Flow SP	AV	Interval	10	3	36	AuxDaFlowSp

abbreviation	description
PT	Point Type
HT	History Type
CI	Collection Interval
LCL	Local Collection Length
SCL	Supervisor Collection Length
AL	Alarm
SN	Software Name

B. Cooling Only VAV (VAVCO)
   1. Occupied Mode: The occupancy of the zone shall be determined by the BMS or by a local override button (if applicable). When in Deadband or Heating modes, the local DDC controller shall modulate the primary damper to its minimum ventilation CFM setpoint. When in Cooling mode, the local DDC controller shall modulate the primary damper open from its minimum to its maximum cooling ventilation CFM setpoint as the cooling calculation ramps between 0 - 100%.
   2. Unoccupied Mode: When in Deadband or Heating modes, the local DDC controller shall modulate the primary damper to its fully closed position. When in Cooling mode, the local DDC controller shall modulate the primary damper open from its minimum to its maximum ventilation CFM setpoint as the cooling calculation ramps between 0 - 100%.

C. Reheat VAV (VAVR)
   1. Occupied Mode: The occupancy of the zone shall be determined by the BMS or by a local override button (if applicable). When in Deadband, the local DDC controller shall modulate the primary damper to its minimum ventilation CFM setpoint and close the hot water reheat valve. When in Heating mode, the local DDC controller shall modulate open the hot water valve from 0 – 100% as the heating calculation rises from 0 – 50%, subject to discharge air temperature at or below 90 DegF. Once heating calculation reaches 50% then modulate open the primary damper from minimum to maximum heating ventilation CFM setpoint as the heating calculation rises from 50 – 100%. When in Cooling mode, the local DDC controller shall modulate the primary damper open from its minimum to its maximum cooling ventilation CFM setpoint as the cooling calculation ramps between 0 - 100% and the reheat valve shall be closed.
   2. Unoccupied Mode: When in Deadband mode, the local DDC controller shall modulate the primary damper and the reheat valve to a fully closed position. When in heating mode, follow the occupied heating sequence of control until zone is above the unoccupied heating setpoint. When in Cooling mode, the local DDC controller shall modulate the primary damper open from its minimum to its maximum cooling ventilation CFM setpoint as the cooling calculation ramps between 0 - 100% and the reheat valve shall be closed.

END OF SECTION

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SECTION 232113
HYDRONIC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Hydronic system requirements.
B. Heating water piping, above grade.
C. Heating water and glycol piping, above grade.
D. Equipment drains and overflows.
E. Pipe hangers and supports.
F. Unions, flanges, mechanical couplings, and dielectric connections.

1.02 RELATED REQUIREMENTS

A. Section 078400 - Firestopping.
B. Section 083100 - Access Doors and Panels.
C. Section 099123 - Interior Painting.
D. Section 220516 - Expansion Fittings and Loops for Plumbing Piping.
E. Section 220548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.
F. Section 220553 - Identification for Plumbing Piping and Equipment.
G. Section 220719 - Plumbing Piping Insulation.
H. Section 230516 - Expansion Fittings and Loops for HVAC Piping.
I. Section 230523 - General-Duty Valves for HVAC Piping.
J. Section 230548 - Vibration and Seismic Controls for HVAC Piping and Equipment.
K. Section 230553 - Identification for HVAC Piping and Equipment.
L. Section 230719 - HVAC Piping Insulation.
M. Section 232114 - Hydronic Specialties.
N. Section 232500 - HVAC Water Treatment: Pipe cleaning.

1.03 REFERENCE STANDARDS

A. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing and Fusing Operators; 2017.
B. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2016.
C. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2012.
D. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2013.
E. ASME B31.9 - Building Services Piping; 2014.
F. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.
G. ASTM A106/A106M - Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service; 2015.
H. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
I. ASTM A183 - Standard Specification for Carbon Steel Track Bolts and Nuts; 2014.

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J. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2017.

K. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984 (Reapproved 2014).

L. ASTM B32 - Standard Specification for Solder Metal; 2008 (Reapproved 2014).

M. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2016.

N. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40; 2017.

O. ASTM D2467 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80; 2015.

P. ASTM D2855 - Standard Practice for the Two-Step (Primer & Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets; 2015.

Q. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers; 1992 (Reapproved 2014).

R. ASTM F876 - Standard Specification for Crosslinked Polyethylene (PEX) Tubing; 2015a.

S. ASTM F877 - Standard Specification for Crosslinked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems; 2011a.

T. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications; 2007 (Reapproved 2013).

U. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2011-AMD 1.

V. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015 (with March 2016 Errata).

W. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings; 2012.

X. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; 2017.

Y. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast; 2009.

Z. AWWA C606 - Grooved and Shouldered Joints; 2015.

AA. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2009.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the installation of all underground piping at service entrances to buildings including size, location and installation locations, noted on contract documents, with Owner's Project Manager.

B. Preinstallation Meeting: Conduct a preinstallation meeting prior to the start of the work of this section; required attendance by all affected installers.

C. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

D. Scheduling: All scheduling shall be coordinated and agreed upon with Owner's Project Manager prior to commencing work.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Welders Certificate: Include welders certification of compliance with ASME BPVC-IX.

C. Product Data:
   1. Include data on pipe materials, pipe fittings, valves, and accessories.
   2. Provide manufacturers catalogue information.

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3. Show grooved joint couplings, fittings, and specialties on drawings and product submittals, specifically identified with the manufacturer's style or series designation.

D. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

E. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

F. 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. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with minimum five years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with minimum three years of experience.

C. Provide all flanges, grooved joint couplings, fittings, and grooving tools from a single manufacturer.

D. Welder Qualifications: Certify in accordance with ASME BPVC-IX.
1. Provide certificate of compliance from authority having jurisdiction, indicating approval of welders.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

E. Deliveries shall not be to owner, but directly to the contractor.

1.08 FIELD CONDITIONS

A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.01 HYDRONIC SYSTEM REQUIREMENTS

A. Comply with ASME B31.9 and applicable federal, state, and local regulations.

B. Piping: Provide piping, fittings, hangers and supports as required, as indicated, and as follows:
1. Where more than one piping system material is specified, provide joining fittings that are compatible with piping materials and ensure that the integrity of the system is not jeopardized.
2. Use non-conducting dielectric connections whenever jointing dissimilar metals.
3. Grooved mechanical joints may be used in any location except direct buried.
   a. Grooved mechanical connections and joints comply with AWWA C606.
      1) Steel: Comply with ASTM A106/A106M, Grade B or ASTM A53/A53M.
   b. Use flexible connectors only at structural expansion joints as indicated by architect or engineer.
   c. Use gaskets of molded synthetic rubber with central cavity, pressure responsive configuration and complying with ASTM D2000, Grade 2CA615A15B44F17Z for circulating medium up to maximum 230 degrees F or Grade M3BA610A15B44Z for circulating medium up to maximum 200 degrees F.
   d. Provide steel coupling nuts and bolts complying with ASTM A183.
4. Provide pipe hangers and supports in accordance with ASME B31.9 or MSS SP-58 unless indicated otherwise.

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C. Pipe-to-Valve and Pipe-to-Equipment Connections: Use flanges, unions, or grooved couplings to allow disconnection of components for servicing; do not use direct welded, soldered, or threaded connections.
   1. Where grooved joints are used in piping, provide grooved valve/equipment connections if available; if not available, provide flanged ends and grooved flange adapters.

D. Valves: Provide valves where indicated:
   1. Provide drain valves where indicated, and if not indicated provide at least at main shut-off, low points of piping, bases of vertical risers, and at equipment. Use ball valves with cap; coordinate, with owner, piping to nearest floor drain.
   2. On discharge of _____ pumps install spring loaded check valve ahead of isolation valve.
   3. Isolate equipment using butterfly valves (4" and above) with lug end flanges or grooved mechanical couplings.
   4. For manual throttling, manual bypass, or manual flow control services, use ball or butterfly valves.
   5. For shut-off and to isolate parts of systems or vertical risers, use gate, ball, or butterfly valves.

E. Welding Materials and Procedures: Conform to ASME BPVC-IX.

2.02 HEATING WATER AND GLYCOL PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53/A53M, Schedule 40, black, using one of the following joint types:
   1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D1.1/D1.1M welded.
   2. Threaded Joints: ASME B16.3, malleable iron fittings.
   3. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.

B. Steel Pipe Sizes 12 Inch and Greater: ASTM A53/A53M, 3/8 inch wall, black, using one of the following joint types:
   1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D1.1/D1.1M welded.
   2. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.

C. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), drawn, using one of the following joint types:
   1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings.
      a. Solder: ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
      b. Braze: AWS A5.8M/A5.8 BCuP copper/silver alloy.
   2. Mechanical Press Sealed Fittings: Double pressed type complying with ASME B16.22, utilizing EPDM, nontoxic synthetic rubber sealing elements.
      a. Manufacturers:
         1) Grinnell Products; _____
         2) Viega LLC; _____
         3) Substitutions: See Section 016000 - Product Requirements.

D. HDPE Pipe: ASTM F2619/F2619M.
   1. Pipe and fittings shall be High-Density Polyethylene material in accordance with ASTM F2619/F2619M.
   2. Manufacturers:
      a. Nupi
      b. JM Eagle
      c. Substitutions: See Section 016000 - Product Requirements.

E. PP (Pressure-rated Polypropylene): ASTM F2389.

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1. Pipe and fittings shall be polypropylene material of type PP-R or PP-RCT in accordance with ASTM F2389.
2. Manufacturers:
    a. Aquatherm
    b. Nupi
    c. Substitutions: See Section 016000 - Product Requirements.

2.03 EQUIPMENT DRAINS AND OVERFLOWS

A. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), drawn; using one of the following joint types:
    1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings; ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
    2. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.

B. PVC Pipe: ASTM D1785, Schedule 40, or ASTM D2241, SDR 21 or 26.
    1. Fittings: ASTM D2466 or D2467, PVC.
    2. Joints: Solvent welded in accordance with ASTM D2855.

C. PVC Pipe Sizes 8 Inch and Greater: ASTM D1785, Schedule 80, or ASTM D2241, SDR 21 or 26.
    1. Fittings: ASTM D2466 or D2467, PVC.
    2. Joints: Solvent welded in accordance with ASTM D2855.

D. ABS Pipe: ASTM D2680.
    1. Fittings: Compatible with piping material.
    2. Joints: Solvent welded with ASTM D2235 cement.

2.04 PIPE HANGERS AND SUPPORTS

A. See specification section 220529 for requirements for this section.

2.05 UNIONS, FLANGES, MECHANICAL COUPLINGS, AND DIELECTRIC CONNECTIONS

A. Unions for Pipe 4 inches and Less:
    1. Ferrous Piping: 150 psig malleable iron, threaded.
    2. Copper Pipe: Bronze, soldered or mechanical press joints.

B. Flanges for Pipe 2 Inches and Greater:
    1. Ferrous Piping: 150 psig forged steel, slip-on.
    2. Copper Piping: Bronze.
    3. Gaskets: 1/16 inch thick preformed compressed fiber gasket.

C. Mechanical Couplings for Grooved and Shouldered Joints: Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket.
    1. Dimensions and Testing: In accordance with AWWA C606.
    2. Mechanical Couplings: Comply with ASTM F1476.
    3. Housing Material: Ductile iron, galvanized complying with ASTM A536.
    4. Gasket Material: EPDM suitable for operating temperature range from minus 30 degrees F to 230 degrees F.
    5. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel.
    6. Manufacturers:
        a. Grinnell Products;
        b. Victaulic Company;
        c. Anvil International; Gruvlock.
        d. Substitutions: See Section 016000 - Product Requirements.

D. Dielectric Connections:

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1. Nipples and couplings:
    a. Water impervious insulation barrier capable of limiting galvanic current to 1 percent of short circuit current in a corresponding bimetallic joint.
    b. Dry insulation barrier able to withstand 600 volt breakdown test.
    c. Suitable for the required operating pressures and temperatures.
2. Flanges:
    a. Dielectric flanges with same pressure ratings as standard flanges.
    b. Water impervious insulation barrier capable of limiting galvanic current to 1 percent of short circuit current in a corresponding bimetallic joint.
    c. Dry insulation barrier able to withstand 600 volt breakdown test.
    d. Suitable for the required operating pressures and temperatures.

PART 3 EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Prepare pipe for grooved mechanical joints as required by coupling manufacturer.

C. Remove scale and dirt on inside and outside before assembly.

D. Prepare piping connections to equipment using jointing system specified.

E. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

F. After completion, fill, clean, and treat systems. Refer to Section 232500 for additional requirements.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install heating water, glycol, chilled water, and condenser water piping to ASME B31.9 requirements.

C. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.

D. Route piping in orderly manner, parallel to building structure, and maintain gradient.

E. Install piping to conserve building space and to avoid interference with use of space.

F. Group piping whenever practical at common elevations.

G. Coordinate with civil to ensure pipe passing through exterior concrete walls shall be sealed with modular, elastomer sealing system. See Section 330660.

H. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 078400.

I. Slope piping and arrange to drain at low points.

J. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 230516.

K. Grooved Joints:
    1. Install in accordance with the manufacturer's latest published installation instructions.
    2. Gaskets to be suitable for the intended service, molded, and produced by the coupling manufacturer.

L. Inserts:
    1. Provide inserts for placement in concrete formwork.
    2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
    3. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

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M. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 230719.

N. Provide access where valves are not exposed. Coordinate size and location of access doors with Section 083100.

O. Install valves with stems upright or horizontal, not inverted.

END OF SECTION

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SECTION 232114
HYDRONIC SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Air vents.
B. Strainers.
C. Pressure-temperature test plugs.
D. Balancing valves.
E. Relief valves.
F. Pressure reducing valves.

1.02 RELATED REQUIREMENTS

A. Section 221006 - Plumbing Piping Specialties: Backflow preventers.
B. Section 232113 - Hydronic Piping.
C. Section 232500 - HVAC Water Treatment: Pipe cleaning.

1.03 REFERENCE STANDARDS

A. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2015.
B. ASME B16.5 - Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard; 2017.
C. ASME B16.11 - Forged Fittings, Socket-welding and Threaded; 2016 (Errata 2017).
D. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1 - Rules for Construction of Pressure Vessels; 2017.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting prior to the start of the work of this section; require attendance by all affected installers.
B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description and model.
C. Certificates: Inspection certificates for pressure vessels from authority having jurisdiction.
D. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.
E. Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.06 QUALITY ASSURANCE

A. 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. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
B. Provide temporary protective coating on cast iron and steel valves.

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C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.01 AIR VENTS

A. Manufacturers:
   1. Armstrong International, Inc
   2. ITT Bell & Gossett
   3. Taco, Inc
   4. Hoffman Specialty ITT;
   5. Spirax Sarco;
   6. Spirotech;
   7. Substitutions: See Section 016000 - Product Requirements.

B. Manual Type: Short vertical sections of 2 inch diameter pipe to form air chamber, with 1/8 inch brass needle valve at top of chamber.

C. Float Type:
   1. Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.
   2. Cast iron body and cover, float, bronze pilot valve mechanism suitable for system operating temperature and pressure; with isolating valve.

D. Maximum Fluid Pressure: 150 psi.

E. Maximum Fluid Temperature: 250 degrees F.

2.02 STRAINERS

A. Manufacturers:
   1. Armstrong International, Inc; _____
   2. Flexicraft Industries; _____
   3. Grinnell Products, a Tyco Business; _____
   4. The Metraflex Company;
   5. Watts;
   6. Victaulic;
   7. Spirax Sarco;
   8. Substitutions: See Section 016000 - Product Requirements.

B. Size 2 inch and Under:
   1. Screwed brass or iron body for a minimum of 200 psi working pressure, Y pattern with 1/32 inch stainless steel perforated screen, full size drain connection with ball valve.

C. Size 2-1/2 inch to 4 inch:
   1. Provide flanged or grooved iron body for 500 psi working pressure, Y pattern with 1/16 inch, or 3/64 inch stainless steel perforated screen, drain connection with ball valve.

D. Size 5 inch and Larger:
   1. Provide flanged or grooved iron body for 500 psi working pressure, basket pattern with 1/8 inch stainless steel perforated screen, drain connection with ball valve.

2.03 PRESSURE-TEMPERATURE TEST PLUGS

A. Manufacturers:
   1. Ferguson Enterprises Inc; _____
   2. Peterson Equipment Company Inc; _____

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3. Sisco Manufacturing Company Inc; _____
4. Substitutions: See Section 016000 - Product Requirements.

B. Construction: Brass body designed to receive temperature or pressure probe with removable protective cap, and Neoprene rated for minimum 200 degrees F.

C. Application: Use extended length plugs to clear insulated piping.

2.04 BALANCING VALVES

A. Manufacturers:
1. ITT Bell & Gossett; _____
2. Taco, Inc; _____
3. IMI Flow Design;
4. Nexus Valve;
5. Substitutions: See Section 016000 - Product Requirements.

B. Size 2 inch and Smaller:
1. Provide ball or globe style with flow balancing, flow measurement, and shut-off capabilities, memory stops, minimum of two metering ports and NPT threaded or soldered connections.
2. Metal construction materials consist of bronze or brass.
3. Non-metal construction materials consist of Teflon or EPDM.

C. Size 2.5 inch and Larger:
1. Provide ball or butterfly style with flow balancing, flow measurement, and shut-off capabilities, memory stops, minimum of two metering ports and flanged, grooved, or weld end connections.
2. Valve body construction materials consist of cast iron, carbon steel, or ductile iron.
3. Internal components construction materials consist of brass, aluminum bronze, bronze, Teflon, or EPDM.

2.05 RELIEF VALVES

A. Manufacturers:
1. Watts;
2. Armstrong International, Inc; _____
3. ITT Bell & Gossett; _____
4. Conbraco Industries; _____
5. Substitutions: See Section 016000 - Product Requirements.

B. Bronze body, Teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labelled.

2.06 PRESSURE REDUCING VALVES

A. Manufacturers:
1. Watts;
2. Armstrong International, Inc; _____
3. ITT Bell & Gossett; _____
4. Taco, Inc; _____
5. Substitutions: See Section 016000 - Product Requirements.

B. Operation: Automatically feeds make-up water to the hydronic system whenever pressure in the system drops below the pressure setting of the valve. Refer to Section 232113.

C. Materials of Construction:
1. Valve Body: Constructed of bronze, cast iron, brass, or iron.
2. Internal Components: Construct of stainless steel or brass and engineered plastics or composition material.

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D. Connections:
   1. NPT threaded: ____ inch.
   2. Soldered: ____ inch.

E. Provide integral check valve and strainer.

F. Maximum Inlet Pressure: 100 psi.

G. Maximum Fluid Temperature: 180 degrees F.

H. Operating Pressure Range: Between 10 psi and 25 psi.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install specialties in accordance with manufacturer's instructions.

B. Where large air quantities can accumulate, provide enlarged air collection standpipes.

C. Provide manual air vents at system high points and as indicated.

D. For automatic air vents in ceiling spaces or other concealed locations, provide vent tubing to nearest drain.

E. Provide air separator on suction side of system circulation pump and connect to expansion tank.

F. Provide valved drain connection or hose connection, where applicable, on strainer blow down.

G. Provide pump suction diffuser on suction side of base mounted centrifugal pumps where indicated. Remove start-up strainers within 24-48 hours after pump start up.

H. Support pump fittings with floor mounted pipe and flange supports.

I. Provide relief valves on pressure tanks, low pressure side of reducing valves, heat exchangers, and expansion tanks.

J. Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.

K. Pipe non-glycol relief valve outlets to nearest floor drain.

L. Pipe glycol relief valve outlets back to glycol tank.

M. Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.

N. Clean and flush glycol system before adding glycol solution. Refer to Section 232500.

O. Feed glycol solution to system through make-up line with pressure regulator, while venting system high points.

P. Perform tests determining strength of glycol and water solution and submit written test results.

Q. Install expansion tank and associated piping so that piping can be easily isolated and removed to maintain service access and to facilitate replacement of tank bladder. Verify that installation meets Owner's requirements with Owner's representative.

3.02 MAINTENANCE

A. See Section 017000 - Execution Requirements, for additional requirements relating to maintenance service.

END OF SECTION

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SECTION 232500

HVAC WATER TREATMENT

PART 1 GENERAL

1.01 GENERAL

A. Power Engineering shall be hired as a subcontractor to provide direction to the mechanical contractor, for all project HVAC Water Treatment.

1.02 SECTION INCLUDES

A. Materials.
   1. System cleaner.
   2. Closed system treatment (water).

B. Conductivity controller.

C. Water meter.

D. Bleed valves.

1.03 RELATED REQUIREMENTS

A. Section 011000 - Summary: Owner furnished treatment equipment.

B. Section 016000 - Product Requirements: Owner furnished treatment equipment.

C. Section 230913 - Instruments and Control Elements.

D. Section 232113 - Hydronic Piping.

E. Section 232114 - Hydronic Specialties.

F. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.

1.04 REFERENCE STANDARDS

A. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide chemical treatment materials, chemicals, and equipment including electrical characteristics and connection requirements. Include all MSDS (Material Safety Data Sheets) as applicable.

C. Shop Drawings: Indicate system schematic, equipment locations, and controls schematics, electrical characteristics and connection requirements.

D. Manufacturer's Installation Instructions: Indicate placement of equipment in systems, piping configuration, and connection requirements.

E. Manufacturer's Field Reports: Indicate start-up of treatment systems when completed and operating properly. Indicate analysis of system water after cleaning and after treatment.

F. Certificate: Submit certificate of compliance from Authority Having Jurisdiction indicating approval of chemicals and their proposed disposal.

G. Project Record Documents: Record actual locations of equipment and piping, including sampling points and location of chemical injectors.

H. Operation and Maintenance Data: Include data on chemical feed pumps, agitators, and other equipment including spare parts lists, procedures, and treatment programs. Include step by step instructions on test procedures including target concentrations.

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1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience. Company shall have local representatives with water analysis laboratories and full time service personnel.

B. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum five years of documented experience and approved by manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Power Engineering Co.

B. Brenntag.

C. Substitutions: See Section 016000 - Product Requirements.

2.02 REGULATORY REQUIREMENTS

A. Comply with applicable codes for addition of non-potable chemicals to building mechanical systems and to public sewage systems.

B. Comply with UL (DIR) requirements.

C. Perform work in accordance with local health department regulations.

D. Provide certificate of compliance from Authority Having Jurisdiction indicating approval of installation.

2.03 MATERIALS

A. System Cleaner:
   1. Liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products.
   2. Biocide chlorine release agents such as sodium hypochlorite or calcium hypochlorite.

B. Closed System Treatment (Water):
   1. Corrosion inhibitors to match what is currently being used in the system.
   2. Oxygen scavenger: Hydrazine or DEHA to match what is currently being used in the system.

C. Steam System Treatment:
   1. Sequestering agent to reduce hardness and prevent feedline fouling; phosphate.
   2. Base to provide alkalinity; hydroxide.
   3. Oxygen scavenger; sodium sulphite.
   4. Carbon dioxide neutralizer; volatile amines such as morpholine or cyclohexylamine.
   5. Filming amines; octadecylamine.

D. Condenser Water System Treatment (Cooling Towers):
   1. Sequestering agent to inhibit scaling; phosphonates, sodium polyphosphates, lignin derivatives, synthetic polymer polyelectrolytes, or organic phosphates.
   2. Acid to reduce alkalinity and pH; sulphury acid.
   3. Corrosion inhibitor; zinc-phosphate, phosphonate-phosphate, and phosphonate-silicate, sodium Toly triazole, or low molecular weight polymers.
   4. Biocide; microbicides such as quaternary ammonia compounds, tributyl tin oxide, methylene bis (thiocyanate) or isothiazolones.

2.04 CONDUCTIVITY CONTROLLER

A. Manufacturers:
   1. WalChem;
   2. Substitutions: See Section 016000 - Product Requirements.

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B. Packaged monitor controller with solid state circuitry, five percent accuracy, all adjustment will be made via a touch screen interface, display shall be programmable for default readings. Controller shall be capable of datalogging.

2.05 WATER METER

A. Manufacturers:
   1. Onicon.

B. Cooling towers, boiler makeup and closed systems: Displacement type cold water meter with sealed, tamper-proof magnetic drive, impulse contact register, single pole, double throw dry contact switch. Manufacturer: Seametrics or Carlon.

C. Boiler feedwater: Turbine flow meter. Dry contact output that can be scaled to feedwater flow.

2.06 BLEED VALVES

A. Manufacturers:
   1. Flow-Tek.

B. Cooling tower bleed valve shall be a motorized ball valve. Design shall be full port. Actuator shall be slow opening with spring return closed operation. Valve shall be fail safe closed. Manufacturer: Belimo

C. Boiler blowdown valve shall be a motorized ball valve. Design shall be full port, high temp with Teflon chevron stem packing. Valve packing shall be adjustable and rebuildable. Actuator shall be power open/power close. Manufacturer: Flow-Tek

PART 3 EXECUTION

3.01 PREPARATION

A. Systems shall be operational, filled, started, and vented prior to cleaning. Use water meter to record capacity in each system.

B. Place terminal control valves in open position during cleaning.

C. Verify that electric power is available and of the correct characteristics.

3.02 CLEANING SEQUENCE

A. Concentration:
   1. As recommended by manufacturer.
   2. Fill steam boilers only with cleaner and water.

B. Hot Water Heating Systems:
   1. Apply heat while circulating, slowly raising temperature to 160 degrees F and maintain for 12 hours minimum.
   2. Remove heat and circulate to 100 degrees F or less; drain systems as quickly as possible and refill with clean water.
   3. Circulate for 6 hours at design temperatures, then drain.
   4. Refill with clean water and repeat until system cleaner is removed.

E. Use neutralizer agents on recommendation of system cleaner supplier and approval of Architect.

F. Flush open systems and glycol filled closed systems with clean water for one hour minimum. Drain completely and refill.

G. Remove, clean, and replace strainer screens.

H. Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.

I. Use DI water to flush glycol systems.

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3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.04 CLOSED SYSTEM TREATMENT

A. Provide one bypass feeder on each system. Install isolating and drain valves and necessary piping. Run drain piping to nearest floor drain. Install around balancing valve downstream of circulating pumps unless indicated otherwise.

B. Introduce closed system treatment through bypass feeder when required or indicated by test.

3.05 CLOSEOUT ACTIVITIES

A. Training: Train Owner's personnel on operation and maintenance of chemical treatment system, as needed.
   1. Have operation and maintenance data prepared and available for review during training.
   2. Conduct training using actual equipment after treated system has been put into full operation.

END OF SECTION

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SECTION 233100
HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal ductwork.

B. Nonmetal ductwork.

1.02 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete.

B. Section 078400 - Firestopping.

C. Section 099113 - Exterior Painting: Weld priming, weather resistant, paint or coating.

D. Section 099123 - Interior Painting: Weld priming, paint or coating.

E. Section 114000 - Foodservice Equipment: Supply of kitchen range hoods for placement by this Section.

F. Section 230130.51 - HVAC Air Duct Cleaning: Cleaning ducts after completion of installation.

G. Section 230593 - Testing, Adjusting, and Balancing for HVAC.

H. Section 230713 - Duct Insulation: External insulation and duct liner.

I. Section 233300 - Air Duct Accessories.

J. Section 233600 - Air Terminal Units.

K. Section 233700 - Air Outlets and Inlets.

1.03 REFERENCE STANDARDS

A. ASHRAE (FUND) - ASHRAE Handbook - Fundamentals; 2017.

B. ASHRAE Std 126 - Method of Testing HVAC Air Ducts; 2016.

C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.

D. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2016.

E. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2017.

F. ASTM A480/A480M - Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip; 2017.

G. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

H. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.

I. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2016.

J. 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; 2015.

K. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

L. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.

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M. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009 (Reapproved 2016).

N. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2016a.

O. ASTM E2336 - Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems; 2020.

P. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2015.

Q. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements; 2015.

R. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2015.

S. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2016.

T. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2015.

U. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2018.

V. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; 2017.

W. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Rev. 2009).

X. SMACNA (FGD) - Fibrous Glass Duct Construction Standards; 2003.

Y. SMACNA (KVS) - Kitchen Ventilation Systems and Food Service Equipment Fabrication and Installation Guidelines; 2001.

Z. SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual; 2012, 2nd Edition.

AA. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; current edition, including all revisions.

AB. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

AC. UL 1978 - Grease Ducts; Current Edition, Including All Revisions.

AD. UL 2221 - Tests of Fire Resistive Grease Duct Enclosure Assemblies; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data for duct materials, duct liner, and duct connections.

C. Shop Drawings: Indicate duct fittings, particulars such as gages, sizes, welds, and configuration prior to start of work for all duct systems.

D. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA (LEAK).

E. Manufacturer's Installation Instructions: Indicate special procedures for glass fiber ducts.

F. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.05 QUALITY ASSURANCE

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

B. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum five years of documented experience.

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1.06 FIELD CONDITIONS

A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

B. Maintain temperatures within acceptable range during and after installation of duct sealants.

PART 2 PRODUCTS

2.01 DUCT ASSEMBLIES

A. Regulatory Requirements: Construct ductwork to NFPA 90A, NFPA 90B, and NFPA 96 standards, as applicable.

B. Ducts: Galvanized steel, unless otherwise indicated.

C. Low Pressure Supply (Heating Systems): 2 inch w.g. pressure class, galvanized steel.

D. Low Pressure Supply (System with Cooling Coils): 2 inch w.g. pressure class, galvanized steel.

E. Buried Supply or Return: 2 inch w.g. pressure class, fiber glass reinforced plastic or Linear Low Density Polyethylene / High Density Polyethylene (EVALENE LLDPE/HDPE).

F. Medium and High Pressure Supply: 6 inch w.g. pressure class, galvanized steel.

G. Return and Relief: 1/2 inch w.g. pressure class, galvanized steel.

H. General Exhaust: 1 inch w.g. pressure class, galvanized steel.

I. Kitchen Cooking Hood Exhaust: 1 inch w.g. pressure class, stainless steel or un-galvanized steel.
   1. Construct of 16 gage, 0.0598 inch sheet steel using continuous external welded joints in rectangular sections.
   2. Construct of 18 gage, 0.0500 inch stainless steel using continuous external welded joints in rectangular sections.

J. Dishwasher Exhaust: 1 inch w.g. pressure class, stainless steel.
   1. Construct of 18 gage, 0.0500 inch stainless steel using continuous external welded joints in rectangular sections.

K. Grease Exhaust: 1 inch w.g. pressure class, stainless or un-galvanized steel.
   1. Construct of ASTM A1011/A1011M 16 gage un-galvanized steel.
   2. Construct of 18 gage, 0.0500 inch stainless steel.
   3. Construction:
      a. Liquid tight with continuous external weld for all seams and joints.
      b. Where ducts are not self-draining back to equipment, provide low point drain pocket with copper drain pipe to sanitary sewer.
   4. Access Doors:
      a. Provide for duct cleaning inside horizontal duct at drain pockets, every 20 feet and at each change of direction.
      b. Use same material and thickness as duct with gaskets and sealants rated 1500 degrees F for grease tight construction.

L. Fume Hood Exhaust: 2 inch w.g. pressure class, galvanized steel.

M. Outside Air Intake: 1/2 inch w.g. pressure class, galvanized steel.

N. Combustion Air: 1/2 inch w.g. pressure class, galvanized steel.

O. Evaporative Condenser Intake and Exhaust: 1/2 inch w.g. pressure class, galvanized steel.

P. Emergency Generation Ventilation: 1/2 inch w.g. pressure class, galvanized steel.

Q. Transfer Air and Sound Boots: 1/2 inch w.g. pressure class, Fibrous glass or sheet metal with acoustic lining.

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2.02 MATERIALS

A. Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G60/Z180 coating.

B. Un-Galvanized Steel for Ducts: 1, Designation CS (commercial steel), cold-rolled.

C. Stainless Steel for Ducts: 1, Type 304.

D. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
   1. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
   2. Surface Burning Characteristics: Flame spread index of zero and smoke developed index of zero, when tested in accordance with ASTM E84.

E. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

F. Sheet Metal Strap.

G. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

H. Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
   1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
   2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
   3. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
   4. Masonry Screw Type Anchors: Complying with ICC-ES AC106.
   5. Concrete Adhesive Type Anchors: Complying with ICC-ES AC308.
   6. Other Types: As required.

2.03 DUCTWORK FABRICATION

A. Fabricate and support in accordance with SMACNA (DCS) and as indicated.

B. No variation of duct configuration or size permitted except by written permission. Where permitted, size round duct installed in place of rectangular ducts in accordance with ASHRAE (FUND) Handbook - Fundamentals.

C. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

D. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline, or where rectangular elbows are used, provide single width blade with trailing edge turning vanes of galvanized steel sheet metal.

E. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

F. Fabricate continuously welded round and oval duct fittings in accordance with SMACNA (DCS).

2.04 MANUFACTURED DUCTWORK AND FITTINGS

A. Flat Oval Ducts: Machine made from round spiral lock seam duct.
   1. Manufacture in accordance with SMACNA (DCS).
   2. Fittings: Manufacture at least two gages heavier metal than duct.
   3. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

B. Double Wall Insulated Flat Oval Ducts: Machine made from round spiral lock seam duct.
   1. Manufacture in accordance with SMACNA (DCS).
   2. Fittings: Manufacture with solid inner wall.
   3. Duct inner wall: Perforated galvanized steel.

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4. Insulation:
    a. Thickness: ___ inch fiberglass.
    b. Insulation K Value: _____.
    c. Insulation Density: _____.

C. Double Wall Insulated Round Ducts: Round spiral lock seam duct with galvanized steel outer wall, perforated galvanized steel inner wall; fitting with solid inner wall.
1. Manufacture in accordance with SMACNA (DCS).
2. Insulation:
    a. Thickness: ___ inch.
    b. Material: Fiberglass.
    c. Insulation K Value: _____.
    d. Insulation Density: _____.

D. Double Wall Insulated Rectangular Ducts: Rectangular spiral lock seam duct with galvanized steel outer wall, perforated galvanized steel inner wall; fitting with solid inner wall.
1. Manufacture in accordance with SMACNA (DCS).
2. Insulation:
    a. Thickness: ___ inch.
    b. Material: Fiberglass.
    c. Insulation K Value: _____.
    d. Insulation Density: _____.

E. Spiral Ducts: Round spiral lock seam duct with galvanized steel outer wall.
1. Manufacture in accordance with SMACNA (DCS).

F. Round Ducts: Round lock seam duct with galvanized steel outer wall.
1. Manufacture in accordance with SMACNA (DCS).

G. Fiber Glass Reinforced Plastic (FRP) Ducts: Glass fiber reinforced plastic, minimum 3/16 inch wall thickness, for all direct-burial underground air duct systems.
1. Class 1 flame and smoke rating.
2. Insulation: R-4 thru R-12 available.
3. Manufacturers:
    a. Spunstrand;Green Duct
    b. Monoxivent;UnderDuct
    c. Perry Fiberglass Products;
    d. Substitutions: See Section 016000 - Product Requirements.

H. Linear Low Density Polyethylene / High Density Polyethylene (EVALENE LLDPE/HDPE) Ducts: Self-insulated, direct-burial underground air duct system for supply air, outside air, return air, and relief air duct systems.
1. Manufacture in accordance with SMACNA (DCS).
2. Fittings: Elbows, tees, wyes, reducers, boots, diffusers, plenums, endcaps, clamps and gaskets.
3. Insulation: R-10 equivalent.
4. Manufacturers:
    a. AQC Industries; The BlueDuct
    b. Substitutions: See Section 016000 - Product Requirements.

I. Flexible Ducts: Woven and coated fiberglass liner permanently bonded to a helically wound coated or galvanized spring steel wire.
1. Class 1.
2. UL labeled.
3. Insulation: Fiberglass insulation with aluminized polyester vapor barrier film.

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4. Pressure Rating: 16 inches WG positive for 4"-10" duct, 10 inches WG positive for 12"-16" duct, and 2 inches WG negative.
5. Maximum Velocity Rating: 5500 fpm.
6. Temperature Range: Minus 20 degrees F to 250 degrees F.
7. Manufacturers:
   a. Flexmaster U.S.A; 3M
   b. Thermaflex; M-KC
   c. Hart & Cooley, Inc; F294
   d. Substitutions: See Section 016000 - Product Requirements.

J. Transverse Duct Connection System: SMACNA "E" rated rigidly class connection, interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner clips in accordance with SMACNA (DCS).

PART 3 EXECUTION

3.01 INSTALLATION

A. Install, support, and seal ducts in accordance with SMACNA (DCS).

B. Install in accordance with manufacturer's instructions.

C. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

D. Flexible Ducts: Connect to metal ducts with draw bands. No more than 24 inch long lengths of flexible ductwork allowed at each use.

E. No spin-in duct fittings allowed. Use high efficiency take-offs or 45 degree take-offs only. Install high efficiency take-offs with 45 degree leg on upstream side of take-off.

F. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.

G. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

H. Use crimp joints with or without bead for joining round duct with crimp in direction of air flow.

I. Use double nuts and lock washers on threaded rod supports.

J. Connect terminal units and diffusers to supply ducts directly, if possible. Where hard ducting connections are not possible, flexible duct shall be installed such that the center line of the terminal unit or diffuser inlet shall not be offset from the center line of the duct elbow by more than one duct radius. No flexible duct elbows allowed and do not use flexible duct to change direction.

K. Set plenum doors 6 to 10 inches above floor. Arrange door swings so that fan static pressure holds door in closed position.

L. At exterior wall louvers, seal duct to louver frame.

END OF SECTION

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SECTION 233300

AIR DUCT ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Air turning vanes.
B. Backdraft dampers.
C. Combination fire and smoke dampers.
D. Duct access doors.
E. High efficiency take-offs with hand dampers.
F. Hand dampers.
G. Duct test holes.
H. Fire dampers.
I. Flexible duct connections.
J. Smoke dampers.
K. Variable control dampers.
L. Miscellaneous products:
    1. Duct opening closure film.

1.02 RELATED REQUIREMENTS

A. Section 078400 - Firestopping.
B. Section 220548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.
C. Section 233100 - HVAC Ducts and Casings.
D. Section 233600 - Air Terminal Units: Pressure regulating damper assemblies.
E. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

A. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2015.
B. NFPA 92 - Standard for Smoke Control Systems; 2015.
C. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; 2017.
D. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Rev. 2009).
E. UL 33 - Safety Heat Responsive Links for Fire-Protection Service; Current Edition, Including All Revisions.
F. UL 555 - Standard for Fire Dampers; Current Edition, Including All Revisions.
G. UL 555S - Standard for Smoke Dampers; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide for shop fabricated assemblies including volume control dampers, duct access doors, and hardware used. Include electrical characteristics and connection requirements.
C. Manufacturer's Installation Instructions: Provide instructions for fire dampers and combination fire and smoke dampers.

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D. Project Record Drawings: Record actual locations of access doors.

1.05 QUALITY ASSURANCE

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

B. Products Requiring Electrical Connection: Listed and classified by testing firm acceptable to the Authority Having Jurisdiction as suitable for the purpose specified and indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect dampers from damage to operating linkages and blades. Store in clean, dry location.

PART 2 PRODUCTS

2.01 AIR TURNING DEVICES

A. Manufacturers:
   1. Carlisle HVAC Products; Model DYN-O-RAIL, DYN-O-RAIL JR.
   2. Elgen Manufacturing, Inc; Model EVR-1
   3. Duro Dyne Corp; Model DHVR2, DHVR4
   4. Ductmate Industries, Inc.; MONOrail
   5. Substitutions: See Section 016000 - Product Requirements.

B. Multi-blade device with radius single wall blades aligned in short dimension of all square duct elbows; steel construction; turning vane spacing per SMACNA (DCS); each blade tack welded or crimped to the vane rail to prevent rattling.

2.02 BACKDRAFT DAMPERS

A. Manufacturers:
   1. Greenheck Fan Corp.; _____
   2. Nailor Industries, Inc; _____
   3. Ruskin Company; _____
   4. Substitutions: See Section 016000 - Product Requirements.

B. Gravity Backdraft Dampers, Size 18 by 18 inches or Smaller, Furnished with Air Moving Equipment: Air moving equipment manufacturer's standard construction.

C. Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: Frame shall be .090” extruded aluminum wall thickness with mitered corners; blades shall be .050” extruded aluminum with extruded vinyl edge seals. Blade edge seals shall be mechanically locked into blade edge; adhesive type seals are unacceptable. Bearings shall be corrosion resistant synthetic and linkage shall be concealed in frame for low pressure drop and noise.; adjustment device to permit setting for varying differential static pressure.

2.03 COMBINATION FIRE AND SMOKE DAMPERS

A. Manufacturers:
   1. Greenheck Fan Corp.; FSD-311
   2. NCA Manufacturing; FSD-AF-211
   3. Pottorff; FSD-151
   4. Ruskin Company; FSD60

B. Fabricate in accordance with NFPA 90A, UL 555, UL 555S, and as indicated.

C. Provide factory sleeve and collar for each damper.

D. Multiple Blade Dampers: Galvanized hat-shaped steel channel frame; steel airfoil shaped double skin construction blades; silicone rubber blade edge seals; flexible compression jamb seals; stainless steel

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bearings; leakage Class I; 4000 fpm velocity rating; damper and operator to be qualified for 350 degrees F temperature rating.

E. Operators: UL listed and labelled spring return electric type suitable for 120 volts, single phase, 60 Hz. Locate damper operator on exterior of duct and link to damper operating shaft. Furnish and install a single pole switch to disconnect power, for testing and servicing.

F. Electro Thermal Link: Cold or return air: Fusible link melting at 165 degrees F; hot air: Fusible link melting at 212 degrees F (100 degrees C); 120 volts, single phase, 60 Hz; UL listed and labeled.

2.04 DUCT ACCESS DOORS

A. Manufacturers:
   1. Acudor Products Inc,; _____
   2. Elgen Manufacturing, Inc; _____
   3. Ductmate Industries, Inc.; _____
   4. Nailor Industries, Inc; _____
   5. Duro Dyne Corp.; _____
   6. SEMCO LLC; _____: www.semcohvac.com
   7. Substitutions: See Section 016000 - Product Requirements.

B. Fabricate in accordance with SMACNA (DCS) and as indicated.

C. Access doors with sheet metal screw fasteners are not acceptable.

2.05 HIGH EFFICIENCY TAKE-OFFS WITH MANUAL BALANCING DAMPERS

A. Manufacturers:
   1. Sheet Metal Connectors, Inc.;
   2. Substitutions: See Section 016000 - Product Requirements.

B. Fabricated in accordance to SPIDA and SMACNA / ASHRAE Leakage Class 3 standards. Testing performed by ETL Testing lab.

C. Fabricated from minimum 22 gauge galvanized steel (ASTM A653).

D. 45 degree take-off angle design for optimal air flow.

E. Supply with gasketed discharge connection.

F. 1" wide flange with minimum 3/4" wide double faced adhesive gasket to assure tight seal and to hold the fitting securely in position during installation.

G. 2" rod extension to extend damper handle location beyond duct insulation.

H. Damper handle with locking hex or wing nut. Position of damper handle shall indicate damper setting.

2.06 MANUAL BALANCING DAMPERS

A. Manufacturers:
   1. Greenheck;
   2. Ruskin;
   3. Pottorff;
   4. Substitutions: See Section 016000 - Product Requirements.

B. Frame: 20 gauge galvanized steel.

C. Blades: 20 gauge galvanized steel.

D. Control shafts and axles: 3/8" square plated steel, extended for stand-off.

E. Bearings: Synthetic.

F. 1 1/2" high stand-off bracket, minimum, with factory installed manual locking quadrant.

G. Rated for maximum system velocity of 1500 fpm.

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2.07 DUCT TEST HOLES

A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

2.08 FIRE DAMPERS

A. Manufacturers:
   1. Greenheck Fan Corp.; _____
   2. NCA Manufacturing; _____
   3. Pottorff; _____
   4. Ruskin Company; _____

B. Fabricate in accordance with NFPA 90A and UL 555, and as indicated.

C. Ceiling Dampers: Galvanized steel, 22 gage, 0.0299 inch frame and 16 gage, 0.0598 inch flap, two layers 0.125 inch ceramic fiber on top side and one layer on bottom side for round flaps, with locking clip.

D. Horizontal Dampers: Galvanized steel, 22 gage, 0.0299 inch frame, stainless steel closure spring, and lightweight, heat retardant non-asbestos fabric blanket.

E. Curtain Type Dampers: Galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for horizontal installations. Configure with blades out of air stream except for 1.0 inch pressure class ducts up to 12 inches in height.

F. Multiple Blade Dampers: 16 gage, 0.0598 inch galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, 1/8 by 1/2 inch plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.

G. Fusible Links: UL 33, separate at 160 degrees F with adjustable link straps for combination fire/balancing dampers.

2.09 FLEXIBLE DUCT CONNECTIONS

A. Manufacturers:
   1. Carlisle HVAC Products
   2. Duro Dyne Corp.; _____
   3. Ductmate Industries, Inc.;_____
   4. Substitutions: See Section 016000 - Product Requirements.

B. Fabricate in accordance with SMACNA (DCS) and as indicated.

C. Flexible Duct Connections: Fabric crimped into metal edging strip.
   1. Fabric: UL listed fire-retardant neoprene or hypalon coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz per sq yd.
      a. Net Fabric Width: Approximately 3.5 inch wide.
   2. Metal: 3 inches wide, 24 gage, 0.0239 inch thick galvanized steel.

2.10 SMOKE DAMPERS

A. Manufacturers:
   1. Greenheck Fan Company; SMD-301:
   2. NCA Manufacturing; SSD-AF-201:
   3. Ruskin Company; SD60:
   4. PottorffSD-151:

B. Fabricate in accordance with NFPA 90A and UL 555S, and as indicated.

C. Dampers: Galvanized hat-shaped steel channel frame; 14-gauge steel airfoil shaped double skin construction blades; silicone rubber blade edge seals; flexible compression jamb seals; stainless steel bearings, leakage Class II; 4000 fpm velocity rating; damper and operator to be qualified for 350

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degrees F temperature rating; damper and electric operator shall be normally closed.

_____

2.11 VARIABLE CONTROL DAMPERS

A. Manufacturers:
   1. Greenheck Fan Company;
   2. Ruskin Company;
   3. T.A. Morrison & Co. (Tamco);

B. Fabricate in accordance with SMACNA (DCS) and as indicated.

C. Variable Control Dampers:

   1. Dampers shall be supported, plenum openings shall be reinforced, the entire assembly shall be sturdy and operate smoothly; install parallel blade dampers to direct outside and return air into each other for mixing; use parallel blade dampers for outside air, return air, use opposed blade dampers for relief air, ventilation air, exhaust air, and supply air.

   2. Low leakage type with spring loaded side seals, inflatable butyl or neoprene fabric edge seals, bronze or Teflon bearings, reinforced extruded aluminum airfoil blades, aluminum frame. Action as indicated on drawings. Air leakage not to exceed 5 CFM per square foot at 4" upstream static pressure.

D. Single Blade Dampers:
   1. Fabricate for duct sizes up to 6 by 30 inch.
   2. Blade: 24 gage, 0.0239 inch, minimum.
   3. Manufacturers:
      a. Greenheck; VCD-43.
      b. Ruskin; CD50.
      c. Tamco; Series 1000.

E. Multi-Blade Damper: Fabricate of opposed or parallel blade pattern with maximum blade sizes 8 by 60 inch. Maximum individual damper section height, 60". Maximum individual damper section width, 60".
   1. Blade: 18 gage, 0.0478 inch, minimum.
   2. Manufacturers:
      a. Greenheck; VCD-43.
      b. Ruskin; CD50.
      c. Tamco; Series 1000.

F. Quadrants:
   1. Provide locking, indicating quadrant regulators on single and multi-blade hand dampers.
   2. On insulated ducts, mount quadrant regulators on stand-off mounting brackets, bases, or adapters.
   3. Where rod lengths exceed 30 inches provide regulator at both ends.

2.12 MISCELLANEOUS PRODUCTS

A. Duct Opening Closure Film: Mold-resistant, self-adhesive film to keep debris out of ducts during construction.
   1. Thickness: 2 mils.
   2. High tack water based adhesive.
   3. UV stable light blue color.
   4. Elongation Before Break: 325 percent, minimum.
   5. Manufacturers:
      a. Carlisle HVAC Products; Dynair Duct Protection Film:

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b. Elgen Manufacturing; Shrink Wrap w/PSA.
c. Substitutions: See Section 016000 - Product Requirements.

PART 3 EXECUTION

3.01 PREPARATION

A. Verify that electric power is available and of the correct characteristics.

B. Examine areas and conditions under which ductwork accessories will be installed. Do not proceed with work until conditions allow for contamination free duct installation.

3.02 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA (DCS). Refer to Section 233100 for duct construction and pressure class.

B. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

C. Provide duct access doors for inspection, cleaning, and maintenance ahead of filters, coils, fans, and automatic dampers, and at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide for cleaning kitchen exhaust ducts in accordance with NFPA 96. Provide duct access door, of adequate size, for equipment requiring hand access or shoulder access, and as indicated. Review duct access door locations with Owner's Representative prior to fabrication.

D. Provide fire dampers, combination fire and smoke dampers, and smoke dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by Authorities Having Jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.

E. Install smoke dampers and combination smoke and fire dampers in accordance with NFPA 92.

F. Demonstrate re-setting of fire dampers to Owner's representative.

G. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.

H. Install turning vanes in square or rectangular 90 degree elbows in supply and exhaust air systems, and elsewhere as indicated.

I. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment.
   1. Refer to Section 230548.

J. For fans developing static pressures of 5.0 inches and over, cover flexible connections with leaded vinyl sheet, held in place with metal straps.

K. **Furnish and install manual balancing dampers on duct take-offs to diffusers, grilles, and registers on zones with multiple outlets.**

END OF SECTION

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SECTION 233600
AIR TERMINAL UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Air terminal units.
   1. Single-duct, variable-volume units.

B. Hot water reheat coil.

C. Round terminal units.
   1. Single-duct, variable volume units.

1.02 RELATED REQUIREMENTS

A. Section 230513 - Common Motor Requirements for HVAC Equipment.

B. Section 230548 - Vibration and Seismic Controls for HVAC Piping and Equipment.

C. Section 230913 - Instruments and Control Elements: Thermostats and actuators.

D. Section 230923 - Direct-Digital Control System for HVAC.

E. Section 230993 - Sequence of Operations for HVAC Controls.

F. Section 232113 - Hydronic Piping: Connections to heating coils.

G. Section 232114 - Hydronic Specialties: Connections to heating coils.

H. Section 233100 - HVAC Ducts and Casings.

I. Section 233300 - Air Duct Accessories.

J. Section 233700 - Air Outlets and Inlets.

K. Section 238200 - Convection Heating and Cooling Units: Air coils.

L. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

A. AHRI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils; 2001 (R2011).

B. AHRI 880 (I-P) - Performance Rating of Air Terminals; 2011 with Addendum 1.

C. AHRI 885 - Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets; 2008 with Addendum 1.

D. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size; 2017.

E. ASHRAE Std 62.1 - Ventilation for Acceptable Indoor Air Quality; 2016.

F. ASHRAE Std 130 - Methods of Testing Air Terminal Units; 2016.

G. ASTM A492 - Standard Specification for Stainless Steel Rope Wire; 1995 (Reapproved 2013).

H. ASTM A603 - Standard Specification for Zinc-Coated Steel Structural Wire Rope; 1998 (Reapproved 2014).

I. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material); 2016.

J. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.

K. ASTM E488/E488M - Standard Test Methods for Strength of Anchors in Concrete Elements; 2015.

L. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.

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M. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

N. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2015.

O. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems; Sheet Metal and Air Conditioning Contractors' National Association; 2008.

P. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; current edition, including all revisions.

Q. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting prior to the start of the work of this section; require attendance by all affected installers.

B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

C. Contractor shall provide a first installation of air terminal unit assembly and installation for owner's review. If both dual duct and vav reheat assemblies are used on project, a first installation shall be provided for each type of assembly. First installations, shall be reviewed and approved by owner's representative prior to any additional terminal unit assembly installations for project. After owner approval, all remaining terminal unit assembly installations shall meet standard of approved terminal assembly first installation.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings that indicate air flow, static pressure, and NC designation.

C. Shop Drawings: Indicate configuration, general assembly, and materials used in fabrication, of air terminal unit assembly. Drawings shall confirm spacing between face of coil and damper housing, as indicated in provided details.

D. Certificates: Certify that coils are tested and rated in accordance with AHRI 410.

E. Manufacturer's Installation Instructions: Indicate support and hanging details, installation instructions, recommendations, and service clearances required.

F. Project Record Documents: Record actual locations of units and locations of access doors required for access of valving.

G. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists.

H. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

I. 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. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

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C. Coordinate with Owner's commissioning representative, on first install, to confirm compliance of specification requirements.

1.07 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 AIR TERMINAL UNITS

A. Manufacturers:
   1. Titus; _____
   2. Krueger; _____
   3. Price Industries, Inc; _____

B. Basis of Design: Price Industries, Inc.
   1. Single-Duct Terminal Unit: SDV5000.

C. Acoustic Performance Requirements:
   1. Use attenuation values found in appendix E of AHRI 885.

D. General:
   1. Factory-assembled, variable volume air control terminal with damper assembly and flow sensor.
   2. AHRI 880 (I-P) rated.

E. Unit Casing:
   1. Minimum 22 gage, 0.0299 inch galvanized steel.
      a. Assembled with longitudinal lock seam construction.
      b. Casing leakage to meet ASHRAE Std 130.
   2. Air Inlet Collar: Provide round, suitable for standard duct sizes 6" dia. and above.
   3. Unit Discharge: Rectangular, with slip-and-drive connections.
   4. Liner:
      a. 1/2 inch thick, coated, fibrous-glass.
         1) Secure with adhesive.
         2) Coat edges exposed to airstream with NFPA 90A approved sealant.
         3) Insulation shall comply with the requirements of UL 181 (erosion), ASTM C1338 (fungi resistance), ASHRAE 62.1, and ASTM C1071, having a maximum flame/smoke spread of 25/50 for both the insulation and the adhesive when tested in accordance with ASTM E84.

F. Damper Assembly:
   1. The damper assembly shall be minimum 18 gauge, galvanized steel with a solid shaft rotating in bearings.
   2. Provide integral position indicator or alternative method for indicating damper position over full range of 90 degrees. Shaft shall be clearly marked on the end to indicate damper position. The vav box shall incorporate mechanical stops to prevent over stroking of the damper and a synthetic seal to limit close-off leakage.
   3. The damper assembly shall incorporate a peripheral gasket on the damper blades for tight airflow shutoff.
   4. The air leakage past the closed damper shall not exceed two percent of unit maximum airflow at 3 inch wg inlet static pressure, tested in accordance with ASHRAE Std 130.

G. Airflow Sensor:
   1. The airflow sensor shall be a differential pressure airflow device measuring total and static pressures, and shall be factory mounted to the air inlet collar.
   2. Plastic parts shall be fire-resistant, complying with UL 94.

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3. Control tubing shall be protected by grommets at the wall of the airflow sensor's housing.
4. The airflow sensor signal accuracy shall be plus or minus five percent throughout terminal operating range.

2.02 HOT WATER REHEAT COIL

A. Coil Construction:
1. Coil Casing: Minimum 22 gage, 0.0299 inch galvanized steel, casing size to match air terminal unit discharge with rectangular outlet, duct connection type. See installation notes and detail for approved installation location of coil.
2. Coil Fins: Aluminum or aluminum plated 0.0045 inch fins, mechanically-bonded to seamless 0.50 by 0.016 inch copper tubes.
   a. Fins to be formed in a high heat transfer sine wave configuration.
   b. Two rows with ten fins-per-inch heating capacity density.
3. Coil leak tested to minimum 300 psig.
4. Base performance data on tests run in accordance with AHRI 410 and units to bear AHRI 410 label.

2.03 ROUND TERMINAL UNITS

A. Manufacturers:
1. Titus; _____
2. Krueger; _____
3. Price Industries, Inc; _____

B. Basis of Design: Price Industries, Inc.
1. General Supply/Exhaust Control Valve: RDV, (direct digital controls).

C. General:
1. The terminal units shall be factory-assembled for variable air volume control with damper assembly and airflow sensor.
2. AHRI 880 (I-P) rated and bearing the AHRI seal.

D. Construction:
1. Casing: Minimum 20 gage, 0.0375 inch galvanized or zinc coated steel, meeting the requirements of NFPA 90A and UL 181.
2. The damper assembly shall be 18 gauge galvanized steel with a solid shaft rotating in bearings.
3. The damper shaft shall incorporate a visual position indicator etched into the end of the damper shaft to clearly indicate damper position over the full range of 90 degrees.
4. The air terminal unit shall incorporate mechanical stops to prevent over stroking of the damper and shall incorporate a peripheral gasket on the damper blades for tight airflow shutoff.
5. Air Inlet/Outlet: Suitable for standard duct sizes 6" dia. and above.
6. Air leakage past the closed damper shall not exceed two percent of the unit maximum airflow at three inches water gauge inlet static pressure, tested in accordance with ASHRAE Std 130.

E. Airflow Sensor:
1. The airflow sensor shall be a differential pressure airflow device measuring total and static pressures, and shall be factory mounted to the air inlet collar.
2. Plastic parts shall be fire-resistant, complying with UL 94.
3. Control tubing shall be protected by grommets at the wall of the airflow sensor's housing.
4. The airflow sensor signal accuracy shall be plus or minus five percent throughout terminal operating range.

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PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that conditions are suitable for installation.

B. Verify that field measurements are as indicated on drawings.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install the inlets of air terminal units and air flow sensors a minimum of four duct diameters from elbows, transitions, and duct takeoffs.

C. Sheet metal contractor shall remove and dispose of entire control box enclosure from all air terminal units prior to installation.

D. Sheet metal contractor shall permanently cap or plug all air terminal box airflow sensor tubing except when controls contractor requires airflow sensor use.

E. See drawings for vav box and reheat coil installation details and the size(s) and duct location(s) of all air terminal units.

F. Install 12" section of ductwork between any air terminal units with reheat coils. Furnish and install a 9"x9" minimum duct access door with, two (2) cam lock latches, in bottom of duct to facilitate inspection and cleaning of reheat coil. Coordinate installation location of assemblies to facilitate inspection and cleaning.

G. Install 12" long section of lined ductwork matching discharge size of air terminal box(es) or reheat coil whenever discharge duct size is smaller than the discharge size of air terminal box(es) or reheat coil.

H. Provide ceiling access doors or locate units above easily removable ceiling components.

I. Support air terminal units individually from structure with 22 gauge hanger strap in accordance with SMACNA (SRM). See Section 230548.

J. Embed support anchors in concrete in accordance with ASTM E488/E488M.

K. Do not support air terminal units and reheat coils from ductwork.

L. Connect to ductwork in accordance with Section 233100.

M. Provide 1 inch thick acoustically lined ductwork downstream of units.

N. Verify that electric power is available and of the correct characteristics.

O. Install reheat coil piping to provide thermal trap by rising supply/return pipes a minimum of 6" rise within three feet of unit.

3.03 FIELD QUALITY CONTROL

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

B. Test and inspect field-assembled components and equipment installation, including connections. Report results in writing.
   1. Leak Test:
      a. After installation, fill water coils and test for leaks.
      b. Repair leaks and retest until no leaks exist.
   2. Operational Test:
      a. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
      b. Test and adjust controls and safeties.
      c. Replace damaged and malfunctioning controls and other equipment.
      d. Remove and replace malfunctioning units and retest as specified above.

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3.04 SCHEDULES - SEE DRAWINGS FOR SCHEDULES OF ALL AIR TEMINALS AND REHEAT COILS.

END OF SECTION

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SECTION 233700
AIR OUTLETS AND INLETS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Diffusers.

C. Round ceiling diffusers.

E. Registers/grilles.
   1. Ceiling mount return air grilles.

F. Door grilles.

1.02 RELATED REQUIREMENTS

A. Section 099123 - Interior Painting: Painting of ducts visible behind outlets and inlets.

1.03 REFERENCE STANDARDS

A. AHRI 880 (I-P) - Performance Rating of Air Terminals; 2011 with Addendum 1.

B. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating; 2015.

C. AMCA 511 - Certified Ratings Program for Air Control Devices; 2010.

D. AMCA 550 - Test Method for High Velocity Wind Driven Rain Resistant Louvers; 2015.

E. ASHRAE Std 70 - Method of Testing the Performance of Air Outlets and Inlets; 2006 (R2011).

F. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.

G. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.

H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.

I. ISO 14644-1 - Cleanrooms and associated controlled environments - Part 1: Classification of air cleanliness by particle concentration; 2015.

J. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

K. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2015.

L. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2018.

M. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

N. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Rev. 2009).

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission.

C. Project Record Documents: Record actual locations of air outlets and inlets.

1.05 QUALITY ASSURANCE

A. Test and rate air outlet and inlet performance in accordance with ASHRAE Std 70.

B. Test and rate louver performance in accordance with AMCA 500-L.

C. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

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D. Coordinate with Owner's commissioning representative, on first install, to confirm compliance of specification requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Diffusers and Grilles:
   1. Titus, a brand of Air Distribution Technologies;
   2. Hart & Cooley, Inc.;
   3. Price Industries;
   4. Krueger-HVAC, Division of Air System Components; _____

B. Louvers:
   1. Greenheck Fan Corporation;
   2. Ruskin Company;
   3. Pottorff;

C. Substitutions: See Section 016000 - Product Requirements.

2.02 ROUND CEILING DIFFUSERS

A. Type: Round, adjustable horizontal discharge pattern, three cone diffuser to discharge air in 360 degree pattern.

B. Fabrication: Steel with baked enamel finish.

C. Connections: Round.

D. Color: As indicated on drawings.

E. Models:
   1. Titus No. TMR
   2. Hart & Cooley No. 20
   3. Price No. RCD
   4. Krueger No. RM1

2.03 SQUARE CEILING SUPPLY AIR DIFFUSERS - MODULAR T-BAR

A. Type: Square, 24" x 24" module, border type for lay-in installation, removable plaque design for all neck sizes. Type as specified on drawings.

B. Connections: Round.

C. Frame: Provide inverted T-bar type as indicated on drawings.

D. Fabrication: Steel with baked enamel finish.

E. Color: As indicated on drawings.

F. Accessories: Furnish diffuser with adjustable pattern controller, to adjust discharge pattern from horizontal to vertical, for diffusers installed 12 feet above finished floor and higher.

G. Models:
   1. Titus No. OMNI
   2. Price No. SPD
   3. Krueger No. PLQ

2.04 SQUARE CEILING SUPPLY AIR DIFFUSERS - MODULAR SURFACE MOUNT

A. Type: Square, full faced, 24" x 24" module, border type for surface installation, removable plaque design for all neck sizes. Type as specified on drawings.

B. Connections: Round.

C. Frame Provide surface mount type as indicated on drawings.

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D. Fabrication: Steel with baked enamel finish.

E. Color: As indicated on drawings.

F. Accessories: Furnish diffuser with adjustable pattern controller, to adjust discharge pattern from horizontal to vertical, for diffusers installed 12 feet above finished floor and higher.

G. Models:
   1. Titus No. OMNI
   2. Price No. SPD
   3. Krueger No. PLQ

2.08 PERFORATED FACE RETURN AIR GRILLES – SURFACE/LAY-IN MOUNT

A. Type: Perforated face, border type for surface installation.

B. Frame: Surface mount type, size as per drawings.

C. Fabrication: Steel with steel frame and baked enamel finish.

D. Color: As indicated on drawings.

E. Models:
   1. Titus No. PAR
   2. Hart & Cooley No. PDF
   3. Price No. PFRF
   4. Krueger No. 1190

2.14 DOOR GRILLES

A. Type: V-shaped louvers of 20 gage, 0.0359 inch thick steel, 1 inch deep on 1/2 inch centers.

B. Frame: 20 gage, 0.0359 inch steel with auxiliary frame to give finished appearance on both sides of door, with factory prime coat finish.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Comply with SMACNA (ASMM) for flashing/counter-flashing of roof penetrations and supports for roof curbs and roof mounted equipment.

C. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.

D. Install diffusers to ductwork with air tight connection.

E. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, despite whether dampers are specified as part of the diffuser, or grille and register assembly.

3.02 AIR OUTLET AND INLET SCHEDULE - SEE DRAWING SCHEDULES.

END OF SECTION

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SECTION 260505
SELECTIVE DEMOLITION FOR ELECTRICAL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical demolition.

1.02 RELATED REQUIREMENTS

A. Section 017000 - Execution and Closeout Requirements: Additional requirements for alterations work.

B. Section 028400 - Polychlorinate Biphenyl (PCB) Remediation: Removal of equipment and materials containing substances regulated under the Federal Toxic Substances Control Act (TSCA), including but not limited to those containing PCBs and mercury.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work: As specified in individual sections.

B. Any existing equipment or materials to remain or be reused, shall meet current individual sections.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify field measurements and circuiting arrangements are as indicated.

B. Verify that abandoned wiring and equipment serve only abandoned facilities.

C. Demolition drawings are based on casual field observation and existing record documents.

D. Report discrepancies to Owner and Owner's Construction Project Coordinator, before disturbing existing installation.

E. Beginning of demolition means installer accepts existing conditions.

3.02 PREPARATION

A. Disconnect electrical systems in walls, floors, and ceilings to be removed.

B. Coordinate utility service outages with Owner and utility provider.

C. Provide temporary wiring and connections to maintain existing systems in service during construction.

D. When work must be performed on energized equipment or circuits, use personnel experienced in such operations, with appropriate safety equipment and practices.

E. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.
   1. Obtain permission from Owner at least 72 hours before partially or completely disabling system, unless otherwise indicated.
   2. Make temporary connections to maintain service in areas adjacent to work area as indicated.

F. Existing Fire Alarm System: Maintain existing system in service until new system is accepted. Disable system only to make switchovers and connections. Minimize outage duration.
   1. Coordinate with Owner at least 72 hours before partially or completely disabling system.

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2. Make temporary connections to maintain service in areas adjacent to work area. In areas where fire alarm system is inoperable, provide fire watch per Division 28.
3. For occupied buildings, provide a Fire Watch, per Section 284600, for all areas where the fire alarm detection and/or annunciation devices have been removed.

G. Existing Telephone/Data System: Maintain existing system in service until new system is complete and ready for service. Disable system only upon the approval of the Owner's Office of Information Technology (OIT), to make switchovers and connections. Minimize outage duration.
1. Coordinate with Owner at least 72 hours before partially or completely disabling system.
2. Notify Owner's Office of Information Technology (OIT) at least 24 hours before partially or completely disabling system.

3.03 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Contractor to perform work for removal of equipment and materials containing toxic substances, regulated under the Federal Toxic Substances Control Act (TSCA), in accordance with Section 028400 and applicable federal, state, and local regulations. Return equipment and materials to Owner's Chemical Management Building, for disposal by the Owner. Applicable equipment and materials include, but are not limited to:
1. PCB-containing electrical equipment, including transformers, capacitors, and switches.
2. PCB- and DEHP-containing lighting ballasts.
3. Mercury-containing lamps and tubes, including fluorescent lamps, high intensity discharge (HID), arc lamps, ultra-violet, high pressure sodium, mercury vapor, ignitron tubes, neon, and incandescent.

B. Remove, relocate, and extend existing installations to accommodate new construction.

C. Remove abandoned wiring to source of supply.

D. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.

E. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.

F. Disconnect and remove abandoned panelboards and distribution equipment.

G. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

H. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories, complete. Remove ballasts and lamps from light fixtures being abandoned. Place ballasts and lamps in Owner furnished barrels. Ballasts and lamps to be disposed of by the Owner.

I. Repair adjacent construction and finishes damaged during demolition and extension work.

J. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.

K. Protect existing electrical equipment and installations indicated to remain. If damaged or disturbed in the course of the Work, remove damaged portions and install new products of equal capacity, quality, and functionality.

L. Accessible Work: Remove exposed electrical equipment and installations, indicated to be demolished, in their entirety.

M. Abandoned Work: Cap raceways and patch surface to match existing finish.

N. Remove demolished material from Project site.

O. Remove, store, clean, reinstall, reconnect, and make operational components indicated for relocation.

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P. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

Q. In areas where the electrical panel feeds loads in areas not affected by this project, do not turn off circuit breakers until the entire circuit have been verified to not affect areas outside this project.

3.04 CLEANING AND REPAIR

A. See Section 017419 - Construction Waste Management and Disposal for additional requirements.

B. Clean and repair existing materials and equipment that remain or that are to be reused.

C. Panelboards: Clean interior and exposed surfaces. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

D. Luminaires: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry.

END OF SECTION

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SECTION 260519

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL **UPDATED MAY 2023**

1.01 SECTION INCLUDES **SEE CHANGES IN BOLD**

A. Single conductor building wire.
B. Nonmetallic-sheathed cable.
C. Underground feeder and branch-circuit cable.
D. Metal-clad cable.
E. Power and control tray cable.
F. Manufactured wiring systems.
G. Aluminum cable terminations.
H. Wiring connectors.
I. Electrical tape.
J. Heat shrink tubing.
K. Oxide inhibiting compound.
L. Wire pulling lubricant.
M. Cable ties.

1.02 RELATED REQUIREMENTS

A. Section 078400 - Firestopping.
B. Section 260505 - Selective Demolition for Electrical: Disconnection, removal, and/or extension of existing electrical conductors and cables.
C. Section 260513 - Medium-Voltage Cables: Cables and terminations for systems 601 V through 35,000 V.
D. Section 260519.13 - Undercarpet Electrical Power Cables: Flat conductor cable and fittings for undercarpet power distribution.
E. Section 260526 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.
F. Section 260536 - Cable Trays for Electrical Systems: Additional installation requirements for cables installed in cable tray systems.
G. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
H. **Section 262300 - Low-Voltage Switchgear.** **H,L, & J Updated May 2023**
I. **Section 262413 - Switchboards.**
J. **Section 262416 - Panelboards.**
K. Section 284600 - Fire Detection and Alarm: Fire alarm system conductors and cables.
L. Section 312316 - Excavation.
M. Section 312316.13 - Trenching: Excavating, bedding, and backfilling.
N. Section 312323 - Fill: Bedding and backfilling.

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1.03 REFERENCE STANDARDS

A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire; 2013.

B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft; 2011 (Reapproved 2017).

C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes; 2010 (Reapproved 2014).

D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation; 2004 (Reapproved 2014).

E. ASTM B800 - Standard Specification for 8000 Series Aluminum Alloy Wire for Electrical Purposes - Annealed and Intermediate Tempers; 2005 (Reapproved 2015).

F. ASTM B801 - Standard Specification for Concentric-Lay-Stranded Conductors of 8000 Series Aluminum Alloy Wire for Subsequent Covering of Insulation; 2016.

G. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape; 2017.

H. ASTM D4388 - Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes; 2013.

I. FS A-A-59544 - Cable and Wire, Electrical (Power, Fixed Installation); Federal Specification; Revision A, 2008.

J. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

K. NECA 104 - Recommended Practice for Installing Aluminum Building Wire and Cable; 2012.

L. NECA 120 - Standard for Installing Armored Cable (AC) and Metal-Clad Cable (MC); 2012.

M. NECA 121 - Standard for Installing Nonmetallic-Sheathed Cable (Type NM-B) and Underground Feeder and Branch-Circuit Cable (Type UF); 2007.

N. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy; 2009.

O. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.

P. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

Q. UL 4 - Armored Cable; Current Edition, Including All Revisions.

R. UL 44 - Thermoset-Insulated Wires and Cables; Current Edition, Including All Revisions.

S. UL 83 - Thermoplastic-Insulated Wires and Cables; Current Edition, Including All Revisions.

T. UL 183 - Manufactured Wiring Systems; Current Edition, Including All Revisions.

U. UL 486A-486B - Wire Connectors; Current Edition, Including All Revisions.

V. UL 486C - Splicing Wire Connectors; Current Edition, Including All Revisions.

W. UL 486D - Sealed Wire Connector Systems; Current Edition, Including All Revisions.

X. UL 493 - Thermoplastic-Insulated Underground Feeder and Branch-Circuit Cables; Current Edition, Including All Revisions.

Y. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape; Current Edition, Including All Revisions.

Z. UL 719 - Nonmetallic-Sheathed Cables; Current Edition, Including All Revisions.

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AA. UL 1277 - Electrical Power and Control Tray Cables with Optional Optical-Fiber Members; Current Edition, Including All Revisions.

AB. UL 1569 - Metal-Clad Cables; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
   2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
   3. Notify Architect and Owner's Construction Project Coordinator, of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.

C. Sustainable Design Documentation: Submit manufacturer's product data on conductor and cable showing compliance with specified lead content requirements.

D. Manufactured Wiring System Shop Drawings: Provide plan views indicating proposed system layout with components identified; indicate branch circuit connections.

E. Design Data: Indicate voltage drop and ampacity calculations for aluminum conductors substituted for copper conductors. Include proposed modifications to raceways, boxes, wiring gutters, enclosures, etc. to accommodate substituted conductors.

F. Field Quality Control Test Reports.

G. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

H. Project Record Documents:
   1. Underground circuits: Record actual installed circuiting arrangements for all underground/underslab circuits. Provide actual size and length of conductors installed.
      a. Provide actual size and length of conductors installed.
      b. Show all junction box locations. Provide dimensions from building, and other permanent structures.
   2. Building circuits: For conduit sizes 1-1/4" and larger, record actual installed circuiting arrangements for all circuits.
      a. Provide actual size and length of conductors installed.
      b. Show all junction box locations. Include boxes, above ceilings, below elevated floors and other hard to access areas.

I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.
   2. Extra Manufactured Wiring Systems Cable Assemblies: One of each configuration, 6 feet length.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

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B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

1.08 FIELD CONDITIONS

A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Architect and obtain direction before proceeding with work.

PART 2 PRODUCTS

2.01 CONDUCTOR AND CABLE APPLICATIONS

A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.

B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.
   1. Exceptions:
      a. Use manufactured wiring systems for branch circuits where concealed under raised floors.
         1) Exception: Provide single conductor building wire in raceway for circuit homeruns from distribution box to panelboard.
      b. Use power and control tray cable for installation in cable tray.

C. Nonmetallic-sheathed cable is permitted only as follows:
   1. Where not otherwise restricted, may be used:
      a. For branch circuit wiring in dry locations within one- and two-family dwellings and their attached or detached garages, and their storage buildings.
      b. For branch circuit wiring in dry locations within multifamily dwellings permitted to be of Types III, IV, and V construction.
      c. Use permitted by Owner's written approval.
   2. In addition to other applicable restrictions, may not be used:
      a. Where exposed to view.
      b. Where exposed to damage.

D. Metal-clad (MC) cable is permitted only as follows:
   1. Where not otherwise restricted, may be used:
      a. When approved by Owner.
      b. Where concealed above accessible ceilings for final connections from junction boxes to luminaires. **Daisy-chaining of light fixtures is not permitted.** **Updated 2/21**
         1) Maximum Length: 8 feet.
      c. **Areas approved for use with MC Cable: In office areas, conference rooms, labs and classrooms only.** **Updated 2/21**
      d. Where concealed in hollow stud walls, above accessible ceilings, and under raised floors for branch circuits up to 20 A.
         1) Exception: Provide single conductor building wire in raceway for circuit homerun from first outlet to panelboard.

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2) Exception: When circuiting multiple rooms on a single circuit, provide single conductor building wire in raceway from circuit homerun panelboard, to each room's pull box.

2. Limitations for use with home run circuiting:
   a. **Metal-clad cable shall not be permitted for direct connection into panel boards. Provide single conductor building wire in raceway for circuit homerun from panel board to first outlet/pull box. Updated 2/21**
3. In addition to other applicable restrictions, may not be used:
   a. Unless approved by Owner.
   b. Where exposed to view.
   c. Where exposed to damage.
   d. For damp, wet, or corrosive locations
   e. For isolated ground circuits.
   f. For patient care areas of health care facilities requiring redundant grounding.
   g. **For Concert and Recital Halls.**
   h. **For mechanical areas, workshops, restrooms, corridors, electrical and data rooms.**
   i. **For exterior areas. Updated 2/21**

E. Manufactured wiring systems are permitted only as follows:
1. Where not otherwise restricted, may be used:
   a. For branch circuits where concealed under carpet flooring and for manufactured furniture systems.
      1) Exception: Provide single conductor building wire in raceway for circuit homerun from distribution box to panelboard.
      2) Exception: Not permitted for lighting or receptacle circuits, unless listed for manufacturer furniture systems.

2.02 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

A. Provide products that comply with requirements of NFPA 70.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Provide new conductors and cables manufactured not more than one year prior to installation.

D. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.

E. Comply with NEMA WC 70.

F. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.

G. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.

H. Conductors for Grounding and Bonding: Also comply with Section 260526.

I. Conductors and Cables Installed in Cable Tray: Listed and labeled as suitable for cable tray use.

J. Conductors and Cables Installed Where Exposed to Direct Rays of Sun: Listed and labeled as sunlight resistant.

K. Conductors and Cables Installed Exposed in Spaces Used for Environmental Air (only where specifically permitted): Plenum rated, listed and labeled as suitable for use in return air plenums.

L. Conductor Material:
1. Provide copper or aluminum conductors. Conductor sizes indicated are based on copper unless specifically indicated as aluminum. Conductors designated with the abbreviation "AL" indicate aluminum.
   a. Permitted use of aluminum conductors for copper is permitted, only for the following:

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1) Services: Aluminum conductors size 1/0 AWG and larger.
2) Feeders: Aluminum conductors size 1/0 AWG and larger.

b. Where aluminum conductors are substituted for copper, comply with the following:
1) Size aluminum conductors to provide, when compared to copper sizes indicated, equivalent or greater ampacity and equivalent or less voltage drop.
2) Increase size of raceways, boxes, wiring gutters, enclosures, etc. as required to accommodate aluminum conductors.
3) Provide copper equipment grounding conductor sized according to NFPA 70.
4) Equip electrical distribution equipment with compression lugs for terminating aluminum conductors. No split bolts or chair lugs, permitted.

2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.
3. Tinned Copper Conductors: Comply with ASTM B33.
4. Aluminum Conductors (only where specifically indicated or permitted for substitution): AA-8000 series aluminum alloy conductors recognized by ASTM B800 and compact stranded in accordance with ASTM B801 unless otherwise indicated.

M. Minimum Conductor Size:
1. Branch Circuits: 12 AWG.
a. Exceptions:
1) 20 A, 120 V circuits longer than 75 feet: 10 AWG, for voltage drop.
2) 20 A, 120 V circuits longer than 150 feet: 8 AWG, for voltage drop.
3) 20 A, 277 V circuits longer than 150 feet: 10 AWG, for voltage drop.
2. Control Circuits: 14 AWG.

N. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

O. Conductor Color Coding:
1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
2. Color Coding Method: Integrally colored insulation.
a. Conductors size 4 AWG and larger may have black insulation color coded using vinyl color coding electrical tape.
b. Color Coding for Power Conductors 600 V and Less: Comply with Section 260553.

2.03 SINGLE CONDUCTOR BUILDING WIRE

A. Manufacturers:
1. Copper Building Wire:
a. Cerro Wire LLC: www.cerrowire.com
b. Encore Wire Corporation: www.encorewire.com
c. General Cable Technologies Corporationwww.generalcable.com
d. Southwire Company: www.southwire.com
e. Windy City Wire; www.smartwire.com.
f. Substitutions: See Section 016000 - Product Requirements.
2. Aluminum Building Wire (only where specifically indicated or permitted for substitution):
a. Encore Wire Corporation: www.encorewire.com
b. Southwire Company: www.southwire.com
c. Stabiloy, a brand of General Cable Technologies Corporation: www.stabiloy.com
d. Windy City Wire; www.smartwire.com, 801-633-0651.
e. Substitutions: See Section 016000 - Product Requirements.

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B. Description: Single conductor insulated wire.

C. Conductor Stranding:
   1. Feeders and Branch Circuits:
      a. Size 10 AWG and Smaller: Stranded.
      b. Size 8 AWG and Larger: Stranded.
   2. Control Circuits: Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation:
   1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2, except as indicated below.
      a. Size 4 AWG and Larger: Type XHHW-2.
      b. Installed Underground: Type XHHW-2.
      c. Fixture Wiring Within Luminaires: Type TFFN/TFN for luminaires with labeled maximum temperature of 90 degrees C; Approved suitable type for luminaires with labeled maximum temperature greater than 90 degrees C.
   2. Aluminum Building Wire (only where specifically indicated or permitted for substitution): Type XHHW-2.

2.04 NONMETALLIC-SHEATHED CABLE

A. Manufacturers:
   1. Cerro Wire LLC: www.cerrowire.com
   2. Encore Wire Corporation: www.encorewire.com
   3. Southwire Company: www.southwire.com
   4. Substitutions: See Section 016000 - Product Requirements.

B. Description: NFPA 70, Type NM multiple-conductor cable listed and labeled as complying with UL 719, Type NM-B.

C. Conductor Stranding:
   1. Size 10 AWG and Smaller: Solid.
   2. Size 8 AWG and Larger: Stranded.

D. Insulation Voltage Rating: 600 V.

2.05 METAL-CLAD CABLE

A. Manufacturers:
   1. AFC Cable Systems Inc: www.afcweb.com
   2. Encore Wire Corporation: www.encorewire.com
   3. Southwire Company: www.southwire.com
   4. Substitutions: See Section 016000 - Product Requirements.

B. Description: NFPA 70, Type MC cable listed and labeled as complying with UL 1569, and listed for use in classified firestop systems to be used.

C. Conductor Stranding:
   1. Size 10 AWG and Smaller: Stranded.
   2. Size 8 AWG and Larger: Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation: Type THHN, THHN/THWN, or THHN/THWN-2.

F. Provide oversized neutral conductors where indicated or required.

G. Provide dedicated neutral conductor for each phase conductor where indicated or required.

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H. Grounding: Full-size integral equipment grounding conductor.
   1. Provide additional isolated/insulated grounding conductor where indicated or required.

I. Armor: Steel, interlocked tape.

J. Provide PVC jacket applied over cable armor where indicated or required for environment of installed location.

K. Where used with 0-10v dc dimming, provide dimming cables within metal sheath.

2.06 POWER AND CONTROL TRAY CABLE

A. Manufacturers:
   1. Encore Wire Corporation: www.encorewire.com
   2. General Cable Technologies Corporation: www.generalcable.com
   3. Okonite: www.okonite.com
   4. Southwire Company: www.southwire.com
   5. Substitutions: See Section 016000 - Product Requirements.

B. Description: NFPA 70, Type TC cable listed and labeled as complying with UL 1277.

C. Where exposed run cable is indicated between cable tray and utilization equipment in qualifying industrial establishments as determined by authorities having jurisdiction, provide tray cable marked as Type TC-ER in accordance with NFPA 70.

D. Conductor Stranding: Stranded.

E. Insulation Voltage Rating: 600 V.

F. Insulation: Type XHHW or XHHW-2.

G. Grounding: Full-size integral equipment grounding conductor.

H. Jacket: PVC or Chlorinated Polyethylene (CPE).

2.07 MANUFACTURED WIRING SYSTEMS

A. Manufacturers:
   1. Steelcase.

B. Description: Manufactured wiring assemblies complying with NFPA 70 Article 604, and listed and labeled as complying with UL 183.

C. Provide components necessary to transition between manufactured wiring system and other wiring methods.

D. Branch Circuit Cables:
   1. Conductor Stranding (Size 10 AWG and Smaller): Stranded.
   2. Insulation Voltage Rating: 600 V.
   3. Insulation: Type THHN.
   4. Provide dedicated neutral conductor for each phase conductor.
   5. Grounding: Full-size integral equipment grounding conductor.
      a. Provide additional isolated/insulated grounding conductor where indicated or required.
   6. Armor: Steel, interlocked tape.

E. Connectors: Keyed and color-coded to prevent interconnection of different voltages.

F. Fixture Leads: Type TFN insulation.

2.08 WIRING CONNECTORS

A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.

B. Connectors for Grounding and Bonding: Comply with Section 260526.

C. Wiring Connectors for Splices and Taps:
   1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors.
   2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.
   3. Connection for Aluminum Conductors: Use **compression** terminals for all connections.

D. Wiring Connectors for Terminations:
   1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
   2. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.
   3. **Copper Conductors Size 8 AWG or Larger: Use mechanical or compression connectors where connection to equipment is required. Updated May 2023**
   4. Aluminum Conductors: Use **compression** terminals for all connections.
   5. Stranded Conductors Size 10 AWG and Smaller: Use crimped terminals for connections to terminal screws.
   6. Conductors for Control Circuits: Use crimped terminals for all connections.

E. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.

F. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.

G. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.
   1. Manufacturers:
      a. 3M: www.3m.com
      b. Ideal Industries, Inc: www.idealindustries.com
      c. NSI Industries LLC: www.nsiindustries.com

H. Push-in Wire Connectors are not permitted on project.

I. Mechanical Connectors: Provide bolted type or set-screw type.
   1. Manufacturers:
      a. Burndy LLC: www.burndy.com
      b. Ilsco: www.ilsco.com
      c. Thomas & Betts Corporation: www.tnb.com
      d. Substitutions: See Section 016000 - Product Requirements.

J. Compression Connectors: Provide circumferential type or hex type crimp configuration.
   1. Manufacturers:
      a. Burndy LLC: www.burndy.com
      b. Ilsco: www.ilsco.com
      c. Thomas & Betts Corporation: www.tnb.com
      d. Substitutions: See Section 016000 - Product Requirements.

K. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.
   1. Manufacturers:
      a. Burndy LLC: www.burndy.com
      b. Ilsco: www.ilsco.com

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c. Thomas & Betts Corporation: www.tnb.com
d. Substitutions: See Section 016000 - Product Requirements.

2.09 WIRING ACCESSORIES

A. Electrical Tape:
1. Manufacturers:
a. 3M: www.3m.com
b. Plymouth Rubber Europa: www.plymouthrubber.com
c. Substitutions: See Section 016000 - Product Requirements.
2. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F.
a. Substitutions: See Section 016000 - Product Requirements.
3. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.
a. Substitutions: See Section 016000 - Product Requirements.
4. Rubber Splicing Electrical Tape: Ethylene Propylene Rubber (EPR) tape, complying with ASTM D4388; minimum thickness of 30 mil; suitable for continuous temperature environment up to 194 degrees F and short-term 266 degrees F overload service.
a. Substitutions: See Section 016000 - Product Requirements.
5. Electrical Filler Tape: Rubber-based insulating moldable putty, minimum thickness of 125 mil; suitable for continuous temperature environment up to 176 degrees F.
6. Varnished Cambric Electrical Tape: Cotton cambric fabric tape, with or without adhesive, oil-primed and coated with high-grade insulating varnish; minimum thickness of 7 mil; suitable for continuous temperature environment up to 221 degrees F.
a. Substitutions: See Section 016000 - Product Requirements.
7. Moisture Sealing Electrical Tape: Insulating mastic compound laminated to flexible, all-weather vinyl backing; minimum thickness of 90 mil.
a. Substitutions: See Section 016000 - Product Requirements.

B. Heat Shrink Tubing: Heavy-wall, split-resistant, with factory-applied adhesive; rated 600 V; suitable for direct burial applications; listed as complying with UL 486D.
1. Manufacturers:
a. 3M: www.3m.com
b. Burndy LLC: www.burndy.com
c. Thomas & Betts Corporation: www.tnb.com
d. Substitutions: See Section 016000 - Product Requirements.

C. Oxide Inhibiting Compound: Listed; suitable for use with the conductors or cables to be installed.
1. Manufacturers:
a. Burndy LLC: www.burndy.com
b. Ideal Industries, Inc: www.idealindustries.com
c. Ilsco: www.ilsco.com

D. Wire Pulling Lubricant: Listed; suitable for use with the conductors or cables to be installed and suitable for use at the installation temperature.
1. Manufacturers:
a. 3M: www.3m.com
b. American Polywater Corporation: www.polywater.com

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c. Ideal Industries, Inc: www.idealindustries.com
d. Substitutions: See Section 016000 - Product Requirements.

E. Cable Ties: Material and tensile strength rating suitable for application.
1. Manufacturers:
a. Burndy LLC: www.burndy.com

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that interior of building has been protected from weather.

B. Verify that work likely to damage wire and cable has been completed.

C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.

D. Verify that field measurements are as indicated.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

B. Pull conduit proofing pulling mandrel through all conduits, 3" or larger. See Section 260533.13 for mandrel pulling requirements.

3.03 INSTALLATION

A. Circuiting Requirements:
1. Unless dimensioned, circuit routing indicated is diagrammatic.
2. When circuit destination is indicated without specific routing, determine exact routing required.
3. Arrange circuiting to minimize splices.
4. Include circuit lengths required to install connected devices within 10 ft of location indicated.
5. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
6. Maintain separation of wiring for emergency systems in accordance with NFPA 70.
7. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are indicated as separate, combining them together in a single raceway is permitted, under the following conditions:
a. Provide no more than six current-carrying conductors in a single raceway. Dedicated neutral conductors are considered current-carrying conductors.
b. Increase size of conductors as required to account for ampacity derating.
c. Size raceways, boxes, etc. to accommodate conductors.
8. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among up to three single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.
9. Provide oversized neutral/grounded conductors where indicated and as specified below.
a. Provide 200 percent rated neutral for feeders fed from K-rated transformers.
b. Provide 200 percent rated neutral for feeders serving panelboards with 200 percent rated neutral bus.

B. Install products in accordance with manufacturer's instructions.

C. Perform work in accordance with NECA 1 (general workmanship).

D. Aluminum conductors:
1. Install aluminum conductors in accordance with NECA 104.

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E. Install nonmetallic-sheathed cable (Type NM-B) in accordance with NECA 121.

F. Install metal-clad cable (Type MC) in accordance with NECA 120.

G. Installation in Raceway:
   1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
   2. Pull all conductors and cables together into raceway at same time.
   3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
   4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.

H. Exposed Cable Installation (only where specifically permitted):
   1. Route cables parallel or perpendicular to building structural members and surfaces.
   2. Protect cables from physical damage.

I. Installation in Cable Tray: Also comply with Section 260536.

J. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.

K. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.
   1. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conductors and cables to lay on ceiling tiles.
   2. Installation in Vertical Raceways: Provide supports where vertical rise exceeds permissible limits.

L. Terminate cables using suitable fittings.
   1. Metal-Clad Cable (Type MC):
      a. Use listed fittings.
      b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.
      c. Use red insulating inserts in all terminated cable ends, per manufacturer's recommendations.

M. Install conductors with a minimum of 12 inches of slack at each outlet.

N. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.

O. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.

P. Make wiring connections using specified wiring connectors.
   1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
   2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
   3. Do not remove conductor strands to facilitate insertion into connector.
   4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.
   5. Connections for Aluminum Conductors: Fill connectors with oxide inhibiting compound where not pre-filled by manufacturer.
   6. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.

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7. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

Q. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.
   1. Dry Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
      a. For taped connections, first apply adequate amount of rubber splicing electrical tape or electrical filler tape, followed by outer covering of vinyl insulating electrical tape.
      b. For taped connections likely to require re-entering, including motor leads, first apply varnished cambric electrical tape, followed by adequate amount of rubber splicing electrical tape, followed by outer covering of vinyl insulating electrical tape.
   2. Damp Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
      a. For connections with insulating covers, apply outer covering of moisture sealing electrical tape.
      b. For taped connections, follow same procedure as for dry locations but apply outer covering of moisture sealing electrical tape.
   3. Wet Locations: Use heat shrink tubing.

R. Insulate ends of spare conductors using vinyl insulating electrical tape.

S. Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.

T. Identify conductors and cables in accordance with Section 260553.

U. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 078400.

V. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

3.04 FIELD QUALITY CONTROL

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

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.3.2. The insulation resistance test is only required for services and feeders. The resistance test for parallel conductors listed as optional is not required.
   1. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.

D. Correct deficiencies and replace damaged or defective conductors and cables.

END OF SECTION

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SECTION 260519.13
UNDERCARPET ELECTRICAL POWER CABLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Undercarpet cable systems and associated components:
   1. Undercarpet power cable.
   2. Undercarpet communications cable.
   3. Service fittings.
   4. Transition fittings.
   5. Accessories.

1.02 RELATED REQUIREMENTS

A. Section 096813 - Tile Carpeting.

B. Section 260519 - Low-voltage Electrical Power Conductors and Cables.

C. Section 260526 - Grounding and Bonding for Electrical Systems.

D. Section 260529 - Hangers and Supports for Electrical Systems.

E. Section 260533.13 - Conduit for Electrical Systems: Additional support and attachment requirements for conduits.

F. Section 260533.16 - Boxes for Electrical Systems: Installation requirements for transition fittings specified in this section.

G. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

H. Section 262726 - Wiring Devices: Wiring device specifications.

I. Section 271005 - Structured Cabling for Voice and Data - Inside-Plant.

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

B. NEMA UC 2 - Undercarpet Power Distribution Systems; 1993 (Reaffirmed 2015).

C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. TIA-568-C.2 - Balanced Twisted-Pair Telecommunications Cabling and Components Standards; Rev C, 2009 (with Addenda; 2016).

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the placement of service fittings with furniture, equipment, etc. installed under other sections or by others.
   2. Coordinate rough-in of conduit provided under Section 260533.13 as required for installation of transition fittings provided under this section.
   3. Coordinate the work with other trades to provide carpet tile suitable for installation over undercarpet cables in accordance with NFPA 70.
   4. Notify Architect and Owner's Construction Project Coordinator, of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

B. Preinstallation Meeting: Convene one week prior to commencing work of this section; require attendance of all affected installers. Review proposed routing, sequence of installation, and protection requirements for installed undercarpet cable system.

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C. Sequencing:
   1. Do not begin installation of carpet tile until installation of undercarpet cable system is complete.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for undercarpet cable system components and accessories. Include dimensions, materials, fabrication details, and finishes.

C. Shop Drawings: Include dimensioned plan views indicating proposed undercarpet cable types and routing, service fitting types and locations, and circuiting arrangements.

D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

E. Project Record Documents: Record actual installed locations of undercarpet cables, transition fittings, and service fittings. Include actual installed circuiting arrangements.

F. Operation and Maintenance Data: Include instructions for adding and removing service fittings, and for extending cables.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.
   2. Specialized Tools Required for Component Installation: One of each type.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Steelcase. Thread series. www.steelcase.com.

B.

2.02 UNDERCARPET CABLE SYSTEM

A. Provide new undercarpet cable system consisting of all required components, fittings, devices, accessories, etc. as necessary for a complete system.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Do not use undercarpet cables for applications other than as permitted by NFPA 70 and product listing/classification.

D. Undercarpet Power Cable: Listed NFPA 70 Type FCC flat conductor cable complying with NEMA UC 2; number of conductors as indicated or as required.
   1. Conductor Size: 12 AWG (min).
   2. Provide full-size integral insulated equipment grounding conductor.

E. Undercarpet Communications Cable: Listed NFPA 70 Type CMUC undercarpet cable; 4-pair UTP (unshielded twisted pair); TIA-568 Category to match premises communications horizontal cable.

F. Service Fittings: Undercarpet cable system manufacturer's floor fittings designed specifically for connection to undercarpet cables to be installed with all components, adapters, and trims required for complete installation.

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1. Finish: Black.
2. Voice and Data Jacks: Provided by others.
3. Type _____ - Single Service Standard Convenience Receptacle:
   a. Configuration: One 20 A, 125 V, NEMA 5-20R standard duplex receptacle(s).
4. Type _____ - Single Service Data Communications Outlet:
   a. Configuration: _____. Data devices and cabling by Owner.

G. Transition Fittings: Undercarpet cable system manufacturer's transition boxes and transition blocks for interface between conventional premises wiring systems and undercarpet cables.

H. Accessories:
1. Floor Preparation Material for Undercarpet Cables: Undercarpet cable system manufacturer's floor preparation material designed to protect cable from floor moisture, chemical reaction, and abrasion.
   a. Applications: Provide on floor surface along undercarpet power cable path for slab-on-grade and sub-grade level applications.
2. Connectors for Undercarpet Power Cables: Undercarpet cable system manufacturer's insulation-piercing tap and splice connectors designed specifically for connections to undercarpet power cables to be installed.
3. Insulator Assemblies for Undercarpet Power Cables: Undercarpet cable system manufacturer's adhesive-faced material for insulation of connections and exposed conductors.
4. Top Shield for Undercarpet Cables: Undercarpet cable system manufacturer's corrosion-resistant steel cover for physical protection of cable; utilize bonding clips for connections between top shield and fittings and between adjacent sections of top shield.
   a. Applications: Provide over undercarpet power cables.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that work likely to damage undercarpet cable system has been completed.

B. Verify that field measurements are as indicated.

C. Verify that floor surfaces are smooth, free of irregularities, and suitable for undercarpet cable system.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Scrape, patch, clean, and vacuum floor in accordance with manufacturer's instructions.

3.03 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Undercarpet Cable Routing:
1. Unless otherwise indicated, arrange undercarpet cables to be parallel or perpendicular to building lines.
2. Arrange undercarpet cables to minimize number of cable crossing points. Where crossing points occur, limit crossing to no more than two cables in accordance with NFPA 70. Separate cables at crossing points with layer of grounded top shield.

D. Use only manufacturer's supplied or recommended materials (e.g. tape, spray adhesive) for securing undercarpet cable system components. Provide additional support and attachment components in accordance with Section 260529 as required for securing fittings.

E. Install transition fittings provided under this section in accordance with requirements for boxes specified in Section 260533.16.

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F. Install floor preparation material on floor surface along undercarpet cable path where specified under PART 2 above .

G. Undercarpet Power Cable Installation:
   1. Connect undercarpet power cables to premises power wiring system at transition fittings.
   2. For changes in undercarpet power cable direction, use overlapping fold in accordance with manufacturer's instructions.
   3. Connect undercarpet power cables together using tap or splice connectors and insulator assemblies as required. Use only manufacturer's supplied or recommended crimping tool for securing connections.
   4. Install insulator assemblies at dead ends.

H. Undercarpet Communications Cable Installation:
   1. Connect undercarpet communications cables to premises communications wiring system at transition fittings.
   2. For changes in undercarpet communications cable direction, use cable bend with radius not less than 10 inches or as recommended by manufacturer. Use only manufacturer's supplied or recommended cable notching tool to facilitate cable bending.

I. Install service fittings, ensuring proper conductor connections.

J. Test undercarpet power cable conductors for continuity prior to installation of top shield.

K. Install top shield over undercarpet power cables, using manufacturer's supplied bonding clips at taps, splices, and changes in direction to achieve ground continuity of shield for entire power circuit path.

L. Provide grounding and bonding in accordance with Section 260526.

M. Identify conductors and devices in accordance with Section 260553.

3.04 FIELD QUALITY CONTROL

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

B. Inspect undercarpet cable system components for damage and defects.

C. Energize and test each device to verify operation and proper polarity prior to installation of carpet tile.

D. Correct deficiencies and replace damaged or defective undercarpet cable system components.

3.05 CLEANING

A. Clean interior of transition boxes to remove dirt, debris, plaster and other foreign material.

B. Repair scratched or marred exposed surfaces to match original factory finish.

3.06 PROTECTION

A. Protect undercarpet cable system from subsequent construction operations. Do not allow traffic over undercarpet cable system until carpet tile is installed.

END OF SECTION

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SECTION 260526
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Grounding and bonding requirements.
B. Conductors for grounding and bonding.
C. Connectors for grounding and bonding.
D. Ground bars.
E. Ground rod electrodes.
F. Chemically-enhanced ground electrodes.
G. Ground plate electrodes.
H. Ground enhancement material.
I. Ground access wells.
J. Pre-fabricated signal reference grids.

1.02 RELATED REQUIREMENTS

A. Section 096500 - Resilient Flooring: Static control flooring.
B. Section 096900 - Access Flooring.
C. Section 260519 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.
   1. Includes oxide inhibiting compound.
D. Section 260536 - Cable Trays for Electrical Systems: Additional grounding and bonding requirements for cable tray systems.
E. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
F. Section 264113 - Lightning Protection.
G. Section 265600 - Exterior Lighting: Additional grounding and bonding requirements for pole-mounted luminaires.
H. Section 337119 - Electrical Underground Ducts, Ductbanks, and Manholes
I. Section 337900 - Site Grounding.

1.03 REFERENCE STANDARDS

A. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System; 2012.
B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
C. NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings; 2007.
D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.
E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
F. NFPA 99 - Health Care Facilities Code; 2017.
G. NFPA 780 - Standard for the Installation of Lightning Protection Systems; 2017.
H. UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.

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1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Verify exact locations of underground metal water service pipe entrances to building.
   2. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode.
   3. For signal reference grids, coordinate the work with access flooring furnished in accordance with Section 096900.
   4. Notify Architect and Owner's Construction Project Coordinator, of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not install ground rod electrodes until final backfill and compaction is complete.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittals procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.

C. Shop Drawings:
   1. Indicate proposed arrangement for signal reference grids. Include locations of items to be bonded and methods of connection.

D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

E. Field quality control test reports.

F. Project Record Documents: Record actual locations of grounding electrode system components and connections.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Installer Qualifications for Signal Reference Grids: Company with minimum five years documented experience with high frequency grounding systems.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 GROUNDING AND BONDING REQUIREMENTS

A. Existing Work: Where existing grounding and bonding system components are indicated to be reused, they may be reused only where they are free from corrosion, integrity and continuity are verified, and where acceptable to the Owner.

B. Do not use products for applications other than as permitted by NFPA 70 and product listing.

C. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.

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D. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

E. Grounding System Resistance:
   1. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by Architect. Precipitation within the previous 48 hours does not constitute normally dry conditions.

F. Grounding Electrode System:
   1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
      a. Provide continuous grounding electrode conductors without splice or joint.
      b. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at both ends of the raceway, with the bonding jumper or use non-metallic conduit.
      c. Provide connection to grounding system indicated, to form a communication grounding system.
   2. Metal Underground Water Pipe(s):
      a. Provide connection to underground metal domestic and fire protection (where present) water service pipe(s) that are in direct contact with earth for at least 10 feet at an accessible location not more than 5 feet from the point of entrance to the building.
      b. Provide bonding jumper(s) around insulating joints/pipes as required to make pipe electrically continuous.
      c. Provide bonding jumper around water meter of sufficient length to permit removal of meter without disconnecting jumper.
   3. Metal In-Ground Support Structure:
      a. Provide connection to metal in-ground support structure that is in direct contact with earth in accordance with NFPA 70.
   4. Concrete-Encased Electrode:
      a. Provide connection to concrete-encased electrode consisting of not less than 20 feet of bare copper conductor not smaller than 4 AWG embedded within concrete foundation or footing that is in direct contact with earth in accordance with NFPA 70.
   5. Ground Ring:
      a. Provide a ground ring encircling the building or structure consisting of bare copper conductor not less than 2 AWG in direct contact with earth, installed at a depth of not less than 30 inches. Where indicated.
      b. Where location is not indicated, locate ground ring conductor at least 24 inches outside building perimeter foundation.
      c. Provide ground enhancement material around conductor where indicated.
      d. Provide connection from ground ring conductor to:
         1) Perimeter columns of metal building frame, as indicated.
         2) Ground rod electrodes located as indicated.
   6. Ground Rod Electrode(s):
      a. Provide two electrodes unless otherwise indicated or required.
      b. Space electrodes not less than 10 feet from each other and any other ground electrode.
      c. Where location is not indicated, locate electrode(s) at least 5 feet outside building perimeter foundation as near as possible to electrical service entrance; where possible, locate in softscape (uncovered) area.
      d. Provide ground enhancement material around electrode where indicated.
      e. Provide ground access well for each electrode.

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7. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.
8. Ground Bar: Provide ground bar, separate from service equipment enclosure, for common connection point of grounding electrode system bonding jumpers as permitted in NFPA 70. Connect grounding electrode conductor provided for service-supplied system grounding to this ground bar.
    a. Ground Bar Size: 1/4" by 4" by 16", unless otherwise indicated or required.
    b. Where ground bar location is not indicated, locate in accessible location as near as possible to service disconnect enclosure. Locate ground bar indoors.
    c. Provide a ground bar in each electrical room, that contain 480 and/or 208 volt systems.
    d. Provide a ground bar in each communication room.
    e. Ground Bar Mounting Height: 18 inches above finished floor unless otherwise indicated.
    f. Provide a ground bar in all Medium Voltage/Power and Communication vaults.
9. Power Ground Riser: Provide common grounding electrode conductor not less than 3/0 AWG for tap connections to multiple separately derived systems as permitted in NFPA 70.
    a. Connect ground riser conductor to each electrical room ground bar.
10. Communication Ground Riser: Provide common grounding electrode conductor not less than 3/0 AWG for tap connections to multiple separately derived systems as permitted in NFPA 70.
    a. Connect ground riser conductor to each communication room ground bar.

G. Service-Supplied System Grounding:
1. For each service disconnect, provide grounding electrode conductor to connect neutral (grounded) service conductor to grounding electrode system. Unless otherwise indicated, make connection at neutral (grounded) bus in service disconnect enclosure.
2. For each service disconnect, provide main bonding jumper to connect neutral (grounded) bus to equipment ground bus where not factory-installed. Do not make any other connections between neutral (grounded) conductors and ground on load side of service disconnect.

H. Grounding for Separate Building or Structure Supplied by Feeder(s) or Branch Circuits:
1. Provide grounding electrode system for each separate building or structure.
2. Provide equipment grounding conductor routed with supply conductors.
3. For each disconnecting means, provide grounding electrode conductor to connect equipment ground bus to grounding electrode system.
4. Do not make any connections and remove any factory-installed jumpers between neutral (grounded) conductors and ground.

I. Separately Derived System Grounding:
1. Separately derived systems include, but are not limited to:
    a. Transformers (except autotransformers such as buck-boost transformers).
    b. Uninterruptible power supplies (UPS), when configured as separately derived systems.
    c. Generators, when neutral is switched in the transfer switch.
2. Provide grounding electrode conductor to connect derived system grounded conductor to nearest effectively grounded metal building frame or to common grounding electrode conductor ground riser _____. Unless otherwise indicated, make connection at neutral (grounded) bus in source enclosure.
3. Provide bonding jumper to connect derived system grounded conductor to nearest metal building frame and nearest metal water piping in the area served by the derived system, where not already used as a grounding electrode for the derived system. Make connection at same location as grounding electrode conductor connection.
4. Where common grounding electrode conductor ground riser is used for tap connections to multiple separately derived systems, provide bonding jumper to connect the metal building frame

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and metal water piping in the area served by the derived system to the common grounding electrode conductor.

5. Outdoor Source: Where the source of the separately derived system is located outside the building or structure supplied, provide connection to grounding electrode at source in accordance with NFPA 70.
6. Provide system bonding jumper to connect system grounded conductor to equipment ground bus. Make connection at same location as grounding electrode conductor connection. Do not make any other connections between neutral (grounded) conductors and ground on load side of separately derived system disconnect.
7. Where the source and first disconnecting means are in separate enclosures, provide supply-side bonding jumper between source and first disconnecting means.

J. Bonding and Equipment Grounding:
1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways, data racks, communication equipment, cable trays and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
7. Bonding of metal boxes. Metal boxes shall be grounded with a separate pig-tailed conductor and threaded screw. Provide a fork terminal for connection to box. Wrapping conductors around box grounding screw or post is not acceptable.
8. Provide bonding for interior metal piping systems in accordance with NFPA 70. This includes, but is not limited to:
   a. Metal water piping where not already effectively bonded to metal underground water pipe used as grounding electrode.
9. Provide bonding for interior metal air ducts.
10. Provide bonding for metal building frame.
11. Provide bonding for metal siding not effectively bonded through attachment to metal building frame.
12. Provide bonding and equipment grounding for pools and fountains and associated equipment in accordance with NFPA 70.
13. Provide redundant grounding and bonding for patient care areas of health care facilities in accordance with NFPA 70 and NFPA 99.

K. Communications Systems Grounding and Bonding:
1. See Specification Section 270526 for Communication Grounding requirements.
   a. Provide intersystem bonding termination at service equipment or metering equipment enclosure and at disconnecting means for any additional buildings or structures in accordance with NFPA 70.
   b. Provide bonding jumper in raceway from intersystem bonding termination to each communications room or backboard and provide ground bar for termination.
      1) Bonding Jumper Size: 6 AWG, unless otherwise indicated or required.

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2) Raceway Size: 3/4 inch trade size unless otherwise indicated or required.
3) Ground Bar Size: 1/4" by 4" by 16", unless otherwise indicated or required.
4) Ground Bar Mounting Height: 18 inches above finished floor unless otherwise indicated.

L. Signal Reference Grids:
1. Provide signal reference grid on subfloor under access floors where indicated.
2. Construct grid using field-welded sections of pre-fabricated signal reference grids.
3. Unless otherwise indicated, locate grid between 6 and 18 inches (150 and 450 mm) from perimeter walls.
4. Unless otherwise indicated, make bonding connections to signal reference grid using exothermic welded connections.
5. Make bonding connections as short as possible, with no sharp folds or bends.
6. Unless otherwise indicated, provide separate bonding connections from signal reference grid to each item to be bonded. Do not daisy chain items together to facilitate single point connection to signal reference grid.
7. Provide 6 AWG bonding jumper to connect every sixth access floor pedestal in each direction to signal reference grid. Make connections to floor pedestals using exothermic welded connections.
8. Provide 6 AWG bonding jumper to connect each steel column within and at the perimeter of room to signal reference grid. Make connections to steel columns using exothermic welded connections.
9. Provide 6 AWG bonding jumper to connect each metal item such as conduits, pipes, ducts, etc. crossing the plane of, or within 6 feet (1.8 m) of, the signal reference grid. Make connections to conduits and pipes using listed ground clamps.
10. Provide 6 AWG bonding jumper to connect signal reference grid to grounding point of separately derived systems serving equipment located on the signal reference grid.
11. Provide low impedance risers to connect each equipment enclosure to signal reference grid. For each piece of equipment, provide two separate connections of different lengths connected to opposite sides of equipment and to different points on the signal reference grid. Make connections to equipment enclosures using mechanical connectors. Do not make connection to signal reference grid on the outermost grid conductor.

M. Lightning Protection Systems, in Addition to Requirements of Section 264113:
1. Do not use grounding electrode dedicated for lightning protection system for component of building grounding electrode system provided under this section.
2. Provide bonding of building grounding electrode system provided under this section and lightning protection grounding electrode system in accordance with NFPA 70 and NFPA 780.

N. Cable Tray Systems: Also comply with Section 260536.

O. Pole-Mounted Luminaires: Also comply with Section 265600.

P. Static Control Flooring: Provide bonding of static control flooring provided in accordance with Section 096500.

2.02 GROUNDING AND BONDING COMPONENTS

A. General Requirements:
1. Provide products listed, classified, and labeled as suitable for the purpose intended.
2. Provide products listed and labeled as complying with UL 467 where applicable.

B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 260526:
1. Use insulated copper conductors unless otherwise indicated.
a. Exceptions:
1) Use bare copper conductors where installed underground in direct contact with earth.

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2) Use bare copper conductors where directly encased in concrete (not in raceway).

C. Connectors for Grounding and Bonding:
1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
2. Unless otherwise indicated, use exothermic welded connections or compression connectors for underground, concealed and other inaccessible connections.
a. Exceptions:
1) Use mechanical connectors for connections to electrodes at ground access wells.
2) Grounding of communication systems, use compression connectors for concealed and other inaccessible connections.
3. Unless otherwise indicated, use compression connectors or exothermic welded connections for accessible connections.
a. Exceptions:
1) Use exothermic welded connections for connections to metal building frame.
4. Manufacturers - Mechanical and Compression Connectors:
a. Advanced Lightning Technology (ALT); _____: www.altfab.com
b. Burndy LLC; _____: www.burndy.com
c. Harger Lightning & Grounding; _____: www.harger.com
d. Ilsco.
e. Thomas & Betts Corporation; _____: www.tnb.com
f. Substitutions: See Section 016000 - Product Requirements.
5. Manufacturers - Exothermic Welded Connections:
a. Burndy LLC; _____: www.burndy.com
b. Cadweld, a brand of Erico International Corporation; _____: www.erico.com
c. ThermOweld, a brand of Continental Industries, Inc; _____: www.thermoweld.com
d. Substitutions: See Section 016000 - Product Requirements.

D. Ground Bars:
1. Description: Copper rectangular ground bars with mounting brackets and insulators.
2. Size: As indicated.
3. Holes for Connections: _____. Provide two holes, with 1-3/4" spacing and 1/2" mounting holes, for two hole lugs.
4. Manufacturers:
a. Advanced Lightning Technology (ALT); _____: www.altfab.com
b. Erico International Corporation; _____: www.erico.com
c. Harger Lightning & Grounding; _____: www.harger.com
d. ThermOweld, a brand of Continental Industries, Inc; _____: www.thermoweld.com
e. Substitutions: See Section 016000 - Product Requirements.

E. Ground Rod Electrodes:
1. Comply with NEMA GR 1.
2. Material: Copper-bonded (copper-clad) steel.
3. Size: 5/8 inch diameter by 10 feet length, unless otherwise indicated.
4. Manufacturers:
a. Advanced Lightning Technology (ALT); _____: www.altfab.com
b. Erico International Corporation; _____: www.erico.com
c. Galvan Industries, Inc; _____: www.galvanelectrical.com
d. Harger Lightning & Grounding; _____: www.harger.com
e. Substitutions: See Section 016000 - Product Requirements.

F. Chemically-Enhanced Ground Electrodes:

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1. Description: Copper tube factory-filled with electrolytic salts designed to provide a low-impedance ground in locations with high soil resistivity; straight (for vertical installations) or L-shaped (for horizontal installations) as indicated or as required.
2. Length: 10 feet.
3. Integral Pigtail: Factory-attached, sized not less than grounding electrode conductor to be attached.
4. Backfill Material: Grounding enhancement material recommended by electrode manufacturer.
5. Manufacturers:
   a. Advanced Lightning Technology (ALT); _____: www.altfab.com
   b. Erico International Corporation; _____: www.erico.com
   c. Harger Lightning & Grounding; _____: www.harger.com
   d. ThermOweld, subsidiary of Continental Industries; division of Burndy LLC; _____: www.thermoweld.com.
   e. Substitutions: See Section 016000 - Product Requirements.

G. Ground Plate Electrodes:
1. Material: Copper.
2. Size: 24 by 24 by 1/4 inches, unless otherwise indicated.

H. Ground Enhancement Material:
1. Description: Factory-mixed conductive material designed for permanent and maintenance-free improvement of grounding effectiveness by lowering resistivity.
2. Resistivity: Not more than 20 ohm-cm in final installed form.
3. Manufacturers:
   a. Erico International Corporation; _____: www.erico.com
   b. Harger Lightning & Grounding; _____: www.harger.com
   c. ThermOweld, subsidiary of Continental Industries; division of Burndy LLC; _____: www.thermoweld.com.

I. Ground Access Wells:
1. Description: Open bottom round or rectangular well with access cover for testing and inspection; suitable for the expected load at the installed location.
2. Size: As required to provide adequate access for testing and inspection, but not less than minimum size requirements specified.
   a. Rectangular Wells: Not less than 12 by 12 inches.
3. Depth: As required to extend below frost line to prevent frost upheaval, but not less than 10 inches.
4. Cover: Factory-identified by permanent means with word "GROUND".
5. Manufacturers:
   a. Substitutions: See Section 016000 - Product Requirements.

J. Pre-Fabricated Signal Reference Grids:
1. Description: Factory pre-fabricated grid manufactured from 2 inch wide, 26 gage, flat copper strips spaced on 24 inch centers, factory-welded at each crossover.
2. Low Impedance Risers: Factory fabricated 2 inch wide, 26 gage, flat copper strips designed for connecting equipment enclosures to pre-fabricated signal reference grid.
3. Manufacturers:
   a. Advanced Lightning Technology (ALT); _____: www.altfab.com
   b. Erico International Corporation; _____: www.erico.com
   c. Harger Lightning & Grounding; _____: www.harger.com
   d. ThermOweld, a brand of Continental Industries, Inc; _____: www.thermoweld.com
   e. Substitutions: See Section 016000 - Product Requirements.

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K. Oxide Inhibiting Compound: Comply with Section 260519.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that work likely to damage grounding and bonding system components has been completed.

B. Verify that field measurements are as indicated.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70.
   1. Outdoor Installations: Unless otherwise indicated, install with top of rod 6 inches below finished grade.
   2. Indoor Installations: Unless otherwise indicated, install with 4 inches of top of rod exposed.

D. Ground Plate Electrodes: Unless otherwise indicated, install ground plate electrodes at a depth of not less than 30 inches.

E. Make grounding and bonding connections using specified connectors.
   1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
   2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
   3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
   4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
   5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

F. Identify grounding and bonding system components in accordance with Section 260553.

3.03 FIELD QUALITY CONTROL

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

B. Inspect and test in accordance with NETA ATS except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.13.

D. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.

E. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.

F. Submit detailed reports indicating inspection and testing results and corrective actions taken.

END OF SECTION

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SECTION 260529
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Support and attachment components for equipment, conduit, cable, boxes, and other electrical work.

1.02 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Concrete equipment pads.

B. Section 055000 - Metal Fabrications: Materials and requirements for fabricated metal supports.

C. Section 260533.13 - Conduit for Electrical Systems: Additional support and attachment requirements for conduits.

D. Section 260536 - Cable Trays for Electrical Systems: Additional support and attachment requirements for cable tray.

E. Section 260533.16 - Boxes for Electrical Systems: Additional support and attachment requirements for boxes.

F. Section 260548 - Vibration and Seismic Controls for Electrical Systems.

G. Section 262513 - Low-Voltage Busways: Additional support and attachment requirements for busway.

H. Section 265100 - Interior Lighting: Additional support and attachment requirements for interior luminaires.

I. Section 265113 - Luminaires, Ballasts, and Drivers: Additional support and attachment requirements for luminaires.

J. Section 265600 - Exterior Lighting: Additional support and attachment requirements for exterior luminaires.

1.03 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.

C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2015.

D. MFMA-4 - Metal Framing Standards Publication; 2004.

E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. UL 5B - Strut-Type Channel Raceways and Fittings; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
2. Coordinate the work with other trades to provide additional framing and materials required for installation.
3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.

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4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
5. Notify Architect and Owner's Construction Project Coordinator, of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

B. Sequencing:
1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 033000.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for metal channel (strut) framing systems, non-penetrating rooftop supports, and post-installed concrete and masonry anchors.

C. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.

D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.06 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Comply with applicable building code.

C. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

D. Installer Qualifications for Powder-Actuated Fasteners (when specified): Certified by fastener system manufacturer with current operator's license.

E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:
1. Comply with the following. Where requirements differ, comply with most stringent.
   a. NFPA 70.
   b. Requirements of authorities having jurisdiction.
2. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of electrical work.
3. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported _____. Include consideration for vibration, equipment operation, and shock loads where applicable.
5. Do not use products for applications other than as permitted by NFPA 70 and product listing.
6. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.

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7. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
    a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
    b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
    c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
    d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Materials for Metal Fabricated Supports: Comply with Section 055000.

C. Conduit and Cable Supports: Straps, clamps, etc. suitable for the conduit or cable to be supported.
1. Conduit Straps: One-hole or two-hole type; steel.
2. Conduit Clamps: Bolted type unless otherwise indicated.
3. Use of cable/conduit clips (batwings) are not an approved method for conduit supports.

D. Outlet Box Supports: Hangers, brackets, etc. suitable for the boxes to be supported.

E. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
1. Comply with MFMA-4.
2. Channel (Strut) Used as Raceway (only where specifically indicated): Listed and labeled as complying with UL 5B.
3. Channel Material:
    a. Indoor Dry Locations: Use galvanized steel.
    b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
4. Minimum Channel Thickness: Steel sheet, 12 gage, 0.1046 inch.
5. Minimum Channel Dimensions: 1-5/8 inch width by 13/16 inch height.
6. Minimum Channel Length 24 inches.
7. Manufacturers:
    a. Cooper B-Line, a division of Eaton Corporation; _____: www.cooperindustries.com
    b. Thomas & Betts Corporation; _____: www.tnb.com
    c. Unistrut, a brand of Atkore International Inc; _____: www.unistrut.com
    d. nVent/Caddy.

F. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.
1. Minimum Size, Unless Otherwise Indicated or Required:
    a. Equipment Supports: Hanger rods per equipment manufacturers recommendations or per the recommendations of a licensed structural engineer.
    b. Busway Supports: Hanger rods per equipment manufacturers recommendations or per the recommendations of a licensed structural engineer.
    c. Single Conduit up to 1 inch (27 mm) trade size: 1/4 inch diameter.
    d. Single Conduit larger than 1 inch (27 mm) trade size: 3/8 inch diameter.
    e. Trapeze Support for Multiple Conduits: 3/8 inch diameter.
    f. Outlet Boxes: 1/4 inch diameter.
    g. Luminaires: 1/4 inch diameter.

G. Non-Penetrating Rooftop Supports for Low-Slope Roofs: Steel pedestals with thermoplastic or rubber bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified.
1. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
2. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.

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3. Mounting Height: Provide minimum clearance of 2" inches under supported component to top of roofing.
4. Manufacturers:
   a. Cooper B-Line, a division of Eaton Corporation; _____: www.cooperindustries.com
   b. Erico International Corporation; _____: www.erico.com
   c. Unistrut, a brand of Atkore International Inc: www.unistrut.com

H. Anchors and Fasteners:
1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
4. Hollow Masonry: Use toggle bolts.
5. Hollow Stud Walls: Use toggle bolts.
6. Steel: Use beam clamps, machine bolts, or welded threaded studs.
7. Sheet Metal: Use sheet metal screws.
8. Wood: Use wood screws.
9. Plastic and lead anchors are permitted.
10. Powder-actuated fasteners are permitted.
    a. Use only threaded studs; do not use pins.
11. Hammer-driven anchors and fasteners are permitted..
    a. Nails are permitted for attachment of nonmetallic boxes to wood frame construction (when specified).
    b. Staples are permitted for attachment of nonmetallic-sheathed cable to wood frame construction (when specified).
12. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
    a. Comply with MFMA-4.
    b. Channel Material: Use galvanized steel.
    c. Minimum Channel Thickness: Steel sheet, 12 gage, 0.1046 inch minimum base metal thickness.
    d. Manufacturer: Same as manufacturer of metal channel (strut) framing system.
13. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.
14. Manufacturers - Mechanical Anchors:
    a. Hilti, Inc; _____: www.us.hilti.com
    b. ITW Red Head, a division of Illinois Tool Works, Inc; _____: www.itwredhead.com
    c. Powers Fasteners, Inc; _____: www.powers.com
    d. Simpson Strong-Tie Company Inc; _____: www.strongtie.com
    e. Substitutions: See Section 016000 - Product Requirements.
15. Manufacturers - Powder-Actuated Fastening Systems:
    a. Hilti, Inc; _____: www.us.hilti.com
    b. ITW Ramset, a division of Illinois Tool Works, Inc; _____: www.ramset.com
    c. Powers Fasteners, Inc; _____: www.powers.com
    d. Simpson Strong-Tie Company Inc; _____: www.strongtie.com

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive support and attachment components.

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C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

E. Unless specifically indicated or approved by Architect, do not provide support from metal roof deck.

F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

G. Provide required vibration isolation and/or seismic controls in accordance with Section 260548.

H. Field-Welding (where approved by Architect): Comply with Section 055000.

I. Equipment Support and Attachment:
   1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
   2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
   3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
   4. Unless otherwise indicated, mount floor-mounted equipment on properly sized 4 inch high concrete pad constructed in accordance with Section 033000.
   5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

J. Conduit Support and Attachment: Also comply with Section 260533.13.

K. Cable Tray Support and Attachment: Also comply with Section 260536.

L. Box Support and Attachment: Also comply with Section 260533.16.

M. Busway Support and Attachment: Also comply with Section 262513.

N. Interior Luminaire Support and Attachment: Also comply with Section 265100.

O. Exterior Luminaire Support and Attachment: Also comply with Section 265600.

P. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.

Q. Secure fasteners according to manufacturer's recommended torque settings.

R. Remove temporary supports.

S. Identify independent electrical component support wires above accessible ceilings (only where specifically indicated or permitted) with color distinguishable from ceiling support wires in accordance with NFPA 70.

T. Multiple Raceway trapeze-type support structure minimum width shall be 24 inches, unless specified otherwise. For shorter widths, obtain permission from the Owners engineer, prior to installation. Sized support structure so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

3.03 FIELD QUALITY CONTROL

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

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B. Inspect support and attachment components for damage and defects.

C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION

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SECTION 260533.13

CONDUIT FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Galvanized steel rigid metal conduit (RMC).
B. Intermediate metal conduit (IMC).
C. PVC-coated galvanized steel rigid metal conduit (RMC).
D. Flexible metal conduit (FMC).
E. Liquidtight flexible metal conduit (LFMC).
F. Electrical metallic tubing (EMT).
G. Rigid polyvinyl chloride (PVC) conduit.
H. Electrical nonmetallic tubing (ENT).
I. Liquidtight flexible nonmetallic conduit (LFNC).
J. Conduit fittings.
K. Accessories.

1.02 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Concrete encasement of conduits.
B. Section 078400 - Firestopping.
C. Section 260519 - Low-Voltage Electrical Power Conductors and Cables.
D. Section 260526 - Grounding and Bonding for Electrical Systems.
   1. Includes additional requirements for fittings for grounding and bonding.
E. Section 260529 - Hangers and Supports for Electrical Systems.
F. Section 260533.16 - Boxes for Electrical Systems.
G. Section 260533.23 - Surface Raceways for Electrical Systems.
H. Section 260539 - Underfloor Raceways for Electrical Systems.
I. Section 260548 - Vibration and Seismic Controls for Electrical Systems.
J. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
K. Section 262100 - Low-Voltage Electrical Service Entrance: Additional requirements for electrical service conduits.
L. Section 262723 - Indoor Service Poles.
M. Section 271005 - Structured Cabling for Voice and Data - Inside-Plant: Additional requirements for communications systems conduits.
N. Section 312316 - Excavation.
O. Section 312316.13 - Trenching: Excavating, bedding, and backfilling.
P. Section 312323 - Fill: Bedding and backfilling.
Q. Section 337119 - Electrical Underground Ducts, Ductbanks, and Manholes.

1.03 REFERENCE STANDARDS

A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2015.
B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S); 2015.

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C. ANSI C80.6 - American National Standard for Electrical Intermediate Metal Conduit (EIMC); 2005.
D. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
E. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); 2013.
F. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC); 2003.
G. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.
H. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit; 2005 (Reaffirmed 2013).
I. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit; 2013.
J. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing; 2016.
K. NEMA TC 13 - Electrical Nonmetallic Tubing (ENT); 2014.
L. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
M. UL 1 - Flexible Metal Conduit; Current Edition, Including All Revisions.
N. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.
O. UL 360 - Liquid-Tight Flexible Steel Conduit; Current Edition, Including All Revisions.
P. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.
Q. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings; Current Edition, Including All Revisions.
R. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.
S. UL 1203 - Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations; Current Edition, Including All Revisions.
T. UL 1242 - Electrical Intermediate Metal Conduit-Steel; Current Edition, Including All Revisions.
U. UL 1653 - Electrical Nonmetallic Tubing; Current Edition, Including All Revisions.
V. UL 1660 - Liquid-Tight Flexible Nonmetallic Conduit; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate minimum sizes of conduits with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
   2. Coordinate the arrangement of conduits with structural members, ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
   3. Verify exact conduit termination locations required for boxes, enclosures, and equipment installed under other sections or by others.
   4. Coordinate the work with other trades to provide roof penetrations that preserve the integrity of the roofing system and do not void the roof warranty.
   5. Notify Architect and Owner's Construction Project Coordinator, of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
B. Sequencing:
   1. Do not begin installation of conductors and cables until installation of conduit is complete between outlet, junction and splicing points.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittals procedures.

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B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.

C. Shop Drawings:
   1. Include proposed locations of roof penetrations and proposed methods for sealing.

D. Project Record Documents: Record actual routing for conduits installed underground, conduits embedded within concrete slabs, and conduits 2 inch (53 mm) trade size and larger.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 CONDUIT APPLICATIONS

A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70 and product listing.

B. Unless otherwise indicated and where not otherwise restricted, use the conduit types indicated for the specified applications. Where more than one listed application applies, comply with the most restrictive requirements. Where conduit type for a particular application is not specified, use galvanized steel rigid metal conduit.

C. Underground:
   1. Under Slab on Grade: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, or rigid PVC conduit.
   2. Exterior, Direct-Buried: Use galvanized steel rigid metal conduit, intermediate metallic conduit (IMC), PVC-coated galvanized steel rigid metal conduit, or rigid PVC conduit.
   3. Exterior, Embedded Within Concrete: Conduit not permitted to be buried in concrete slabs.
   4. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit where emerging from underground.
   5. Where rigid polyvinyl (PVC) conduit is provided, use galvanized steel rigid metal conduit elbows for bends.
   6. Where steel conduit is installed in direct contact with earth, use corrosion protection tape to provide supplementary corrosion protection or use PVC-coated galvanized steel rigid metal conduit. Install 150% overlap of PVC tape on steel conduit in direct contact with earth.
   7. Where steel conduit emerges from concrete into soil, use corrosion protection tape to provide supplementary corrosion protection for a minimum of 4 inches on either side of where conduit emerges or use PVC-coated galvanized steel rigid metal conduit. Install 150% overlap of PVC tape on steel conduit in direct contact with earth.

D. Embedded Within Concrete:
   1. Within Slab on Grade: Not permitted.
   2. Within Slab Above Ground: Not permitted.

E. Concealed Within Masonry Walls: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).

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F. Concealed Within Hollow Stud Walls: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).

G. Concealed Above Accessible Ceilings: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).

H. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or PVC-coated galvanized steel rigid metal conduit. Electrical metal conduit (EMT) acceptable for damp locations only where indicated in the Drawings.

I. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).

J. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).
   1. Locations subject to physical damage include, but are not limited to:
      a. Where exposed below 8 feet, except within electrical and communication rooms or closets.
      b. Where exposed below 20 feet in warehouse areas.

K. Exposed, Exterior: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or PVC-coated galvanized steel rigid metal conduit.

L. Concealed, Exterior, Not Embedded in Concrete or in Contact With Earth: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).

M. Corrosive Locations Above Ground: Use PVC-coated galvanized steel rigid metal conduit or fiberglass conduit.
   1. Corrosive locations include, but are not limited to:
      a. Cooling towers.
      b. Areas specified in the National Electrical Code (NEC) NFPA 70..

N. Hazardous (Classified) Locations: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or PVC-coated galvanized steel rigid metal conduit.

O. Connections to Luminaires Above Accessible Ceilings: Use flexible metal conduit.
   1. Maximum Length: 6 feet.

P. Connections to Vibrating Equipment:
   1. Dry Locations: Use flexible metal conduit.
   2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit.
   3. Maximum Length: 6 feet unless otherwise indicated.
   4. Vibrating equipment includes, but is not limited to:
      a. Transformers.
      b. Motors.

Q. Fished in Existing Walls, Where Necessary: Use flexible metal conduit.

2.02 CONDUIT REQUIREMENTS

A. Existing Work: Where existing conduits are indicated to be reused, they may be reused only where they comply with specified requirements, are free from corrosion, and integrity is verified by pulling a mandrel through them.

B. Electrical Service Conduits: Also comply with Section 262100.

C. Communications Systems Conduits: Also comply with Section 271005.

D. Fittings for Grounding and Bonding: Also comply with Section 260526.

E. Provide all conduit, fittings, supports, and accessories required for a complete raceway system.

F. Provide products listed, classified, and labeled as suitable for the purpose intended.

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G. Minimum Conduit Size, Unless Otherwise Indicated:
   1. Branch Circuits: 3/4 inch (21 mm) trade size.
   2. Branch Circuit Homeruns: 3/4 inch (21 mm) trade size.
   3. Control Circuits: 3/4 inch (21 mm mm) trade size.
   4. Flexible Connections to Luminaires: 3/8 inch (12 mm) trade size.
   5. Underground, Interior: 3/4 inch (21 mm) trade size.
   6. Underground, Exterior: 1 inch (27 mm) trade size.
   7. **Communication conduits:**
      a. Interior communication conduits: 1 inch (27mm) trade size.
      b. Duct bank conduits:
         1) Minimum conduit bend radii:
            (a) Minimum of 48-inch radius bends.
         2) No more than two (2) 90 degree bends, per conduit run.
   8. Medium Voltage Circuits (5 KV through 15 KV): 5" trade size.
      a. Minimum conduit bend radii:
         1) For conduit lengths up to 100 feet: 5-inch trade size with 48-inch minimum radius bends.
         2) For conduit lengths over 100 feet: 5-inch trade size with 60-inch minimum radius bends.
   9. Door Jams for Security Systems: 3/8" (12 mm) trade size.

H. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.03 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Manufacturers:
   1. Allied Tube & Conduit: www.alliedeg.com
   2. Republic Conduit: www.republic-conduit.com
   3. Wheatland Tube Company: www.wheatland.com
   4. Substitutions: See Section 016000 - Product Requirements.

B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.

C. Fittings:
   1. Manufacturers:
      a. Bridgeport Fittings Inc: www.bptfittings.com
      b. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com
      c. Thomas & Betts Corporation: www.tnb.com
      d. Substitutions: See Section 016000 - Product Requirements.
   2. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   3. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
   4. Material: Use steel.
      a. Do not use die cast zinc fittings.
   5. Connectors and Couplings: Use threaded type, threadless set screw and compression (gland) fittings are permitted. _____.

2.04 INTERMEDIATE METAL CONDUIT (IMC)

A. Manufacturers:
   1. Allied Tube & Conduit: www.alliedeg.com

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2. Republic Conduit: www.republic-conduit.com
3. Wheatland Tube Company: www.wheatland.com
4. Substitutions: See Section 016000 - Product Requirements.

B. Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.

C. Fittings:
1. Manufacturers:
a. Bridgeport Fittings Inc: www.bptfittings.com
b. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com
c. Thomas & Betts Corporation: www.tnb.com
d. Substitutions: See Section 016000 - Product Requirements.
2. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
4. Material: Use steel.
a. Do not use die cast zinc fittings.
5. Connectors and Couplings: Use _____ threaded type, threadless set screw and compression (gland) fittings are permitted.

2.05 PVC-COATED GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Manufacturers:
1. Thomas & Betts Corporation; _____: www.tnb.com
2. Robroy Industries; _____: www.robroy.com
3. Substitutions: See Section 016000 - Product Requirements.

B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit with external polyvinyl chloride (PVC) coating complying with NEMA RN 1 and listed and labeled as complying with UL 6.

C. Exterior Coating: Polyvinyl chloride (PVC), nominal thickness of 40 mil.

D. Interior Coating: Urethane, minimum thickness of 2 mil, where identified on the Drawings.

E. PVC-Coated Fittings:
1. Manufacturer: Same as manufacturer of PVC-coated conduit to be installed.
2. Non-Hazardous Locations: Use fittings listed and labeled as complying with UL 514B.
3. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
4. Material: Use steel.
5. Exterior Coating: Polyvinyl chloride (PVC), minimum thickness of 40 mil.
6. Interior Coating: Urethane, minimum thickness of 2 mil, where identified on the Drawings.

F. PVC-Coated Supports: Furnish with exterior coating of polyvinyl chloride (PVC), minimum thickness of 15 mil.

2.06 FLEXIBLE METAL CONDUIT (FMC)

A. Manufacturers:
1. Substitutions: See Section 016000 - Product Requirements.

B. Description: NFPA 70, Type FMC standard wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems to be used.

C. Fittings:
1. Manufacturers:
a. Bridgeport Fittings Inc: www.bptfittings.com

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b. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com
c. Thomas & Betts Corporation: www.tnb.com
d. Substitutions: See Section 016000 - Product Requirements.

2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Material: Use steel, malleable iron, or die cast zinc.

2.07 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

A. Manufacturers:
1. Substitutions: See Section 016000 - Product Requirements.

B. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.

C. Fittings:
1. Manufacturers:
a. Substitutions: See Section 016000 - Product Requirements.
2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Material: Use steel.
a. Do not use die cast zinc fittings.

2.08 ELECTRICAL METALLIC TUBING (EMT)

A. Manufacturers:
1. Substitutions: See Section 016000 - Product Requirements.

B. Description: NFPA 70, Type EMT steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.

C. Fittings:
1. Manufacturers:
a. Substitutions: See Section 016000 - Product Requirements.
2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Material: Use steel or malleable iron.
a. Do not use die cast zinc fittings.
4. Connectors and Couplings: Use compression (gland) or set-screw type.
a. Do not use indenter type connectors and couplings.
5. Damp or Wet Locations (where permitted): Use fittings listed for use in wet locations.
6. Embedded Within Concrete (where permitted): Use fittings listed as concrete-tight. Fittings that require taping to be concrete-tight are acceptable.

2.09 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

A. Manufacturers:
1. Substitutions: See Section 016000 - Product Requirements.

B. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.

C. Fittings:
1. Manufacturer: Same as manufacturer of conduit to be connected.
2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

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2.10 ELECTRICAL NONMETALLIC TUBING (ENT)

A. Manufacturers:
   1. Cantex Inc; _____: www.cantexinc.com
   2. Carlon, a brand of Thomas & Betts Corporation; _____: www.carlon.com
   3. Substitutions: See Section 016000 - Product Requirements.

B. Description: NFPA 70, Type ENT electrical nonmetallic tubing complying with NEMA TC 13 and listed and labeled as complying with UL 1653.

C. Fittings:
   1. Manufacturer: Same as manufacturer of ENT to be connected.
   2. Use solvent-welded type fittings. Snap-on fittings are not permitted.
   3. Solvent-Welded Fittings: Rigid PVC fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; suitable for use with ENT.

2.11 LIQUIDTIGHT FLEXIBLE NONMETALLIC CONDUIT (LFNC)

A. Manufacturers:
   1. Substitutions: See Section 016000 - Product Requirements.

B. Description: NFPA 70, Type LFNC liquidtight flexible nonmetallic conduit listed and labeled as complying with UL 1660.

C. Fittings:
   1. Manufacturer: Same as manufacturer of conduit to be connected.
   2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B; suitable for the type of conduit to be connected.

2.12 ACCESSORIES

A. Corrosion Protection Tape: PVC-based, minimum thickness of 20 mil.
   1. Substitutions: See Section 016000 - Product Requirements.

B. Conduit Joint Compound: Corrosion-resistant, electrically conductive; suitable for use with the conduit to be installed.
   1. Substitutions: See Section 016000 - Product Requirements.

C. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.

D. Pull Strings: Use nylon cord with average breaking strength of not less than 200 pound-force.

E. Sealing Compound for Sealing Fittings: Listed for use with the particular fittings to be installed.

F. Modular Seals for Conduit Penetrations: Rated for minimum of 40 psig; Suitable for the conduits to be installed.
   1. Product: Linkseal.
   2. Other manufacturer's approved through submittal process.
   3. Substitutions: See Section 016000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive conduits.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

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B. Perform work in accordance with NECA 1 (general workmanship).

C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.

D. Install intermediate metal conduit (IMC) in accordance with NECA 101.

E. Install PVC-coated galvanized steel rigid metal conduit (RMC) using only tools approved by the manufacturer.

F. Install rigid polyvinyl chloride (PVC) conduit in accordance with NECA 111.

G. Install electrical nonmetallic tubing (ENT) in accordance with NECA 111.

H. Install liquidtight flexible nonmetallic conduit (LFNC) in accordance with NECA 111.

I. Conduit Routing:
   1. Unless dimensioned, conduit routing indicated is diagrammatic.
   2. When conduit destination is indicated without specific routing, determine exact routing required.
   3. Conceal all conduits unless specifically indicated to be exposed.
   4. Conduits in the following areas may be exposed, unless otherwise indicated:
      a. Electrical rooms.
      b. Mechanical equipment rooms.
      c. Within joists in areas with no ceiling.
   5. Unless otherwise approved, do not route conduits exposed:
      a. Across floors.
      b. Across roofs.
      c. Across top of parapet walls.
      d. Across building exterior surfaces.
   6. Conduits installed underground may be routed in the shortest possible manner unless otherwise indicated. Route all other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
   7. Data conduit systems: Arrange conduit to provide no more than the equivalent of two 90 degree bends between pull points. Three 90 degree bends are acceptable, if one 90 degree bend is located within 5 feet of the first or last box.
   8. Arrange conduit to provide no more than [100] feet between pull points.
   9. Arrange conduit to maintain adequate headroom, clearances, and access.
   10. Arrange conduit to provide no more than the equivalent of four 90 degree bends between pull points.
   11. Above Grade: Arrange conduit to provide no more than 150 feet between pull points.
   12. Below Grade: Arrange conduit to provide no more than 400 feet between pull points.
   13. Route conduits above water and drain piping where possible.
   14. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
   15. Maintain minimum clearance of 6 inches between conduits and piping for other systems.
   16. Maintain minimum clearance of 12 inches between conduits and hot surfaces. This includes, but is not limited to:
      a. Heaters.
      b. Hot water piping.
      c. Flues.
   17. Group parallel conduits in the same area together on a common rack.
   18. Elevator shafts and elevator equipment areas. Only conduits associated with the elevator system shall be permitted in the elevator equipment room and elevator shaft area. All other conduit systems shall not be routed through these areas.

J. Conduit Support:

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1. Secure and support conduits in accordance with NFPA 70 and Section 260529 using suitable supports and methods approved by the authority having jurisdiction.
2. Provide required vibration isolation and/or seismic controls in accordance with Section 260548.
3. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
4. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
5. Use conduit strap to support single surface-mounted conduit.
   a. Use clamp back spacer with conduit strap for damp and wet locations to provide space between conduit and mounting surface.
6. Use metal channel (strut) with accessory conduit clamps to support multiple parallel surface-mounted conduits.
7. Use conduit clamp to support single conduit from beam clamp or threaded rod.
8. Use trapeze hangers assembled from threaded rods and metal channel (strut) with accessory conduit clamps to support multiple parallel suspended conduits.
9. Use non-penetrating rooftop supports to support conduits routed across rooftops (only where approved).
10. Use of spring steel conduit clips for support of conduits is not permitted.
11. Use of wire for support of conduits is permitted only as follows:
    a. For securing conduits to studs in hollow stud walls.
12. Where conduit support intervals specified in NFPA 70 and NECA standards differ, comply with the most stringent requirements.

K. Connections and Terminations:
1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
3. Use suitable adapters where required to transition from one type of conduit to another.
4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
6. Where spare conduits stub up through concrete floors and are not terminated in a box or enclosure, provide threaded couplings equipped with threaded plugs set flush with finished floor.
7. Provide insulating bushings or insulated throats at all conduit terminations to protect conductors.
8. Secure joints and connections to provide maximum mechanical strength and electrical continuity.

L. Penetrations:
1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
2. Make penetrations perpendicular to surfaces unless otherwise indicated.
3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
4. Conceal bends for conduit risers emerging above ground.
5. Seal interior of conduits entering the building from underground at first accessible point to prevent entry of moisture and gases.
6. Provide modular seal assembly where conduits penetrate through below grade, exterior walls.
7. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.

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8. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty. Include proposed locations of penetrations and methods for sealing with submittals.
9. Provide metal escutcheon plates for conduit penetrations exposed to public view.
10. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 078400.

M. Underground Installation:
1. Provide trenching and backfilling in accordance with Section 312316 and Section 312323.
2. Minimum Cover, Unless Otherwise Indicated or Required:
   a. Underground, Exterior: 24 inches.
   b. Under Slab on Grade: 12 inches to bottom of slab.
3. Provide underground warning tape in accordance with Section 260553 along entire conduit length.

N. Concrete Encasement: Where conduits not otherwise embedded within concrete are indicated to be concrete-encased, provide concrete in accordance with Section 033000 with minimum concrete cover of 3 inches on all sides unless otherwise indicated.

O. Hazardous (Classified) Locations: Where conduits cross boundaries of hazardous (classified) locations, provide sealing fittings located as indicated or in accordance with NFPA 70.

P. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
2. Where calculated in accordance with NFPA 70 for rigid polyvinyl chloride (PVC) conduit installed above ground to compensate for thermal expansion and contraction.
3. Where conduits are subject to earth movement by settlement or frost.

Q. Conduit Sealing:
1. Use foam conduit sealant to prevent entry of moisture and gases. This includes, but is not limited to:
   a. Where conduits enter building from outside.
   b. Where service conduits enter building from underground distribution system.
   c. Where conduits enter building from underground.
   d. Where conduits may transport moisture to contact live parts.
2. Where conduits cross barriers between areas of potential substantial temperature differential, use foam conduit sealant at accessible point near penetration to prevent condensation. This includes, but is not limited to:
   a. Where conduits pass from outdoors into conditioned interior spaces.
   b. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.

R. Condensation Prevention: Where conduits cross barriers between areas of potential substantial temperature differential, provide sealing fitting or approved sealing compound at an accessible point near the penetration to prevent condensation. This includes, but is not limited to:
1. Where conduits pass from outdoors into conditioned interior spaces.
2. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.
3. Where conduits penetrate coolers or freezers.

S. Provide pull string in all empty conduits and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches at each end.

T. Provide grounding and bonding in accordance with Section 260526.

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U. Identify conduits in accordance with Section 260553.

3.03 FIELD QUALITY CONTROL

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

B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

C. Where coating of PVC-coated galvanized steel rigid metal conduit (RMC) contains cuts or abrasions, repair in accordance with manufacturer's instructions.

D. Correct deficiencies and replace damaged or defective conduits.

3.04 CLEANING AND PROOFING

A. Clean interior of conduits to remove moisture and foreign matter.

B. Underground raceways. All underground raceways shall be proofed, prior to the installation of conductors or cables. Mandrel shall be sized to a minimum of 80% of raceway size. Proof with cylinder style mandrels as follows:

1. 2" conduit - Mandrel Diameter 1.75"" (nominal), Minimum Mandrel length 6", Maximum Mandrel length - 8".
2. 2-1/2" conduit - Mandrel Diameter 2" (nominal), Minimum Mandrel length 6", Maximum Mandrel length - 12".
3. 3" conduit - Mandrel Diameter 2.5" (nominal), Minimum Mandrel length 6", Maximum Mandrel length - 12".
4. 4" conduit - Mandrel Diameter 3.5" (nominal), Minimum Mandrel length 6", Maximum Mandrel length - 12".
5. 5" conduit - Mandrel Diameter 4" (nominal), Minimum Mandrel length 8", Maximum Mandrel length - 12".

C. Provide a pull rope on both ends of the mandrel, when pulling through conduits.

3.05 PROTECTION

A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

3.06 SURVEY ALL UNDERGROUND CONDUITS.

A. Prior to burial of exterior conduits, contact Owner's project coordinator, to schedule Owner's survey crew to survey all exterior conduits.

END OF SECTION

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SECTION 260533.16

BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Outlet and device boxes up to 100 cubic inches, including those used as junction and pull boxes.

B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches.

C. Boxes and enclosures for integrated power, data, and audio/video.

D. Boxes for hazardous (classified) locations.

E. Floor boxes.

F. Underground boxes/enclosures.

1.02 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete.

B. Section 078400 - Firestopping.

C. Section 083100 - Access Doors and Panels: Panels for maintaining access to concealed boxes.

D. Section 260526 - Grounding and Bonding for Electrical Systems.

E. Section 260529 - Hangers and Supports for Electrical Systems.

F. Section 260533.13 - Conduit for Electrical Systems:
   1. Conduit bodies and other fittings.
   2. Additional requirements for locating boxes to limit conduit length and/or number of bends between pulling points.

G. Section 260533.23 - Surface Raceways for Electrical Systems:
   1. Accessory boxes designed specifically for surface raceway systems.

H. Section 260539 - Underfloor Raceways for Electrical Systems:

I. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

J. Section 260916 - Electrical Controls and Relays.

K. Section 262725 - Wiring Devices:
   1. Wall plates.
   2. Floor box service fittings.
   3. Poke-through assemblies.
   4. Access floor boxes.
   5. Additional requirements for locating boxes for wiring devices.

L. Section 262813 - Fuses: Spare fuse cabinets.

M. Section 271005 - Structured Cabling for Voice and Data - Inside-Plant: Additional requirements for communications systems boxes.

N. Section 337119 - Electrical Underground Ducts, Ductbanks, and Manholes: Concrete manholes for electrical systems.

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2010.

C. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.

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D. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; 2013.

E. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports; 2013.

F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.

G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. SCTE 77 - Specification for Underground Enclosure Integrity; 2013.

I. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

J. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.

K. UL 508A - Industrial Control Panels; Current Edition, Including All Revisions.

L. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.

M. UL 514C - Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers; Current Edition, Including All Revisions.

N. UL 1203 - Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
6. Coordinate the work with other trades to preserve insulation integrity.
7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
8. Notify Architect and Owner's Construction Project Coordinator, of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for cabinets and enclosures, boxes for hazardous (classified) locations, floor boxes, and underground boxes/enclosures.

1. Underground Boxes/Enclosures: Include reports for load testing in accordance with SCTE 77 certified by a professional engineer or an independent testing agency upon request.

C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

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D. Project Record Documents: Record actual locations for outlet and device boxes, junction boxes, pull boxes, cabinets and enclosures, floor boxes, and underground boxes/enclosures.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.
   2. Keys for Lockable Enclosures: Two of each different key.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 BOXES

A. General Requirements:
   1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
   2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
   3. Provide products listed, classified, and labeled as suitable for the purpose intended.
   4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
   5. Provide grounding terminals within boxes where equipment grounding conductors terminate.

B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:
   1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
   2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
   3. Use cast iron boxes or cast aluminum boxes where exposed galvanized steel rigid metal conduit or exposed intermediate metal conduit (IMC) is used.
   4. Use suitable concrete type boxes where flush-mounted in concrete.
   5. Use suitable masonry type boxes where flush-mounted in masonry walls.
   6. Use raised covers suitable for the type of wall construction and device configuration where required.
   7. Use shallow boxes where required by the type of wall construction.
   8. Do not use "through-wall" boxes designed for access from both sides of wall.
   9. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
   10. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
   11. Nonmetallic Boxes: Comply with NEMA OS 2, and list and label as complying with UL 514C.
   12. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required. For light fixtures 50 pounds and heavier, provide boxes rated at 150% of fixture weight.
   13. Boxes for Ganged Devices: Use multi gang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.
   14. Minimum Box Size, Unless Otherwise Indicated:

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a. Wiring Devices (Other Than Communications Systems Outlets): 4 inch square by 2-1/8 inch deep (100 by 54 mm) trade size.
b. Communications Systems Outlets: Comply with Section 271005.
c. Ceiling Outlets: 4 inch octagonal or square by 2-1/8 inch deep (100 by 54 mm) trade size.

15. Wall Plates: Comply with Section 262725.
16. Manufacturers:
    a. Cooper Crouse-Hinds, a division of Eaton Corporation; _____: www.cooperindustries.com
    b. Hubbell Incorporated; Bell Products; _____: www.hubbell-rtb.com
    c. Hubbell Incorporated; RACO Products; _____: www.hubbell-rtb.com
    d. O-Z/Gedney, a brand of Emerson Industrial Automation; _____: www.emersonindustrial.com
    e. Thomas & Betts Corporation; _____: www.tnb.com
    f. Bowers.
    g. Substitutions: See Section 016000 - Product Requirements.

C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches:
1. Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
2. NEMA 250 Environment Type, Unless Otherwise Indicated:
    a. Indoor Clean, Dry Locations: Type 1, painted steel.
    b. Outdoor Locations: Type 4, painted steel.
3. Junction and Pull Boxes Larger Than 100 cubic inches:
    a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
    b. Boxes 6 square feet and Larger: Provide hinged-cover enclosures, unless otherwise indicated.
4. Cabinets and Hinged-Cover Enclosures, Other Than Junction and Pull Boxes:
    a. Provide lockable hinged covers, all locks keyed alike unless otherwise indicated.
    b. Back Panels: Painted steel, removable.
    c. Terminal Blocks: For low voltage controls, provide voltage/current ratings and terminal quantity suitable for purpose indicated, with 25 percent spare terminal capacity. Terminal blocks not permitted for Class 1 wiring. Class 1 wiring to utilize wirenut termination methods.
5. Finish for Painted Steel Enclosures: Manufacturer's standard grey unless otherwise indicated.
6. Manufacturers:
    a. Cooper B-Line, a division of Eaton Corporation; _____: www.cooperindustries.com
    b. Hoffman, a brand of Pentair Technical Products; _____: www.hoffmanonline.com
    c. Hubbell Incorporated; Wiegmann Products; _____: www.hubbell-wiegmann.com

D. Boxes and Enclosures for Integrated Power, Data, and Audio/Video: Size and configuration as indicated or as required with partitions to separate services; field-connected gangable boxes may not be used.
1. See Section 271005.

E. Boxes for Hazardous (Classified) Locations: Listed and labeled as complying with UL 1203 for the classification of the installed location.
1. Manufacturers:
    a. Appleton, a brand of Emerson Industrial Automation; _____: www.emersonindustrial.com
    b. Cooper Crouse-Hinds, a division of Eaton Corporation; _____: www.cooperindustries.com
    c. Hubbell Incorporated; Killark Products; _____: www.hubbell-killark.com
    d. Substitutions: See Section 016000 - Product Requirements.

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F. Floor Boxes:
   1. Description: Floor boxes compatible with floor box service fittings provided in accordance with Section 262725; with partitions to separate multiple services; furnished with all components, adapters, and trims required for complete installation.
   2. Metallic Floor Boxes: Fully adjustable (with integral means for leveling adjustment prior to and after concrete pour).
   3. Manufacturer: Same as manufacturer of floor box service fittings.

G. Underground Boxes/Enclosures:
   1. See Section 337119 for underground boxes and enclosures.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive boxes.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install boxes in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide separate boxes for emergency power and normal power systems.

E. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.

F. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.

G. Unless otherwise indicated, boxes may be surface-mounted where exposed conduits are indicated or permitted.

H. Box Locations:
   1. Locate boxes to be accessible. Provide access panels in accordance with Section 083100 as required where approved by the Architect.
   2. Unless dimensioned, box locations indicated are approximate.
   3. Locate boxes as required for devices installed under other sections or by others.
      a. Switches, Receptacles, and Other Wiring Devices: Comply with Section 262725.
      b. Communications Systems Outlets: Comply with Section 271005.
   4. Locate boxes so that wall plates do not span different building finishes.
   5. Locate boxes so that wall plates do not cross masonry joints.
   6. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
   7. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches horizontal separation unless otherwise indicated.
   8. Acoustic-Rated Walls: Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches horizontal separation.
   9. Fire Resistance Rated Walls: Install flush-mounted boxes such that the required fire resistance will not be reduced.
      a. Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches separation where wall is constructed with individual noncommunicating stud cavities or protect both boxes with listed putty pads.

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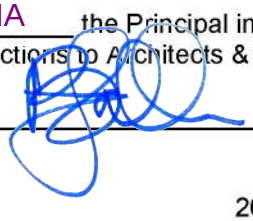
Signature & Date:  03.15.2024

b. Do not install flush-mounted boxes with area larger than 16 square inches or such that the total aggregate area of openings exceeds 100 square inches for any 100 square feet of wall area.

10. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 260533.13.
11. Locate junction and pull boxes in the following areas, unless otherwise indicated or approved by the Architect:
    a. Concealed above accessible suspended ceilings.
    b. Within joists in areas with no ceiling.
    c. Electrical rooms.
    d. Mechanical equipment rooms.

I. Box Supports:
1. Secure and support boxes in accordance with NFPA 70 and Section 260529 using suitable supports and methods approved by the authority having jurisdiction.
2. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.
3. Installation Above Suspended Ceilings: Do not provide support from ceiling grid or ceiling support system.
4. Use far-side support to secure flush-mounted boxes supported from single stud in hollow stud walls. Repair or replace supports for boxes that permit excessive movement.

J. Install boxes plumb and level.

K. Flush-Mounted Boxes:
1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch or does not project beyond finished surface.
2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.
3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch at the edge of the box.

L. Floor-Mounted Cabinets: Mount on properly sized 3 inch high concrete pad constructed in accordance with Section 033000.

M. Install boxes as required to preserve insulation integrity.

N. Metallic Floor Boxes: Install box level at the proper elevation to be flush with finished floor.

O. Nonmetallic Floor Boxes: Cut box flush with finished floor after concrete pour.

P. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

Q. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 078400.

R. Close unused box openings.

S. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.

T. Provide grounding and bonding in accordance with Section 260526.

U. Identify boxes in accordance with Section 260553.

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3.03 CLEANING

A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

3.04 PROTECTION

A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

END OF SECTION

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SECTION 260533.23
SURFACE RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface raceway systems.

B. Wireways.

1.02 RELATED REQUIREMENTS

A. Section 260526 - Grounding and Bonding for Electrical Systems.

B. Section 260529 - Hangers and Supports for Electrical Systems.
   1. Includes metal channel (strut) used as raceway for lighting systems.

C. Section 260533.13 - Conduit for Electrical Systems.

D. Section 260533.16 - Boxes for Electrical Systems.

E. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

F. Section 262723 - Indoor Service Poles.

G. Section 262725 - Wiring Devices: Receptacles.

H. Section 271005 - Structured Cabling for Voice and Data - Inside-Plant: Voice and data jacks.

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.

D. NEMA PRP 5 - Installation Guidelines for Surface Nonmetallic Raceway; 2015.

E. UL 5 - Surface Metal Raceways and Fittings; Current Edition, Including All Revisions.

F. UL 5A - Nonmetallic Surface Raceways and Fittings; Current Edition, Including All Revisions.

G. UL 111 - Outline of Investigation for Multioutlet Assemblies; Current Edition, Including All Revisions.

H. UL 870 - Wireways, Auxiliary Gutters, and Associated Fittings; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the placement of raceways with millwork, furniture, equipment, etc. installed under other sections or by others.
   2. Coordinate rough-in locations of outlet boxes provided under Section 260533.16 and conduit provided under Section 260533.13 as required for installation of raceways provided under this section.
   3. Verify minimum sizes of raceways with the actual conductors and components to be installed.
   4. Notify Architect and Owner's Construction Project Coordinator, of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not install raceways until final surface finishes and painting are complete.
   2. Do not begin installation of conductors and cables until installation of raceways is complete between outlet, junction and splicing points.

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1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets including dimensions, knockout sizes and locations, materials, fabrication details, finishes, service condition requirements, and accessories.
   1. Surface Raceway Systems: Include information on fill capacities for conductors and cables.

C. Shop Drawings:
   1. Pre-wired Surface Raceway Systems: Provide plan and elevation views including dimensioned locations of wiring devices and circuiting arrangements.
   2. Wireways: Provide dimensioned plan and elevation views including adjacent equipment with all required clearances indicated.

D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 RACEWAY REQUIREMENTS

A. Provide all components, fittings, supports, and accessories required for a complete raceway system.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Do not use raceways for applications other than as permitted by NFPA 70 and product listing.

2.02 SURFACE RACEWAY SYSTEMS

A. Manufacturers:
   1. Hubbell Incorporated; _____: www.hubbell.com
   2. Wiremold, a brand of Legrand North America, Inc; _____: www.legrand.us
   3. Panduit.

B. Surface Metal Raceways: Listed and labeled as complying with UL 5.
   1. Wiremold, #4000 or #4000DS series.
   2. Wiremold, #700 series.
   3. Panduit. Equivalent to Wiremold, as specified above.

C. Surface Nonmetallic Raceways: Listed and labeled as complying with UL 5A.
   1. Wiremold, #800 or #2300 series, data use only.
   2. Wiremold, #40N2 series.
   3. Panduit. Equivalent to Wiremold, as specified above.

D. Metal Channel (Strut) Used as Raceway: Comply with Section 260529.
   1. For use with lighting systems only.

E. Type _____ - Surface Raceway System:

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1. Raceway Type: single or two channel, metal or non-metal.
   a. For areas with power and data, provide two channel raceway systems.
   b. For areas with either power or data, provide single channel systems.
2. Size: As indicated on the drawings.
3. Length: As indicated on the drawings.
4. Color: Gray, white or Ivory. Final color to be selected by architect.
5. Accessory Device Boxes: Suitable for the devices to be installed; color to match raceway.
6. Integrated Device Provisions:
   a. Receptacles:
      1) Comply with Section 262725.
      2) Configuration: As indicated on the drawings.
      3) Color: As specified in Section 262725.
      4) Spacing: As indicated on the drawings.
   b. Communications Outlets:
      1) Voice and Data Jacks: As specified in Section 271005.
      2) Spacing: As indicated on the drawings.

2.03 WIREWAYS

A. Manufacturers:
   1. Cooper B-Line, a division of Cooper Industries: www.cooperindustries.com.
   2. Hoffman, a brand of Pentair Technical Products; _____: www.hoffmanonline.com
   3. Schneider Electric; Square D Products: www.schneider-electric.us.
   4. Circle AW.

B. Description: Lay-in wireways (gutter) and wiring troughs with removable covers; listed and labeled as complying with UL 870. Surface mounted only.

C. Wireway Type, Unless Otherwise Indicated:
   1. Indoor Clean, Dry Locations: NEMA 250, Type 1, painted steel with screw-cover.
   2. Outdoor Locations: NEMA 250, Type 3R, painted steel with screw-cover; include provision for padlocking. All fasteners shall be stainless steel.

D. Finish for Painted Steel Wireways: Manufacturer's standard grey unless otherwise indicated.

E. Minimum Wireway Size: 4 by 4 inches unless otherwise indicated.

F. Where wireway size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

G. Include offsets, elbows, couplings, expansion joints, adapters, hold-down straps, end caps, and other fittings; to match and mate with wireways as required for complete system.

2.04 SOURCE QUALITY CONTROL

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

B. Factory test each production unit for pre-wired surface raceway systems to verify proper wiring.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes and conduit terminations are installed in proper locations and are properly sized in accordance with NFPA 70 to accommodate raceways.

C. Verify that mounting surfaces are ready to receive raceways and that final surface finishes are complete, including painting.

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D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install raceways complete, prior to installation of conductors and devices.

C. Perform work in accordance with NECA 1 (general workmanship).

D. Surface Nonmetallic Raceways: Install in accordance with NEMA PRP 5.

E. Install raceways plumb and level.

F. 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.

G. Arrange wireways and associated raceway connections to comply with NFPA 70, including but not limited to requirements for deflected conductors and wireways used as pull boxes. Increase size of wireway where necessary.

H. Secure and support raceways in accordance with Section 260529 at intervals complying with NFPA 70 and manufacturer's requirements.

I. Close unused raceway openings, unless identified for an owner installed device.

J. Install temporary seals to prevent foreign materials from entering raceways.

K. Provide grounding and bonding in accordance with Section 260526.

L. Identify raceways in accordance with Section 260553.

M. Provide all accessories required for a complete surface raceway system.

N. Where data devices are identified on the contract drawings, and where applicable, provide a Decora cover plate.

3.03 FIELD QUALITY CONTROL

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

B. Inspect raceways for damage and defects.

C. Surface Raceway Systems with Integrated Devices: Test each wiring device to verify operation and proper polarity.

D. Correct wiring deficiencies and replace damaged or defective raceways.

3.04 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.05 PROTECTION

A. Protect installed raceways from subsequent construction operations.

END OF SECTION

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SECTION 260536
CABLE TRAYS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES UPDATED OCT 2022

A. Metal cable tray systems:
   1. Metal ladder cable tray.
   2. Metal solid-bottom cable tray.
   3. Metal wire mesh/basket cable tray.
   4. J-hook cable management system.

1.02 RELATED REQUIREMENTS

A. Section 078400 - Firestopping.
B. Section 260519 - Low-Voltage Electrical Power Conductors and Cables.
C. Section 260526 - Grounding and Bonding for Electrical Systems.
D. Section 260529 - Hangers and Supports for Electrical Systems.
E. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
F. Section 271005 - Structured Cabling for Voice and Data - Inside-Plant.

1.03 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
C. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2009 (Reapproved 2015).
D. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2015.
E. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2014.
F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.
G. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
H. NECA/BICSI 568 - Standard for Installing Commercial Building Telecommunications Cabling; 2006.
I. NEMA VE 1 - Metal Cable Tray Systems; 2017.
J. NEMA VE 2 - Cable Tray Installation Guidelines; 2013, with Errata (2016).
K. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
L. NFPA 101 - Life Safety Code; 2015.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the arrangement of cable tray with structural members, ductwork, piping, equipment and other potential conflicts installed under other sections or by others. Coordinate the work with other trades to avoid installation of obstructions within cable tray required clearances.
   2. Coordinate arrangement of cable tray with the dimensions and clearance requirements of the actual products to be installed.

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3. Coordinate the work with placement of supports, anchors, etc. required for mounting.
4. Notify Architect, and the Owner's Construction Project Coordinator, of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

B. Preinstallation Meeting: Convene one week prior to commencing work of this section; require attendance of all affected installers. Review proposed routing, sequence of installation, and protection requirements for installed cable tray.

C. Sequencing:
1. Do not begin installation of cables until installation of associated cable tray run is complete.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for cable tray system components and accessories. Include dimensions, materials, fabrication details, finishes, and span/load ratings.

C. Shop Drawings: Include dimensioned plan views and sections indicating proposed cable tray routing, required clearances, and locations and details of supports, fittings, building element penetrations, and equipment connections.

D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

E. Project Record Documents: Record actual routing of cable tray and locations of supports.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions and NEMA VE 2, except do not store cable tray outdoors without cover as permitted in NEMA VE 2.

B. Handle products carefully to avoid damage to finish.

PART 2 PRODUCTS

2.01 CABLE TRAY SYSTEM - GENERAL REQUIREMENTS

A. Provide new cable tray system consisting of all required components, fittings, supports, accessories, etc. as necessary for a complete system.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Do not use cable tray for applications other than as permitted by NFPA 70 and product listing/classification.

D. Provide cable tray system and associated components suitable for use at indicated span/load ratings under the service conditions at the installed location.

E. Unless otherwise indicated, specified span/load ratings are according to NEMA VE 1 (metal cable tray systems) or NEMA FG 1 (fiberglass cable tray systems) with safety factor of 1.5 and working load only (no additional concentrated static load).

F. Unless otherwise indicated, specified load/fill depths and inside widths are nominal values according to NEMA VE 1 (metal cable tray systems) or NEMA FG 1 (fiberglass cable tray systems) with applicable allowable tolerances.

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2.02 METAL CABLE TRAY SYSTEMS

A. Manufacturers:
   1. Metal Cable Tray System:
      a. Cablofil, a brand of Legrand North America, Inc; _____: www.legrand.us
      b. Chalfant Manufacturing Company; _____: www.chalfant-obo.com
      c. Cooper B-Line, Inc.
      d. Cope, a brand of Atkore International Inc; _____: www.copecabletray.com
      e. Mono-Systems, Inc.
      f. MP Husky
      g. Thomas & Betts Corporation; _____: www.tnb.com
      h. PW Industries.
   2. Source Limitations: Furnish cable tray system and associated components and accessories produced by a single manufacturer and obtained from a single supplier.

B. Comply with NEMA VE 1.

C. Finishes:
   1. Zinc Electroplated Steel: Comply with ASTM B633.
   2. Mill-Galvanized Before Fabrication (Pre-Galvanized) Steel: Comply with ASTM A653/A653M, G90 coating.
   3. Hot-Dip Galvanized After Fabrication (H.D.G.A.F.) Steel: Comply with ASTM A123/A123M.
   4. Aluminum Cable Trays, Fittings, and Accessories: Aluminum, complying with NEMA VE 1, Aluminum Association's Alloy 6063-T6 for rails, rungs, and cable trays, and Alloy 5052-H32 or Alloy 6061-T6 for fabricated parts; with chromium-zinc, ASTM F 1136, splice-plate fasteners, bolts, and screws.

D. Metal Ladder Cable Tray:
   1. Material: Mill-galvanized before fabrication (pre-galvanized) steel.
   2. Load/Fill Depth: As indicated on drawings.
   3. Span/Load Rating: As indicated on drawings.
   4. Rung Spacing: 9 inches on center for straight lengths.
   5. Inside Width: As indicated on drawings.
   6. Inside Radius of Fittings: 12 inches.
   7. Covers: Solid flat flanged. Use where indicated on drawings.

E. Metal Solid-Bottom Cable Tray:
   1. Material: Mill-galvanized before fabrication (pre-galvanized) steel.
   2. Bottom Type: Solid corrugated or flat.
   3. Load/Fill Depth: As indicated on drawings.
   4. Span/Load Rating: As indicated on drawings.
   5. Inside Width: As indicated on drawings.
   6. Inside Radius of Fittings: 12 inches.
   7. Covers: Solid flat flanged. As indicated on drawings.
   8. Applications:
      a. _____.

F. Metal Wire Mesh/Basket Cable Tray:
   1. Material: Zinc electroplated steel.
   2. Tray Depth: As indicated on drawings.
   3. Span/Load Rating: As indicated on drawings.
   4. Mesh Spacing: 2 by 4 inches.
   5. Tray Width: As indicated on drawings.

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2.03 SOURCE QUALITY CONTROL

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

B. Metal (Steel and Aluminum) Cable Tray: Perform factory design tests in accordance with NEMA VE 1, including electrical continuity and load testing.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that work likely to damage cable tray system has been completed.

B. Verify that field measurements are as indicated.

C. Verify that the dimensions and span/load ratings of cable tray system components are consistent with the indicated requirements.

D. Verify that mounting surfaces are ready to receive cable tray and associated supports.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Modifications to Existing Cable Tray Systems: Remove inactive or abandoned cables from existing cable tray system.

3.03 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install cable tray in accordance with NECA 1 (general workmanship), and NEMA VE 2.

C. Unless otherwise indicated, arrange cable tray to be parallel or perpendicular to building lines.

D. Arrange cable tray to provide required clearances and maintain cable access.
   1. Minimum Clearance Above and Adjacent to Cable Tray: 12 inches **above cable tray siderail and 12 inches from one side of cable tray. Updated Oct 2022.**
   2. Cable Tray for Telecommunications Cables: Maintain recommended separation from sources of EMI greater than 5 kVA in accordance with NECA/BICSI 568.

E. Install cable tray plumb and level, with sections aligned and with horizontal runs at the proper elevation.

F. In ceiling grid and hard ceiling areas, locate bottom of cable tray within 24" of the bottom of the ceiling.

G. Metal Wire Mesh/Basket Cable Tray: Field fabricate fittings in accordance with manufacturer's instructions, using only manufacturer-approved connectors classified for bonding.
   1. Inside Radius of Fittings: 12 inches.

H. Hot-Dip Galvanized After Fabrication (H.D.G.A.F.) Steel Cable Tray: After cutting, drilling, or deburring, use approved zinc-rich paint to repair finish in accordance with ASTM A780/A780M.

I. Cable Tray Movement Provisions:
   1. Provide suitable expansion fittings where cable tray is subject to movement, including but not limited to:
      a. Where cable tray crosses structural joints intended for expansion.
      b. Long straight cable tray runs in accordance with NEMA VE 2.
   2. Use expansion guides in lieu of hold-down clamps where prescribed in NEMA VE 2.
   3. Set gaps for expansion fittings in accordance with NEMA VE 2.

J. Cable Provisions:
   1. Use suitable fixed barrier strips to maintain separation of cables as indicated and as required by NFPA 70.

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2. Use suitable drop-out fittings or bushings where cables exit cable tray as required to maintain minimum cable bending radius.
3. Use suitable cable support fittings for long vertical cable tray runs with heavy cables.

K. Provide end closures at unconnected ends of cable tray runs.

L. Cable Tray Support:
1. Use manufacturer's recommended hangers and supports, located in accordance with NEMA VE 2 and manufacturer's requirements, but not exceeding specified span unless otherwise approved by Engineer. Provide required support and attachment components in accordance with Section 260529, where not furnished by cable tray manufacturer.
2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

M. Grounding and Bonding Requirements, in Addition to Requirements of Section 260526:
1. Comply with grounding and bonding requirements of NEMA VE 2.
2. Metal Cable Tray Systems: Use suitable bonding jumpers or classified connectors to provide electrical continuity.
3. Metal cable tray system may be used as sole equipment grounding conductor only where all conditional requirements of NFPA 70 are met, including but not limited to:
   a. Installation must be in a qualifying facility with suitable maintenance and supervision.
   b. Cable tray system must be steel or aluminum (as specified) and classified as an equipment grounding conductor (note that stainless steel cable tray is not permitted for use as an equipment grounding conductor).
   c. Cable tray must meet minimum cross-sectional area requirements.

N. Conduit Termination:
1. Use listed cable tray conduit clamps (evaluated for bonding connection) to terminate conduits at cable tray.
2. Provide insulating bushing at conduit termination to protect cables.
3. Provide independent support for conduit.

O. Cable Installation:
1. Comply with cable installation requirements of NEMA VE 2.
2. Use appropriate cable pulling tools, applied to prevent excessive force on cable tray system and maintain minimum cable bending radius.
3. Communication systems. Use Velcro ties to fasten communication conductors/cables to vertical runs of cable tray.
4. Power systems. Use cable clamps or cable ties to fasten conductors/cables to vertical and horizontal runs of cable trays.
   a. Distance Between Fastening Points for Vertical Runs: 18 inches.
   b. Distance Between Fastening Points for Horizontal Runs: As required to maintain spacing and confine conductor/cable within the cable fill area.

P. Penetrations: Install firestopping to preserve fire resistance rating of building elements, using materials and methods specified in Section 078400.

Q. Identification Requirements, in Addition to Those Specified in Section 260553.
1. Use warning labels to identify electrical hazards for cable tray containing conductors operating at over 600 V nominal with the word message "DANGER; HIGH VOLTAGE; KEEP AWAY" at maximum intervals of 10 feet.
2. Use warning labels to identify cable tray with the word message "WARNING! Do Not Use As A Walkway, Ladder, Or Support For Personnel. Use Only As A Mechanical Support For Cables, Tubing and Raceways." at maximum intervals of 20 feet.

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3.04 FIELD QUALITY CONTROL

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

B. Inspect cable tray system for damage and defects.

C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

D. Correct deficiencies and replace damaged or defective cable tray system components.

3.05 ADJUSTING

A. Adjust tightness of mechanical connections to manufacturer's recommended torque settings.

3.06 CLEANING

A. Remove dirt and debris from cable tray.

B. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.07 PROTECTION

A. Protect cable tray system from subsequent construction operations.

END OF SECTION

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SECTION 260548

VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Vibration isolation requirements.

B. Seismic control requirements.
   1. Includes requirements for seismic qualification of equipment not specified in this section.

C. Vibration-isolated equipment support bases.

D. Vibration isolators.

E. External seismic snubber assemblies.

F. Seismic restraint systems.

1.02 RELATED REQUIREMENTS

A. Section 014533 - Code-Required Special Inspections.

B. Section 033000 - Cast-in-Place Concrete.

C. Section 055000 - Metal Fabrications: Materials and requirements for fabricated metal supports.

D. Section 260529 - Hangers and Supports for Electrical Systems.

1.03 DEFINITIONS

A. Electrical Component: Where referenced in this section in regards to seismic controls, applies to any portion of the electrical system subject to seismic evaluation in accordance with applicable codes, including distributed systems (e.g. conduit, cable tray).

B. Seismic Restraint: Structural members or assemblies of members or manufactured elements specifically designed and applied for transmitting seismic forces between components and the seismic force-resisting system of the structure.

1.04 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; 2010, with 2013 Supplements and Errata.

B. ASCE 19 - Structural Applications of Steel Cables for Buildings; 2016.

C. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications; 2015.

D. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2016.

E. FEMA 413 - Installing Seismic Restraints for Electrical Equipment; 2004.

F. FEMA E-74 - Reducing the Risks of Nonstructural Earthquake Damage; 2011.

G. ICC (IBC) - International Building Code; 2015.

H. ICC-ES AC156 - Acceptance Criteria for Seismic Certification by Shake-Table Testing of Nonstructural Components; 2010, with Editorial Revision (2015).

I. MFMA-4 - Metal Framing Standards Publication; 2004.

J. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

K. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

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L. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems; Sheet Metal and Air Conditioning Contractors' National Association; 2008.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate selection and arrangement of vibration isolation and/or seismic control components with the actual equipment to be installed.
   2. Coordinate the work with other trades to provide additional framing and materials required for installation.
   3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
   4. Seismic Controls:
      a. Coordinate the arrangement of seismic restraints with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
      b. Coordinate the work with other trades to accommodate relative positioning of essential and non-essential components in consideration of seismic interaction.
   5. Notify Architect and Owners' Construction Coordinator, of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 033000.

1.06 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Design Documents: Prepare and submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, details, and calculations.

C. Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.

D. Shop Drawings - Vibration Isolation Systems:
   1. Include dimensioned plan views and sections indicating proposed arrangement of vibration isolators; indicate equipment weights and static deflections.
   2. Vibration-Isolated Equipment Support Bases: Include base weights, including concrete fill where applicable; indicate equipment mounting provisions.

E. Shop Drawings - Seismic Controls:
   1. Include dimensioned plan views and sections indicating proposed electrical component locations and distributed system routing, with locations and details of gravity supports and seismic restraints and associated attachments.
   2. Identify anchor manufacturer, type, minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
   3. Indicate proposed arrangement of distributed system trapeze support groupings.
   4. Indicate proposed locations for distributed system flexible fittings and/or connections.
   5. Indicate locations of seismic separations where applicable.

F. Certification for seismically qualified equipment; identify basis for certification.

G. Evaluation Reports: For products specified as requiring evaluation and recognition by a qualified evaluation service, provide current evaluation reports.

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H. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

I. Manufacturer92s detailed field testing and inspection procedures.

1.07 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Comply with applicable building code.

C. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 VIBRATION ISOLATION REQUIREMENTS

A. Design and provide vibration isolation systems to reduce vibration transmission to supporting structure from vibration-producing electrical equipment and/or electrical connections to vibration-isolated equipment.

B. Comply with applicable general recommendations of ASHRAE (HVACA), where not in conflict with other specified requirements:

C. General Requirements:
1. Select vibration isolators to provide required static deflection.
2. Select vibration isolators for uniform deflection based on distributed operating weight of actual installed equipment.
3. Select vibration isolators for outdoor equipment to comply with wind design requirements.

D. Equipment Isolation:
1. Transformers:
   a. Specified vibration isolators are in addition to any factory-installed internal core and coil assembly vibration isolators unless otherwise indicated.
   b. Floor-Mounted Transformers, Non-Seismic Applications: Use resilient material isolator pads, resilient material isolator mounts, or open (unhoused) spring isolators.
   c. Floor-Mounted Transformers, Seismic Applications: Use seismic type resilient material isolator mounts or seismic type restrained spring isolators.
   d. Suspended Transformers, Non-Seismic Applications: Use resilient material isolator hangers, spring isolator hangers, or combination resilient material/spring isolator hangers.
   e. Suspended Transformers, Seismic Applications: Use seismic type resilient material isolator hangers, seismic type spring isolator hangers, or seismic type combination resilient material/spring isolator hangers.
   f. Wall-Mounted Transformers, Non-Seismic Applications: Use resilient material isolator mounts.
   g. Wall-Mounted Transformers, Seismic Applications: Use seismic type resilient material isolator mounts.
2. Engine Generators:
   a. Specified vibration isolators are in addition to any factory-installed internal vibration isolators between generator set and integral base unless otherwise indicated; obtain generator set manufacturer approval of applied vibration isolation.

E. Conduit Isolation:

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1. Use flexible conduit or cable for electrical connections to vibration-isolated equipment, including equipment installed under other sections or by others.

2.02 SEISMIC CONTROL REQUIREMENTS

A. Design and provide electrical component restraints, supports, and attachments suitable for seismic loads determined in accordance with applicable codes, as well as gravity and operating loads and other structural design considerations of the installed location. Consider wind loads for outdoor electrical components.

B. Seismic Design Criteria: ICC (IBC)/ASCE 7.
   1. Five Percent Damped Design Spectral Response Acceleration at Short Periods (SDS): _____.

C. Component Importance Factor (Ip): Electrical components essential to life safety to be assigned a component importance factor (Ip) of 1.5 as indicated or as required. This includes but is not limited to:
   1. Electrical components required to function for life safety purposes after an earthquake.
   2. Electrical components that support or otherwise contain hazardous substances.

D. Seismic Attachments:
   1. Attachments to be bolted, welded, or otherwise positively fastened without consideration of frictional resistance produced by the effects of gravity.
   2. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) or qualified evaluation service acceptable to authorities having jurisdiction for compliance with applicable building code, and qualified for seismic applications; concrete anchors to be qualified for installation in both cracked and uncracked concrete.
   3. Do not use power-actuated fasteners.
   4. Comply with anchor minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
   5. Concrete Housekeeping Pads:
      a. Increase size of pad as required to comply with anchor requirements.
      b. Provide pad reinforcement and doweling to ensure integrity of pad and connection and to provide adequate load path from pad to supporting structure.

E. Seismic Interactions:
   1. Include provisions to prevent seismic impact between electrical components and other structural or nonstructural components.
   2. Include provisions such that failure of a component, either essential or nonessential, does not cause the failure of an essential component.

2.03 VIBRATION-ISOLATED EQUIPMENT SUPPORT BASES

A. Manufacturers:
   1. Vibration-Isolated Equipment Support Bases:
      a. Kinetics Noise Control, Inc; _____: www.kineticsnoise.com
      b. Mason Industries; _____: www.mason-ind.com
      c. Vibration Eliminator Company, Inc; _____: www.veco-nyc.com
   2. Substitutions: See Section 016000 - Product Requirements.

2.04 VIBRATION ISOLATORS

A. Manufacturers:
   1. Vibration Isolators:
      a. Kinetics Noise Control, Inc; _____: www.kineticsnoise.com
      b. Mason Industries; _____: www.mason-ind.com
      c. Vibration Eliminator Company, Inc; _____: www.veco-nyc.com

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d. _____.

2. Substitutions: See Section 016000 - Product Requirements.

B. General Requirements:

1. Resilient Materials for Vibration Isolators: Oil, ozone, and oxidant resistant.

2.05 SEISMIC RESTRAINT SYSTEMS

A. Manufacturers:

1. Seismic Restraint Systems:
   a. Eaton Corporation; _____: www.eaton.com
   b. Kinetics Noise Control, Inc; _____: www.kineticsnoise.com
   c. Mason Industries; _____: www.mason-ind.com
2. Substitutions: See Section 016000 - Product Requirements.
3. Source Limitations: Furnish seismic restraint system components and accessories produced by a single manufacturer and obtained from a single supplier.

B. Description: System components and accessories specifically designed for field assembly and attachment of seismic restraints.

C. Cable Restraints:

1. Comply with ASCE 19.
2. Cables: Pre-stretched, galvanized steel wire rope with certified break strength.
3. Cable Connections: Use only swaged end fittings. Cable clips and wedge type end fittings are not permitted in accordance with ASCE 19.
4. Use protective thimbles for cable loops where potential for cable damage exists.

D. Rigid Restraints: Use MFMA-4 steel channel (strut), steel angle, or steel pipe for structural element; suitable for both compressive and tensile design loads.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that mounting surfaces are ready to receive vibration isolation and/or seismic control components and associated attachments.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install products in accordance with applicable requirements of NECA 1 (general workmanship).

C. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.

D. Secure fasteners according to manufacturer's recommended torque settings.

E. Field-Welding (where approved by Architect): Comply with Section 055000.

F. Install flexible conduit and cable connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.

G. Vibration Isolation Systems:

1. Vibration-Isolated Equipment Support Bases:
   a. Provide specified minimum clearance beneath base.
2. Spring Isolators:
   a. Position equipment at operating height; provide temporary blocking as required.

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b. Lift equipment free of isolators prior to lateral repositioning to avoid damage to isolators.
c. Level equipment by adjusting isolators gradually in sequence to raise equipment uniformly such that excessive weight or stress is not placed on any single isolator.

3. Isolator Hangers:
   a. Use precompressed isolator hangers where required to facilitate installation and prevent damage to equipment utility connection provisions.
   b. Locate isolator hangers at top of hanger rods in accordance with manufacturer's instructions.
4. Clean debris from beneath vibration-isolated equipment that could cause short circuiting of isolation.
5. Use elastomeric grommets for attachments where required to prevent short circuiting of isolation.
6. Adjust isolators to be free of isolation short circuits during normal operation.
7. Do not overtighten fasteners such that resilient material isolator pads are compressed beyond manufacturer's maximum recommended deflection.

H. Seismic Controls:
1. Provide specified snubbing element air gap; remove any factory-installed spacers, debris or other obstructions.
2. Use only specified components, anchorage, and hardware evaluated by seismic design. Comply with conditions of seismic certification where applicable.
3. Where mounting hole diameter exceeds bolt diameter by more than 0.125 inch, use epoxy grout, elastomeric grommet, or welded washer to reduce clearance to 0.125 inch or less.
4. Equipment with Sheet Metal Housings:
   a. Use Belleville washers to distribute stress over a larger surface area of the sheet metal connection interface as approved by manufacturer.
   b. Attach additional steel as approved by manufacturer where required to transfer loads to structure.
   c. Where mounting surface is irregular, do not shim housing; reinforce housing with additional steel as approved by manufacturer.
5. Concrete Housekeeping Pads:
   a. Size in accordance with seismic design to meet anchor requirements.
   b. Install pad reinforcement and doweling in accordance with seismic design to ensure integrity of pad and associated connection to slab.
6. Seismic Restraint Systems:
   a. Do not attach seismic restraints and gravity supports to dissimilar parts of structure that may move differently during an earthquake.
   b. Install restraints within permissible angles in accordance with seismic design.
   c. Install cable restraints straight between component/run and structural attachment; do not bend around other nonstructural components or structural elements.
   d. Install cable restraints for vibration-isolated components slightly slack to prevent short circuiting of isolation.
   e. Install hanger rod stiffeners where indicated using only specified clamps; do not weld stiffeners to hanger rod.

3.03 FIELD QUALITY CONTROL

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

B. Inspect vibration isolation and/or seismic control components for damage and defects.

C. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.

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D. Submit detailed reports indicating inspection and testing results and corrective actions taken.

END OF SECTION

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SECTION 260553
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical identification requirements.
B. Identification nameplates and labels.
C. Wire and cable markers.
D. Voltage markers.
E. Underground warning tape.
F. Floor marking tape.
G. Warning signs and labels.
H. Identification for conductors.
I. Identification for raceways.
J. Circuit identification of wiring devices.
K. Handicapped door operators.
L. Instruction signs.

1.02 RELATED REQUIREMENTS

A. Section 099113 - Exterior Painting.
B. Section 099123 - Interior Painting.
C. Section 260513 - Medium-Voltage Cables.
D. Section 260519 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.
E. Section 260519.13 - Undercarpet Electrical Power Cables.
F. Section 260526 - Grounding and Bonding for Electrical Systems.
G. Section 260533.13 - Conduit for Electrical Systems.
H. Section 260536 - Cable Trays for Electrical Systems: Additional identification requirements for cable tray systems.
I. Section 260573 - Power System Studies: Arc flash hazard warning labels.
J. Section 262300 - Low-Voltage Switchgear: Factory-installed mimic bus.
K. Section 262725 - Wiring Devices: Electrical power devices.
L. Section 262713 - Electricity Metering: Metering for main service entrance gear.
M. Section 271005 - Structured Cabling for Voice and Data - Inside-Plant: Identification for communications cabling and devices.
N. Section 284050 - Conductors and Cables for Fire Detection and Alarm.
O. Section 285600 - Fire Detection and Alarm.
P. Section 337900 - Site Grounding.

1.03 REFERENCE STANDARDS

A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs; 2011.
B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels; 2011.

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C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. NFPA 70E - Standard for Electrical Safety in the Workplace; 2017.

E. UL 969 - Marking and Labeling Systems; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.

B. Sequencing:
   1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.
   2. Do not install identification products until final surface finishes and painting are complete.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittals procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.

C. Shop Drawings: Provide schedule of items to be identified indicating proposed designations, materials, legends, and formats.

D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation and installation of product.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

1.07 FIELD CONDITIONS

A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

B. Coordinate installation of labels, marking, stickers, etc., on devices, conduit, equipment, conductors, etc., after installation and painting phases are complete.

PART 2 PRODUCTS

2.01 IDENTIFICATION REQUIREMENTS

A. Existing Work: Unless specifically excluded, identify existing elements to remain that are not already identified in accordance with specified requirements.

B. Identification for Equipment:
   1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
      a. Switchgear, 600V or less.
         1) Identify ampere rating.
         2) Identify voltage and phase.
         3) Use identification nameplate to identify main and tie devices.
         4) Use identification nameplate to identify load(s) served for each branch device. Identify spares and spaces. Provide engraved micarta nameplates for all circuit breakers. Black face with white engraved letters.
         5) See Section 262300 for factory-installed mimic bus.
      b. MV Switchgear, Isolation Switches and Dead Break Junctions (DBJ), over 600V.

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1) Use identification nameplate to identify switchgear, isolation switches and dead break junction name.
2) Use identification nameplate to identify name for each switchgear, isolation switches and dead break junction, switched or non-switched way.
3) Provide self-adhesive vinyl labels.
4) Labels shall be black text on a yellow background.
5) Text for switch name shall be 1" high.
6) Text for each switched/non-switched way shall be 3/8" high.

c. Switchboards:
1) Identify ampere rating.
2) Identify voltage and phase.
3) Identify power source and circuit number. Include location when not within sight of equipment.
4) Use identification nameplate to identify main overcurrent protective device.
5) Use identification nameplate to identify load(s) served for each branch device. Identify spares and spaces. Provide engraved micarta nameplates for all circuit breakers. Black face with white engraved letters.

d. Motor Control Centers:
1) Identify ampere rating.
2) Identify voltage and phase.
3) Identify power source and circuit number. Include location when not within sight of equipment.
4) Use identification nameplate to identify main overcurrent protective device or incoming section.
5) Use identification nameplate to identify load(s) served for each branch device. Identify spares and spaces. Provide engraved micarta nameplates for all circuit breakers. Black face with white engraved letters.

e. Panelboards:
1) Identify ampere rating.
2) Identify voltage and phase.
3) Identify power source and circuit number. Include location when not within sight of equipment.
4) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces using pencil.
5) Provide engraved micarta nameplate to identify panel. Black face with white engraved letters.

f. Transformers, 600 V and less:
1) Identify power source and circuit number. Include location when not within sight of equipment.
2) Identify load(s) served. Include location when not within sight of equipment.

g. Transformers, over 600V.
1) Use identification nameplate to identify transformer name.
2) Provide self-adhesive viny labels.
3) Labels shall be black text on a yellow background.
4) Text shall be 1.5" high.

h. Enclosed switches, circuit breakers, motor controllers, and variable frequency drives (VFDs):
1) Identify voltage and phase.
2) Identify power source and circuit number. Include location when not within sight of equipment.

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3) Identify load(s) served. Include location when not within sight of equipment.

i. Enclosed Enclosures and Electrical Cabinets:
   1) Identify voltage and phase.
   2) Identify power source and circuit number. Include location when not within sight of equipment.
   3) Where enclosure serves electrical equipment, identify load(s) served. Include location when not within sight of equipment.

j. Enclosed Push Button Stations:
   1) Identify voltage and phase.
   2) Identify power source and circuit number. Include location when not within sight of equipment.
   3) Where enclosure serves electrical equipment, identify load(s) served. Include location when not within sight of equipment.

k. Busway:
   1) Identify ampere rating.
   2) Identify voltage and phase.
   3) Identify power source and circuit number. Include location when not within sight of equipment.
   4) Provide identification at maximum intervals of 12 feet for horizontal busway. For vertical busway, identify on each floor.
   5) Use identification nameplate to identify load(s) served for each plug-in unit. Include location when not within sight of equipment.

l. Access Doors and panels that conceal electrical items:
   1) Identify equipment behind access door or panel.
   2) Identify power source and circuit number.

m. Time Switches:
   1) Identify load(s) served and associated circuits controlled. Include location.
   2) Identify power source and circuit number.

n. Enclosed Contactors:
   1) Identify ampere rating.
   2) Identify voltage and phase.
   3) Identify configuration, electrically or mechanically held.
   4) Identify coil voltage.
   5) Identify load(s) and associated circuits controlled. Include location.
   6) Identify power source and circuit number.

o. Emergency system boxes and enclosures:
   1) Identify input and output voltage and phase.
   2) Identify power source and circuit number for normal power source. Include location when not within sight of equipment.
   3) Identify load(s) served. Include location.

p. Centralized Emergency Lighting Inverters, and Battery Racks:
   1) Identify input and output voltage and phase.
   2) Identify power source and circuit number for normal power source. Include location when not within sight of equipment.
   3) Identify load(s) served. Include location.

q. Emergency Generators and Transfer Switches:
   1) Identify voltage, amperage and phase for transfer switches.
   2) Identify voltage, amperage, kilo-watt (KW), kilo-volt-amp (KVA) and phase for emergency generators.

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3) Identify power source and circuit number for both normal power source and standby power source. Include location when not within sight of equipment.
4) Identify load(s) served. Include location when not within sight of equipment.
5) Identify short circuit current rating based on the specific overcurrent protective device type and settings protecting the generator and transfer switch.

r. Uninterruptible Power Supply (UPS):
1) Identify voltage, amperage, kilo-watt (KW), kilo-volt-amp (KVA) and phase.
2) Identify power source and circuit number for both normal power source and UPS power source. Include location when not within sight of equipment.
3) Identify load(s) served. Include location when not within sight of equipment.
4) Identify short circuit current rating based on the specific overcurrent protective device type and settings protecting the UPS.

s. Electricity Meters:
1) Identify load(s) metered.

2. Service Equipment:
a. Use identification nameplate to identify each service disconnecting means.
b. For buildings or structures supplied by more than one service, or any combination of branch circuits, feeders, and services, use identification nameplate or means of identification acceptable to Owner's Construction Coordinator, at each service disconnecting means to identify all other services, feeders, and branch circuits supplying that building or structure. Verify format and descriptions with Owner Construction Coordinator. Provide engraved micarta nameplates for all circuit breakers. Black face with white engraved letters.

3. Emergency System Equipment:
a. Use identification nameplate or voltage marker to identify emergency system equipment in accordance with NFPA 70.
b. Use identification nameplate at each piece of service equipment to identify type and location of on-site emergency power sources. Provide engraved micarta nameplates for all circuit breakers. Red face with white engraved letters.
c. Use identification label to identify emergency operating instructions for emergency system equipment.

4. Use voltage marker to identify highest voltage present for each piece of electrical equipment.
5. Use identification nameplate to identify switchboards and panelboards utilizing a high leg delta system in accordance with NFPA 70.
6. Use identification nameplate to identify disconnect location for equipment with remote disconnecting means.
7. Use identification label or handwritten text using indelible marker on inside of door at each fused switch to identify required NEMA fuse class and size.
8. Use identification label or handwritten text using indelible marker on inside of door at each motor controller to identify nameplate horsepower, full load amperes, code letter, service factor, voltage, and phase of motor(s) controlled.
9. Use identification label to identify overcurrent protective devices for branch circuits serving fire alarm circuits. Identify with text "FIRE ALARM CIRCUIT".
10. Use field-painted floor markings, floor marking tape, or warning labels to identify required equipment working clearances where indicated or where required by the authority having jurisdiction.
a. Field-Painted Floor Markings: Alternating black and white stripes, 3 inches wide, painted in accordance with Section 099123 and 099113.
11. Available Fault Current Documentation: Use identification label to identify the available fault current and date calculations were performed at locations requiring documentation by NFPA 70, including but not limited to the following.

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a. Service equipment.
b. Industrial control panels.
c. Motor control centers.
d. Elevator control panels.
e. Industrial machinery.

12. Arc Flash Hazard Warning Labels: Comply with Section 260573.
13. Use warning signs to identify electrical hazards for entrances to all rooms and other guarded locations that contain exposed live parts operating at 600 V nominal or less with the word message "DANGER; Electrical hazard; Authorized personnel only" or approved equivalent.
14. Use warning signs to identify electrical hazards for entrances to all buildings, vaults, rooms, or enclosures containing exposed live parts or exposed conductors operating at over 600 V nominal with the word message "DANGER; HIGH VOLTAGE; KEEP OUT".
15. Use warning labels to identify electrical hazards for equipment, compartments, and enclosures containing exposed live parts or exposed conductors operating at over 600 V nominal with the word message "DANGER; HIGH VOLTAGE; KEEP OUT".
16. Use warning labels, identification nameplates, or identification labels to identify electrical hazards for equipment where multiple power sources are present with the word message "DANGER; Hazardous voltage; Multiple power sources may be present; Disconnect all electric power including remote disconnects before servicing" or approved equivalent.

C. Identification for Conductors and Cables:
1. Identification for Communications Conductors and Cables: Comply with Section 271005.
2. Color Coding for Power Conductors and Cables, 600V or Less:
a. Color Code:
1) 480Y277 V, 3 Phase, 4 Wire System:
(a) Phase A: Brown.
(b) Phase B: Orange.
(c) Phase C: Yellow.
(d) Neutral/Grounded:
(1) Phase A: Gray with Brown stripe.
(2) Phase B: Gray with Orange stripe.
(3) Phase C: Gray with Yellow stripe.
2) 208Y120 V, 3 Phase, 4 Wire System:
(a) Phase A: Black.
(b) Phase B: Red.
(c) Phase C: Blue.
(d) Neutral/Grounded:
(1) Phase A: White with Black stripe.
(2) Phase B: White with Red stripe.
(3) Phase C: White with Blue stripe.
3) 240/120 V (High-Leg) Delta: 3 Phase, 4 Wire System:
(a) Phase A: Black.
(b) Phase B: (High Leg): Orange.
(c) Phase C: Blue.
(d) Neutral/Grounded:
(1) Phase A: White with Black stripe.
(2) Phase C: White with Blue stripe.
4) 240/120 V, 1 Phase, 3 Wire System:
(a) Phase A: Black.
(b) Phase B: Red.

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(c) Neutral/Grounded:
(1) Phase A: White with Black stripe.
(2) Phase B: White with Red stripe.
5) Equipment Ground, All Systems: Green.
6) Isolated Ground, All Systems: Green with yellow stripe.
7) Travelers for 3-Way and 4-Way Switching: Pink and Purple.

b. Color shall be factory applied or field applied for sizes larger than No. 8 AWG

3. Labeling and Color-Coding for Power Conductors/Cables over 600 V:
   a. Color Code:
      1) 12,4700Y/7200 V, 3 Phase, 3 and 4 Wire Systems:
         (a) Phase A: Orange.
         (b) Phase B: Red.
         (c) Phase C: Blue.
         (d) Neutral/Grounded: White.
      2) 4,160Y/2400 V, 3 Phase, 3 and 4 Wire Systems:
         (a) Phase A: Orange.
         (b) Phase B: Red.
         (c) Phase C: Blue.
         (d) Neutral/Grounded: White.
   b. Power Conductor Identification, More than 600 V: For conductors in vaults, pull and junction boxes, manholes, handholes, MV switches, transformers, and all other areas where conductors are exposed to view; use color-coded adhesive tape to identify all cables.
      1) Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns a minimum distance of 12 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.
   c. Power Feeders Identification, More than 600 V. Identify each set of MV feeders.
      1) Provide an engraved micarta label for each set of feeder. Provide labeling at all locates described below:
         (a) Provide label at all terminations to switches.
         (b) provide labeling where feeders enter/exit all man holes, hand holes and vaults.
         (c) Do not provide labeling where feeders terminate at a transformer.
         (d) Attach label to feeders with an UV-Stabilized Cable Ties. See Cable Ties section below for additional information.
      2) Labeling text shall include the following:
         (a) Labels shall be white text on a black background.
         (b) Text shall be 3/8" high.
         (c) Text shall include the termination point of each end of the feeder, the vault name, switch name; and on which switch, the feeders are terminated.
4. Use identification label to identify color code for ungrounded and grounded power conductors and cables, at each piece of feeder or branch-circuit distribution equipment.
5. For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
6. Use wire and cable markers to identify circuit number or other designation indicated for power, control, and instrumentation conductors and cables at the following locations:
   a. At each source and load connection.
   b. Within boxes when more than one circuit is present.
   c. Within equipment enclosures when conductors and cables enter or leave the enclosure.
   d. In cable tray, at maximum intervals of 20 feet.

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7. Use wire and cable markers to identify connected grounding electrode system components for grounding electrode conductors.
8. Use underground warning tape to identify direct buried cables.
9. Multiple Power or Lighting Circuits in the Same Enclosure: Identify each conductor with source, voltage, circuit number, and phase. Use color-coding to identify circuits' voltage and phase.
10. Multiple Control and Communication Circuits in the Same Enclosure: Identify each conductor by its system and circuit designation. Use a consistent system of tags, color-coding, or cable marking tape.

D. Identification for Raceways and Boxes. For all raceways, 600v and less:
1. Use paint identification to identify the system cables/conductors, inside the conduit.
2. Use color-coded paint to identify all, accessible and inaccessible, conduits as follows:
3. Paint all conduit fittings.
   a. Paint the exterior of pull and junction boxes. Paint the exterior of all box covers.
   b. Paint conduit as it enters/exits wall and floors.
   c. In congested areas, paint bands at 5 foot intervals.
   d. Only paint boxes dimensions that are 12" by 12" and smaller.
   e. Color Code:
      1) Fire-Alarm System: Red.
      2) Fire-Suppression Supervisory and Control System: Red and Yellow.
      3) Security System: Purple
      4) Mechanical and Electrical Supervisory System: Green and Blue.
      5) Telecommunications System: Blue
      6) Emergency/UPS power system: Yellow.
      7) 277/480 volts system: Brown.
      8) 120/208 volts system: Black.
      9) Clocks & Bells: Orange.
      10) Sound System: Green.
      11) Traveler (switch to light or switch to switch) 120 volts: Pink and Black.
      12) Traveler (switch to light or switch to switch) 277 volts: Pink and Brown.
      13) Lighting control and dimmers systems: White.
      14) Field-Painting: Comply with Section 099123 and 099113.
4. Use underground warning tape to identify underground raceways and duct banks.
5. For all pull and junction boxes, write the source panel and circuit number on the inside box cover, with a permanent, waterproof type marker.
6. Conductors to Be Extended in the Future: Attach write-on tags to raceways and list source.

E. Identification for Raceways. For all raceways, over 600v:
1. Install self-adhesive labels on 10-foot centers over the full length of the raceway or duct. The labels shall read "DANGER - HIGH VOLTAGE".
2. Apply to the following finished surfaces:
   a. 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.
   b. Wall surfaces directly external to raceways concealed within wall.
   c. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.

F. Identification for Cable Tray Conductors: Comply with Section 260536.
1. Use color-coded bands to identify conductors at maximum intervals of 10 feet.
   a. Color-Coded Bands: Use vinyl color coding electrical tape to mark bands 1/2 inch(es) wide.
      1) Color Code:
         (a) Fire-Alarm System: Red.

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(b) Fire-Suppression Supervisory and Control System: Red and Yellow.
(c) Security System: Purple
(d) Mechanical and Electrical Supervisory System: Green and Blue.
(e) Telecommunications System: Blue
(f) Emergency/UPS power system: Yellow.
(g) 277/480 volts system: Brown.
(h) 120/208 volts system: Black.
(i) Clocks & Bells: Orange.
(j) Sound System: Green.
(k) Traveler (switch to light or switch to switch) 120 volts: Pink and Black.
(l) Traveler (switch to light or switch to switch) 277 volts: Pink and Brown.
(m) Lighting control and dimmers systems: White.

2) Field-Painting: Comply with Section 099123 and 099113.
3) Vinyl Color Coding Electrical Tape: Comply with Section 260519.

2. Use identification labels, handwritten text using indelible marker, or plastic marker tags to identify circuits enclosed for accessible conduits at wall penetrations, at floor penetrations, at roof penetrations, and at equipment terminations when source is not within sight.
3. Use identification labels, handwritten text using indelible marker, or plastic marker tags to identify spare conduits at each end. Identify purpose and termination location.

G. Identification for Devices:
1. Identification for Communications Devices: Comply with Section 271005.
2. Identification for Fire Alarm Equipment and Devices: Comply with Section 284600.
3. Wiring Device and Wall plate Finishes: Comply with Section 262725.
4. Use identification label or engraved wall plate to identify serving branch circuit for all receptacles.
5. Use identification label or engraved wall plate to identify load controlled for wall-mounted control devices controlling loads that are not visible from the control location and for multiple wall-mounted control devices installed at one location.
6. Use identification label to identify receptacles protected by upstream GFI protection, where permitted.

H. Identification in Tunnels/Vaults:
1. Where ductbanks enter/exit vaults and tunnels, label the origination point of all conduits. i.e.., vaults, tunnels building, etc.

2.02 IDENTIFICATION NAMEPLATES AND LABELS

A. Identification Nameplates:
1. Manufacturers:
a. Brimar Industries, Inc: www.brimar.com
b. Kolbi Pipe Marker Co; _____: www.kolbipipemarkers.com
c. Seton Identification Products; _____: www.seton.com
d. Substitutions: See Section 016000 - Product Requirements.
2. Materials:
a. Indoor Clean, Dry Locations: Use plastic nameplates.
b. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.
3. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch; engraved text.
a. Exception: Provide minimum thickness of 1/8 inch when any dimension is greater than 4 inches.
4. Stainless Steel Nameplates: Minimum thickness of 1/32 inch; engraved or laser-etched text.

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5. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch; engraved or laser-etched text.
6. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.

B. Identification Labels:
1. Manufacturers:
   a. Brady Corporation; _____: www.bradyid.com
   b. Brother International Corporation: www.brother-usa.com
   c. Panduit Corp: www.panduit.com
   d. Substitutions: See Section 016000 - Product Requirements.
2. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
3. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.

C. Format for Equipment Identification:
1. Minimum Size: 1 inch by 2.5 inches.
2. Legend:
   a. Equipment designation or other approved description.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height:
   a. System Designation: 1 inch.
   b. Equipment Designation: 1/2 inch.
   c. Other Information: 1/4 inch.
   d. Exception: Provide minimum text height of 1 inch for equipment located more than 10 feet above floor or working platform.
5. Color:
   a. Normal Power System: White text on black background.
   b. Emergency Power System: White text on red background.
   c. Fire Alarm System: White text on red background.

D. Format for General Information and Operating Instructions:
1. Minimum Size: 1 inch by 2.5 inches.
2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 1/4 inch.
5. Color: Black text on white background unless otherwise indicated.
   a. Exceptions:
      1) Provide white text on red background for general information or operational instructions for emergency systems.
      2) Provide white text on red background for general information or operational instructions for fire alarm systems.

E. Format for Caution and Warning Messages:
1. Minimum Size: 2 inches by 4 inches.
2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 1/2 inch.
5. Color: Black text on yellow background unless otherwise indicated.

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F. Format for Receptacle Identification:
   1. Minimum Size: 3/8 inch by 1.5 inches.
   2. Legend: Power source and circuit number or other designation indicated.
      a. Include voltage and phase for other than 120 V, single phase circuits.
   3. Text: All capitalized unless otherwise indicated.
   4. Label Type: Machine printed, pressure-sensitive adhesive labels.
   5. Minimum Text Height: 3/16 inch.
   6. Color: Black text on clear background.

G. Format for Control Device Identification:
   1. Minimum Size: 3/8 inch by 1.5 inches.
   2. Legend: Load controlled or other designation indicated.
   3. Text: All capitalized unless otherwise indicated.
   4. Minimum Text Height: 3/16 inch.
   5. Color: Black text on clear background.

H. Format for Fire Alarm Device Identification:
   1. See Section 284600 - Fire Detection and Alarm, for identification of fire alarm devices and equipment.

2.03 WIRE AND CABLE MARKERS

A. Manufacturers:
   1. Brady Corporation; _____: www.bradyid.com
   2. HellermannTyton; _____: www.hellermanntyton.com
   3. Panduit Corp: www.panduit.com
   4. _____.
   5. Substitutions: See Section 016000 - Product Requirements.

B. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.

C. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.

D. Legend: Power source and circuit number or other designation indicated.

E. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.

F. Minimum Text Height: 1/8 inch.

G. Color: Black text on white background unless otherwise indicated.

2.04 VOLTAGE MARKERS

A. Manufacturers:
   1. Brady Corporation; _____: www.bradyid.com
   2. Brimar Industries, Inc: www.brimar.com
   3. Seton Identification Products; _____: www.seton.com
   4. Substitutions: See Section 016000 - Product Requirements.

B. Markers for Conduits: Use factory pre-printed self-adhesive vinyl type markers.

C. Markers for Boxes and Equipment Enclosures: Use factory pre-printed self-adhesive vinyl type markers.

D. Minimum Size:
   1. Markers for Equipment: 1 1/8 by 4 1/2 inches.
   2. Markers for Conduits: As recommended by manufacturer for conduit size and voltage to be identified.

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3. Markers for Pull Boxes: 1 1/8 by 4 1/2 inches.
4. Markers for Junction Boxes: 1/2 by 2 1/4 inches.

E. Legend:
1. Markers for Voltage Identification: Highest voltage present.
2. Markers for System Identification:
   a. Emergency Power System: Text "EMERGENCY".
   b. Communication and fiber optic cables: Text "COMMUICATION".

F. Color: Black text on orange background unless otherwise indicated.

2.05 UNDERGROUND WARNING TAPE

A. Manufacturers:
1. Brady Corporation; _____: www.bradyid.com
2. Brimar Industries, Inc: www.brimar.com
3. L.H. Dottie.
4. Seton Identification Products; _____: www.seton.com
5. Thomas & Betts - USA.
6. Substitutions: See Section 016000 - Product Requirements.

B. Materials: Use foil-backed detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.

C. Foil-backed Detectable Type Tape: 6 inches wide, with minimum thickness of 5 mil, unless otherwise required for proper detection.

D. Legend: Type of service, continuously repeated over full length of tape.

E. Color:
1. Tape for Buried Power Lines: Black text on red background.
2. Tape for Buried Communication, Alarm, and Signal Lines: Black text on orange background.

2.06 FLOOR MARKING TAPE

A. Manufacturers:
1. Brady Corporation; _____: www.bradyid.com
2. Brimar Industries, Inc: www.brimar.com
3. Seton Identification Products; _____: www.seton.com
4. Substitutions: See Section 016000 - Product Requirements.

B. Floor Marking Tape for Equipment Working Clearance Identification: Self-adhesive vinyl or polyester tape with overlaminate, 3 inches wide, with alternating black and white stripes.

2.07 CABLE TIES:

A. General Purpose Cable Ties: Fungus Inert, Self-Extinguishing, One Piece, Self-Locking, Nylon:
1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black except where used for color-coding.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, nylon:
1. Minimum Width: 3/16 inch.
2. For MV cabling, provide 1/4 inch or larger cable ties.
3. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
4. Temperature Range: Minus 40 to plus 185 deg F.
5. Color: Black.

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C. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, self-locking:
   1. Minimum Width: 3/16 inch.
   2. Tensile Strength at 73 deg F, According to ASTM D 638: 7000 psi.
   3. UL 94 Flame Rating: 94V-0.
   4. Temperature Range: Minus 50 to plus 284 deg F.
   5. Color: Black.

D. Use general-purpose type cable ties, with the following exceptions:
   1. Exterior: UV-stabilized nylon.
   2. Areas of Environmental Air: Plenum rated.

2.08 WARNING SIGNS AND LABELS

A. Manufacturers:
   1. Brimar Industries, Inc: www.brimar.com
   2. Clarion Safety Systems, LLC; _____: www.clarionsafety.com
   3. Seton Identification Products; _____: www.seton.com
   4. Substitutions: See Section 016000 - Product Requirements.

B. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.

C. Warning Signs:
   1. Materials:
      a. Indoor Dry, Clean Locations: Use factory pre-printed rigid plastic or self-adhesive vinyl signs.
      b. Outdoor Locations: Use factory pre-printed rigid aluminum or rigid plastic signs.
   2. Rigid Signs: Provide four mounting holes at corners for mechanical fasteners.
   3. Minimum Size: 7 by 10 inches unless otherwise indicated.

D. Warning Labels:
   1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
      a. Do not use labels designed to be completed using handwritten text.
   2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.
   3. Minimum Size: 2 by 4 inches unless otherwise indicated.

2.09 HANDICAPPED DOOR OPERATORS

A. Provide labeling for maintenance workers inside of accessible panels. Labeling shall include the following:
   1. Identify location of panel feeding door operator.
   2. Identify panel name and circuit number.

PART 3 EXECUTION

3.01 PREPARATION

A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Use consistent naming designations, throughout project.

C. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Do not install where label will interfere with maintenance and operation of equipment. Unless otherwise indicated, locate products as follows:

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1. Surface-Mounted Equipment: Enclosure front.
2. Flush-Mounted Equipment: Inside of equipment door.
3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
4. Elevated Equipment: Legible from the floor or working platform.
5. Branch Devices: Adjacent to device.
6. Interior Components: Legible from the point of access.
7. Conduits: Legible from the floor.
8. Boxes: Outside face of cover.
9. Conductors and Cables: Legible from the point of access.
10. Devices: Outside face of cover.

D. Labeling of conduits and cables in Tunnels:
   1. Install labels where upon conduits/cables enter and exit from tunnel. Label every 10 feet, thereafter.

E. Install identification products centered, level, and parallel with lines of item being identified.

F. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing or epoxy cement.

G. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.

H. Install underground warning tape above buried lines with one tape per trench at 3 inches below finished grade.

I. Secure rigid signs using stainless steel screws.

J. Mark all handwritten text, where permitted, to be neat and legible.

3.03 UNDERGROUND WARNING TAPE:

A. Install continuous, underground-line warning tape. Locate directly above duct bank.

B. Locate warning tape at 6 to 8 inches, below finished grade.

3.04 FIELD QUALITY CONTROL

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

B. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

END OF SECTION

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SECTION 260574
ELECTRICAL TESTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical testing of equipment.

1.02 RELATED REQUIREMENTS

A. Section 260553 - Identification for Electrical Systems.

1.03 REFERENCE STANDARDS

A. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (R2015).

B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS

A. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

B. This Section includes general requirements for electrical field testing and inspecting. Detailed requirements are specified in each Section containing components that require testing. General requirements include the following:
   1. Qualifications of testing agencies and their personnel.
   2. Suitability of test equipment.
   3. Calibration of test instruments.
   4. Coordination requirements for testing and inspecting.
   5. Reporting requirements for testing and inspecting.

C. Retain below if electrical testing and inspecting will be paid for by an allowance. Coordinate requirements with Division 1 Section "Allowances."
   1. Allowances: Electrical tests and inspections specified in various Division 23 and 26 Sections are covered by a testing and inspecting allowance specified in Division 1 Section "Allowances." See Division 1 Section "Allowances" for what is included in allowance amount, the amount of the allowance, payment procedures for allowances, changes to allowance amounts, and disposition of unused portions of allowance.

1.05 QUALITY ASSURANCE

A. Testing Agency Qualifications: As specified in each Section containing electrical testing requirements and in subparagraph and associated subparagraph below.
   1. Delete subparagraph and associated subparagraph below if independent testing agencies are not required for this Project.
   2. Independent Testing Agencies: Independent of manufacturers, suppliers, and installers of components to be tested or inspected.
      a. Testing Agency's Field Supervisor for Power Component Testing: Person currently certified by the International Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Division 16 power component Sections.

B. Test Equipment Suitability: Comply with NETA ATS, Section 5.2.

C. Test Equipment Calibration: Comply with NETA ATS, Section 5.3.

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PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL TESTS AND INSPECTIONS

A. If a group of tests are specified to be performed by an independent testing agency, prepare systems, equipment, and components for tests and inspections, and perform preliminary tests to ensure that systems, equipment, and components are ready for independent agency testing. Include the following minimum preparations as appropriate:
   1. Perform insulation-resistance tests.
   2. Perform continuity tests.
   3. Perform rotation test (for motors to be tested).
   4. Provide a stable source of single-phase, 208/120-V electrical power for test instrumentation at each test location.
   5. Provide certification for main GFI.

B. Test and Inspection Reports: In addition to requirements specified elsewhere, report the following:
   1. Manufacturer's written testing and inspecting instructions.
   2. Calibration and adjustment settings of adjustable and interchangeable devices involved in tests.
   3. Tabulation of expected measurement results made before measurements.
   4. Tabulation of "as-found" and "as-left" measurement and observation results.

END OF SECTION

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SECTION 260583
WIRING CONNECTIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical connections to equipment.

1.02 RELATED REQUIREMENTS

A. Section 083323 - Overhead Coiling Doors: Electrical connections to powered coiling doors.

B. Section 260519 - Low-Voltage Electrical Power Conductors and Cables.

C. Section 260533.13 - Conduit for Electrical Systems.

D. Section 260533.16 - Boxes for Electrical Systems.

E. Section 260553 - Identification for Electrical Systems.

F. Section 262725 - Wiring Devices.

G. Section 262816.16 - Enclosed Switches.

H. Section 262913 - Enclosed Controllers.

1.03 REFERENCE STANDARDS

A. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (R2015).

B. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2016.

C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
   2. Determine connection locations and requirements.

B. Sequencing:
   1. Install rough-in of electrical connections before installation of equipment is required.
   2. Make electrical connections before required start-up of equipment.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide wiring device manufacturer's catalog information showing dimensions, configurations, and construction.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Products: Listed, classified, and labeled as suitable for the purpose intended.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

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PART 2 PRODUCTS

2.01 MATERIALS

A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
   1. Colors: Conform to NEMA WD 1. Comply with Section 260553 - Identification for Electrical Systems, for device and cable/conductor colors.
   2. Cord Construction: NFPA 70, Type SJO, multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
   3. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.
   4. Provide receptacles from same manufacturers as Wiring Devices - Section 26 2726.

B. Disconnect Switches: As specified in Section 262816.16 and in individual equipment sections.

C. Wiring Devices: As specified in Section 262725.

D. Flexible Conduit: As specified in Section 260533.13.

E. Wire and Cable: As specified in Section 260519.

F. Boxes: As specified in Section 260533.16.

2.02 EQUIPMENT CONNECTIONS

A. See construction drawings for equipment device requirements.

B. Strain Relief/Support Grip Connections:
   1. Provide strain relief for all suspended cables with over 10 in feet drop.
   2. Provide strain relief for all wiring devices, suspended from the ceiling. Provide strain relief at both the ceiling and device box connections.
   3. Provide flexible conduit connection to all vibrating equipment.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.02 ELECTRICAL CONNECTIONS

A. Make electrical connections in accordance with equipment manufacturer's instructions.

B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.

C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.

D. Provide receptacle outlet to accommodate connection with attachment plug.

E. Provide cord and cap where field-supplied attachment plug is required.

F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.

G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.

H. Install terminal block jumpers to complete equipment wiring requirements.

I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

J. Coolers and Freezers: Cut and seal conduit openings in freezer and cooler walls, floor, and ceilings.

END OF SECTION

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SECTION 260916
ELECTRIC CONTROLS AND RELAYS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pushbuttons, pilot lights and selector switches.

B. Control stations and panels.

C. Relays and time-delay relays.

D. Control power transformers.

1.02 RELATED REQUIREMENTS

A. Section 260519 - Low-Voltage Electrical Power Conductors and Cables. Power and control cables.

B. Section 260526 - Grounding and Bonding for Electrical Systems. Grounding and bonding system.

C. Section 260533.16 - Boxes for Electrical Systems: Cabinets and terminal blocks.

D. Section 160533 - Identification for Electrical Systems. Identification of box, equipment and conductors.

1.03 REFERENCE STANDARDS

A. NEMA ICS 1 - Industrial Control and Systems General Requirements; 2000 (Reaffirmed 2015).

B. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2000, with Errata (2008).

C. NEMA ICS 6 - Industrial Control and Systems: Enclosures; 1993 (Reaffirmed 2016).

D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Submit to NEMA ICS 1 indicating control panel layouts, wiring connections and diagrams, dimensions, support points.

C. Product Data: Provide for each component showing electrical characteristics and connection requirements.

D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

1.05 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Products: Listed, classified, and labeled as suitable for the purpose intended.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Allen-Bradley/Rockwell Automation; _____: ab.rockwellautomation.com

B. ABB; www.abb.com.

C. Eaton Corporation; _____: www.eaton.com

D. Schneider Electric; Square D Products; _____: www.schneider-electric.us

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2.02 COMPONENTS

A. Control Switches and Stations:
   1. Contacts: NEMA ICS 2, Form Z.
   2. Contact Ratings: NEMA ICS 2, A150.
   3. Selector Switch Operators: _____ Position rotary selector switch, as specified.
   4. Pushbutton Operator: ____ Type as specified.
   5. Control Stations: Standard duty type pushbutton station.
      a. Product: _____.
   6. Pilot Light Indicators: Standard Duty, LED light source.

B. Magnetic Control Relays: NEMA ICS 2, Class A300.
   1. Contacts: NEMA ICS 2, Form Z.
   2. Contact Ratings: NEMA ICS 2, Class A150.
   3. Coil Voltage: ____ volts as specified, 60 Hz, AC.

C. Solid-State Relays: NEMA ICS 2.
   1. Contacts: NEMA ICS 2, Form Z.
   2. Contact Ratings: NEMA ICS 2, Class A150.
   3. Coil Voltage: ____ volts as specified, 60 Hz, AC.

D. Time-Delay Relays: NEMA ICS 2, Class ____, solid-state time-delay relay with ____ second time delay after energization, as specified.
   1. Contacts: NEMA ICS 2, Form Z.
   2. Contact Ratings: NEMA ICS 2, Class A150.
   3. Coil Voltage: ____ volts as specified, 60 Hz, AC.

E. Interval Timing Relays: NEMA ICS 2, Class A300, repeat cycle timer.
   1. Contacts: NEMA ICS 2, Form Z.
   2. Contact Ratings: NEMA ICS 2, Class A150.
   3. Coil Voltage: ____ volts as specified, 60 Hz, AC.

F. Timers: NEMA ICS 2, Class A300, time duration as need for timer.
   1. Contacts: NEMA ICS 2, Form Z.
   2. Contact Ratings: NEMA ICS 2, Class A150.
   3. Coil Voltage: 120 volts, 60 Hz, AC.

G. Control Power Transformers: Machine tool transformer with isolated secondary winding.
   1. Power Rating: ____ VA as specified.
   2. Voltage Rating: ____ primary volts as specified; ____ secondary volts as specified.

2.03 ENCLOSURES

A. Control Station Enclosures: NEMA ICS 6; Type ____.

B. Relay Enclosures: NEMA ICS 6; Type ____.

C. Fabrication: Shop fabricate control panels to NEMA ICS 1, using cabinets and terminal blocks furnished in accordance with Section 260533.16.

D. Enclosure types:
   1. Where enclosures are required, provide an enclosure with the appropriate enclosure type for the environment in which it will be installed. Provide all enclosures with a piano type, continuous hinge.
   2. See Section 260533.16 - Boxes for Electrical Systems, for NEMA rating requirements for enclosures.

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PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install individual relays and time-delay relays in enclosures.

C. Install cabinets in accordance with Section 260533.16.

D. Make electrical wiring interconnections as indicated.

E. Clean up construction debris prior to Substantial Completion.

END OF SECTION

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SECTION 260917
PROGRAMMABLE CONTROLLERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Programmable controllers.

B. Remote input/output units.

C. Programmer/loader unit.

1.02 REFERENCE STANDARDS

A. NEMA ICS 1 - Industrial Control and Systems General Requirements; 2000 (Reaffirmed 2015).

B. NEMA ICS 6 - Industrial Control and Systems: Enclosures; 1993 (Reaffirmed 2016).

C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate electrical characteristics and connection requirements, including layout of completed assemblies, interconnecting cabling, dimensions, weights, and external power requirements.

C. Product Data: Provide data for each component specified showing electrical characteristics and connection requirements.

D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

E. Project Record Documents: Record actual locations of controller cabinets and input and output devices connected to system. Include interconnection wiring and cabling information, and terminal block layouts in controller cabinets.

F. Operation Data: Include bound copies of operating and programming instructions.

G. Maintenance Data: Include card replacement, adjustments, and preventative maintenance procedures and materials.

1.04 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience and with service facilities within 100 miles of Project.

C. Supplier Qualifications: Authorized distributor of specified manufacturer with minimum three years documented experience.

D. Products: Listed, classified, and labeled as suitable for the purpose intended.

E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store products in clean, dry area; maintain temperature to NEMA ICS 1.

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1.06 FIELD CONDITIONS

A. Maintain temperature above 32 degrees F and below 104 degrees F during and after installation of products.

B. Maintain area free of dirt and dust during and after installation of products.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. **Allen Bradley.**

B. **Square D.**

C. **Siemens.**

D. **Eaton.**

2.02 PROGRAMMABLE CONTROLLER

A. Description: Programmable controller manufactured to NEMA ICS 3 Part 2.

B. Service Conditions:
   1. Temperature: As recommended by manufacturer.
   2. Humidity: As recommended by manufacturer.
   3. Altitude: 6,000 ft minimum.

C. Configuration:
   1. Processor Unit: Include processor, power supply, random access memory and input/output modules.
   2. Remote Input/Output Unit: Include input/output modules, interface module and power supply for system inputs and outputs.

D. Ratings:
   1. Input/Output Capacity: _____ As specified.
   2. Scan Rate: _____ Milliseconds per KB, per manufacturer's recommendations.
   3. Digital Inputs: _____ As specified.
   4. Analog Inputs: _____ As specified.
   5. Digital Outputs: _____ As specified.
   6. Analog Outputs: _____ As specified.

E. Programming Instruction Set:
   1. Language Characteristics: Ladder diagram.
   2. Logic Operations: AND, OR, XOR, NOT.
   3. Register Operations: Store, recall.
   4. Arithmetic Operations: Addition, subtraction, multiplication, division, square root.
   5. Process Control: Proportional-Integral-Derivative.
   6. Other Functions: Timing; counter; data moving operations; and _____.

F. Processor Unit:
   1. Memory Size: 2 KB, minimum.
   2. Storage Registers: _____ Per manufacturer's recommendations.
   3. Internal Relay Equivalents: 256 retentive; 256 non-retentive.

G. Input/Output Units:
   1. Input/Output Structure Capacity: _____ kB, as recommended per manufacturer's recommendations and size of program.
   2. Digital Input Characteristics: _____ Volts, reed relay or fiber optic isolation, as specified.
   3. Analog Input Characteristics: _____ Milli-volts or volts, as specified. AC or DC, as specified.

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4. Digital Output Characteristics: ____ Mili-volts or volts, as specified. Fiber optic or reed relay isolation, as specified.
5. Analog Output Characteristics: _____ Milli-volts or volts, as specified. AC or DC, as specified.
6. Remote Input Output Communications Unit: RS 232 or RS 485, as specified.

H. Power Supply: Input voltage of 120 volts, 60 Hz _____.

I. Enclosure: NEMA ICS 6; Type 12.

J. Programmer/Loader Unit: Manual graphic display type, Human machine interface (HMI).

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Do not install products until major construction is complete and building interior is enclosed and heated.

C. Connect input and output devices as indicated.

3.02 FIELD QUALITY CONTROL

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

B. Manufacturer Services: Provide the services of the manufacturer's technical representative to prepare and start systems.

C. Perform operational testing on control systems to verify proper operation and field wiring connections.

3.03 CLOSEOUT ACTIVITIES

A. See Section 017800 - Closeout Submittals, for closeout submittals.

B. See Section 017900 - Demonstration and Training, for additional requirements.

C. Demonstrate operation and programming of controller.

D. Provide 2 hours, minimum, of instruction each for four persons.
1. Conduct instruction at project site with manufacturer's representative.
2. Include travel and living expenses for Owner personnel.

E. Program licensing:
1. Provide an electronic copy of operating system programming.
2. Provide a site license for operating system.

3.04 MAINTENANCE

A. See Section 017000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.

B. Provide a separate maintenance contract for specified maintenance service.

C. Provide manufacturer's service and maintenance of programmable controllers for one year from Date of Substantial Completion.

END OF SECTION

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SECTION 260923
LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Occupancy Sensors.
B. Dimming Occupancy Sensors.
C. Time switches.
D. In-wall interval timers.
E. Outdoor lighting controls.
F. Lighting contactors.
G. Control accessories.

1.02 RELATED REQUIREMENTS

A. Section 260526 - Grounding and Bonding for Electrical Systems.
B. Section 260529 - Hangers and Supports for Electrical Systems.
C. Section 260533.16 - Boxes for Electrical Systems.
D. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
E. Section 260573 - Power System Studies.
F. Section 260923 - Modular Lighting Control Systems
G. Section 262725 - Wiring Devices: Devices for manual control of lighting, including wall switches.
   1. Includes finish requirements for wall controls specified in this section.
   2. Includes accessory receptacles, switches, dimmers and wall plates, to match lighting controls specified in this section.
H. Section 262813 - Fuses.
I. Section 262913 - Enclosed Controllers : General purpose contactors.
J. Section 265100 - Interior Lighting.
K. Section 265113 - Luminaires, Ballasts, and Drivers.
L. Section 265561 - Theatrical Lighting: Controls for stage lighting units.
M. Section 265600 - Exterior Lighting.

1.03 REFERENCE STANDARDS

A. 47 CFR 15 - Radio Frequency Devices; current edition.
B. ANSI C136.10 - American National Standard for Roadway and Area Lighting Equipment - Locking-Type Photocontrol Devices and Mating Receptacles - Physical and Electrical Interchangeability and Testing; 2010.
C. ANSI C136.24 - American National Standard for Roadway and Area Lighting Equipment - Nonlocking (Button) Type Photocontrols; 2004 (R2010).
D. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
E. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2010.
F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.
G. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts; 2015.

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H. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2000, with Errata (2008).

I. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices; 2017.

J. NEMA ICS 6 - Industrial Control and Systems: Enclosures; 1993 (Reaffirmed 2016).

K. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

L. UL 773 - Plug-in, Locking Type Photocontrols for Use with Area Lighting; Current Edition, Including All Revisions.

M. UL 773A - Nonindustrial Photoelectric Switches for Lighting Control; Current Edition, Including All Revisions.

N. UL 916 - Energy Management Equipment; Current Edition, Including All Revisions.

O. UL 917 - Clock-Operated Switches; Current Edition, Including All Revisions.

P. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.

Q. UL 60947-1 - Low-Voltage Switchgear and Controlgear - Part 1: General Rules; Current Edition, Including All Revisions.

R. UL 60947-4-1 - Low-Voltage Switchgear and Controlgear - Part 4-1: Contactors and Motor-starters - Electromechanical Contactors and Motor-starters; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the placement of lighting control devices with millwork, furniture, equipment, etc. installed under other sections or by others.
   2. Coordinate the placement of wall switch occupancy sensors with actual installed door swings.
   3. Coordinate the placement of occupancy sensors with millwork, furniture, equipment or other potential obstructions to motion detection coverage installed under other sections or by others.
   4. Coordinate the placement of photo sensors for daylighting controls with windows, skylights, and luminaires to achieve optimum operation. Coordinate placement with ductwork, piping, equipment, or other potential obstructions to light level measurement installed under other sections or by others.
   5. Notify Architect and Owner's Construction Project Coordinator, of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

B. Sequencing:
   1. Do not install lighting control devices until final surface finishes and painting are complete.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Include ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
   1. Occupancy Sensors: Include detailed motion detection coverage range diagrams.

C. Shop Drawings:
   1. Occupancy Sensors: Provide lighting plan indicating location, model number, and orientation of each occupancy sensor and associated system component.
   2. Daylighting Controls: Provide lighting plan indicating location, model number, and orientation of each photo sensor and associated system component.

D. Field Quality Control Reports.

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E. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

F. Operation and Maintenance Data: Include detailed information on device programming and setup.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.

H. Project Record Documents: Record actual installed locations and settings for lighting control devices.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

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

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

1.08 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.09 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Provide five year manufacturer warranty for all occupancy sensors.

C. Provide five year manufacturer warranty for utility grade locking receptacle-mounted outdoor photo controls.

D. Provide two year manufacturer warranty for all daylighting controls.

PART 2 PRODUCTS

2.01 LIGHTING CONTROL DEVICES - GENERAL REQUIREMENTS

A. Provide products listed, classified, and labeled as suitable for the purpose intended.

B. Unless specifically indicated to be excluded, provide all required conduit, wiring, connectors, hardware, components, accessories, etc. as required for a complete operating system.

C. Products for Switching of Electronic Ballasts/Drivers: Tested and rated to be suitable for peak inrush currents specified in NEMA 410.

2.02 OCCUPANCY SENSORS

A. Manufacturers (non-dimming):
   1. Hubbell Incorporated: www.hubbell.com
   2. Sensor Switch Inc: www.sensorswitch.com
   3. WattStopper: www.wattstopper.com
   4. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

B. All Occupancy Sensors:

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1. Description: Factory-assembled commercial specification grade devices for indoor use capable of sensing both major motion, such as walking, and minor motion, such as small desktop level movements, according to published coverage areas, for automatic control of load indicated.
2. Sensor Technology:
   a. Passive Infrared/Ultrasonic Dual Technology Occupancy Sensors: Designed to detect occupancy using a combination of both passive infrared and ultrasonic technologies.
   b. Passive Infrared/Acoustic Dual Technology Occupancy Sensors: Designed to detect occupancy using a combination of both passive infrared and audible sound sensing technologies.
3. Provide LED to visually indicate motion detection with separate color LEDs for each sensor type in dual technology units.
4. Operation: Unless otherwise indicated, occupancy sensor to turn load on when occupant presence is detected and to turn load off when no occupant presence is detected during an adjustable turn-off delay time interval.
5. Dual Technology Occupancy Sensors: Field configurable turn-on and hold-on activation with settings for activation by either or both sensing technologies.
6. Passive Infrared Lens Field of View: Field customizable by addition of factory masking material, adjustment of integral blinders, or similar means to block motion detection in selected areas.
7. Turn-Off Delay: Field adjustable, with time delay settings up to 30 minutes.
8. Sensitivity: Field adjustable.
9. Adaptive Technology: Field selectable; capable of self-adjusting sensitivity and time delay according to conditions.
10. Integral Photocell: For field selectable and adjustable inhibition of automatic turn-on of load when ambient lighting is above the selected level.
11. Compatibility (Non-Dimming Sensors): Suitable for controlling incandescent lighting, low-voltage lighting with electronic and magnetic transformers, fluorescent lighting with electronic and magnetic ballasts, and fractional motor loads, with no minimum load requirements.
12. Load Rating for Line Voltage Occupancy Sensors: As required to control the load indicated on drawings.
13. Isolated Relay for Low Voltage Occupancy Sensors: SPDT dry contacts, ratings as required for interface with system indicated. When specified on contract documents.
14. Where wired sensors are indicated, wireless sensors are not acceptable without prior approval of Architect.

C. Wall Switch Occupancy Sensors:
   1. All Wall Switch Occupancy Sensors:
      a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with a field of view of 180 degrees, integrated manual control capability, and no leakage current to load in off mode.
      b. Unless otherwise indicated or required to control the load indicated on drawings, provide line voltage units with self-contained relay.
      c. Where indicated, provide two-circuit units for control of two separate lighting loads, with separate manual controls and separately programmable operation for each load.
      d. Operation: Field selectable to operate either as occupancy sensor (automatic on/off) or as vacancy sensor (manual-on/automatic off).
      e. Manual-Off Override Control: When used to turn off load while in automatic-on mode, unit to revert back to automatic mode after no occupant presence is detected during the delayed-off time interval.
      f. Finish: Match finishes specified for wiring devices in Section 262725, unless otherwise indicated.

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g. Provide vandal resistant lenses for passive infrared (PIR) and dual technology wall switch occupancy sensors where indicated.

2. Passive Infrared/Ultrasonic Dual Technology Wall Switch Occupancy Sensors: Capable of detecting motion within an area of 900 square feet.

D. Wall Dimmer Occupancy Sensors:
1. General Requirements:
a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with a field of view of 180 degrees, integrated dimming control capability , and no leakage current to load in off mode.
b. Operation: Field selectable to operate either as occupancy sensor (automatic on/off) or as vacancy sensor (manual-on/automatic off).
c. Manual-Off Override Control Capability: When used to turn off load while in automatic-on mode, unit to revert back to automatic mode after no occupant presence is detected during the delayed-off time interval.
d. Dimmer: Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, and listed as complying with UL 1472; type and rating suitable for load controlled.
e. Provide field adjustable dimming preset for occupied state.
f. Provide fade-to-off operation to notify occupant of impending load turn-off.
g. Finish: Match finishes specified for wiring devices in Section 262725, unless otherwise indicated.

E. Ceiling Mounted Occupancy Sensors:
1. All Ceiling Mounted Occupancy Sensors:
a. Description: Low profile occupancy sensors designed for ceiling installation.
b. Unless otherwise indicated or required to control the load indicated on the drawings, provide line voltage units with self-contained relay, or low voltage units, for use with separate compatible accessory power packs.
c. Finish: White unless otherwise indicated.
2. Passive Infrared/Ultrasonic Dual Technology Wall Mounted Occupancy Sensors:
a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
1) Products:
(a) Wattstopper, DW-311.
3. Passive Infrared/Ultrasonic Dual Technology Ceiling Mounted Occupancy Sensors:
a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
1) Products:
(a) Wattstopper, DT-355 series

F. Power Packs for Low Voltage Occupancy Sensors:
1. Description: Plenum rated, self-contained low voltage class 2 transformer and relay compatible with specified low voltage occupancy sensors for switching of line voltage loads.
2. Provide quantity and configuration of power and slave packs with all associated wiring and accessories as required to control the load indicated on drawings.
3. Input Supply Voltage: Dual rated for 120/277 V ac.
4. Load Rating: As required to control the load indicated on drawings.

G. Accessories:
1. Provide heavy duty coated steel wire protective guards compatible with specified occupancy sensors where indicated.

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2.03 TIME SWITCHES

A. Manufacturers:
   1. Tork, a division of NSI Industries LLC; _____: www.tork.com
      a. Product: #7200ZL series.

B. Electromechanical Time Switches:
   1. Description: Factory-assembled controller with motor-operated timing dial mechanism and adjustable trippers for setting on/off operations, listed and labeled as complying with UL 917.
   2. Program Capability:
      a. Astronomic Time Switches: With same schedule for each day of the week and skip-a-day feature to omit selected days with automatic adjustment for seasonal changes in sunrise and sunset times.
   3. Schedule Capacity:
      a. 24-Hour Time Switches: Accommodating not less than 12 pairs of selected on/off operations per day.
      b. Astronomic Time Switches: Capable of turning load on at sunset and off at either sunrise or selected fixed time.
   4. Provide spring reserve backup to maintain clock during power outage.
   5. Manual override: Capable of overriding current schedule both permanently and temporarily until next scheduled event.
   6. Input Supply Voltage: As indicated on the drawings.
   7. Output Switch Configuration: As required to control the load indicated on drawings.
   8. Output Switch Contact Ratings: As required to control the load indicated on drawings.
   9. Provide lockable enclosure; environmental type per NEMA 250 as specified for the following installation locations:
      a. Indoor clean, dry locations: Type 1.
      b. Outdoor locations: Type 3R.
   10. Provide flush-mounted unit where indicated, where mounted in public areas, or where mounted adjacent to flush-mounted equipment.

2.04 IN-WALL INTERVAL TIMERS

A. Manufacturers:
   1. Intermatic, Inc; _____: www.intermatic.com
   2. Tork, a division of NSI Industries LLC; _____: www.tork.com

B. Spring Wound In-Wall Interval Timers:
   1. Description: Factory-assembled controller with mechanical spring wound timing mechanism requiring no electricity to operate; suitable for mounting in standard wall box; rotary control operator with matching wall plate factory marked with time interval units; listed and labeled as complying with UL 916 or UL 917.
   2. Program Capability: Designed to turn load off at end of preset time interval.
   3. Time Interval: User selectable from zero up to 2 hours.
   4. Switch Configuration: SPST.
   5. Contact Ratings: As required to control the load indicated on drawings.
   6. Contact Ratings:

2.05 LIGHTING CONTACTORS

A. Manufacturers:
   1. Rockwell Automation Inc; Allen-Bradley Products; _____: ab.rockwellautomation.com
   2. Schneider Electric; Square D Products; _____: www.schneider-electric.us
   3. Siemens Industry, Inc; _____: www.usa.siemens.com

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4. Substitutions: See Section 016000 - Product Requirements.

B. Description: Magnetic lighting contactors complying with NEMA ICS 2, and listed and labeled as complying with UL 60947-1 and UL 60947-4-1; noncombination type unless otherwise indicated; ratings, configurations and features as indicated on the drawings.

C. Short Circuit Current Rating:
1. Provide contactors with listed short circuit current rating not less than the available fault current at the installed location as determined by short circuit study performed in accordance with Section 260573.

D. Enclosures:
1. Comply with NEMA ICS 6.
2. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
   a. Indoor Clean, Dry Locations: Type 1 or Type 12.
   b. Outdoor Locations: Type 3R or Type 4.
3. Finish: Manufacturer's standard unless otherwise indicated.

2.06 CONTROL ACCESSORIES

A. Auxiliary Contacts:
1. Comply with NEMA ICS 5.
2. Provide number and type of contacts indicated or required to perform necessary functions, including holding (seal-in) circuit and interlocking, plus one normally open (NO) and one normally closed (NC) spare contact for each lighting contactor, minimum.

B. Pilot Devices:
1. Comply with NEMA ICS 5; heavy-duty type.
2. Nominal Size: 30 mm.
3. Pushbuttons: Unless otherwise indicated, provide momentary, non-illuminated type with flush button operator; normally open or normally closed as indicated or as required.
4. Selector Switches: Unless otherwise indicated, provide maintained, non-illuminated type with knob operator; number of switch positions as indicated or as required.
5. Indicating Lights: Push-to-test type unless otherwise indicated.
6. Provide LED lamp source for indicating lights and illuminated devices.

C. Control and Timing Relays:
1. Comply with NEMA ICS 5.
2. Provide number and type of relays indicated or required to perform necessary functions.
3. Timing Relays: Electronic.
   a. Adjustable Timing Range: As indicated on drawings.

D. Fire-Rated Device Enclosures:
1. Manufacturers:
   a. Fire Rated Product Specialties Corp; _____: www.frpsonline.com
   b. Substitutions: See Section 016000 - Product Requirements.
2. Provide as required to preserve fire resistance rating of building elements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.

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C. Verify that openings for outlet boxes are neatly cut and will be completely covered by devices or wall plates.

D. Verify that final surface finishes are complete, including painting.

E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to lighting control devices.

F. Verify that the service voltage and ratings of lighting control devices are appropriate for the service voltage and load requirements at the location to be installed.

G. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

A. Install lighting control devices in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.

B. Coordinate locations of outlet boxes provided under Section 260533.16 as required for installation of lighting control devices provided under this section.
   1. Mounting Heights: Unless otherwise indicated, as follows:
      a. Wall Switch Occupancy Sensors: 48 inches above finished floor.
   2. Orient outlet boxes for vertical installation of lighting control devices unless otherwise indicated.
   3. Locate wall switch occupancy sensor on strike side of door. Where locations are indicated otherwise, notify Architect to obtain direction prior to proceeding with work.

C. Install lighting control devices in accordance with manufacturer's instructions.

D. Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

E. Install lighting control devices plumb and level, and held securely in place.

F. Where required and not furnished with lighting control device, provide wall plate in accordance with Section 262725.

G. Provide required supports in accordance with Section 260529.

H. Where applicable, install lighting control devices and associated wall plates to fit completely flush to mounting surface with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.

I. Identify lighting control devices in accordance with Section 260553.

J. Occupancy Sensor Locations:
   1. Location Adjustments: Within the design intent, reasonably minor adjustments to locations may be made in order to optimize coverage and avoid conflicts or problems affecting coverage.
   2. Locate dual technology passive infrared/ultrasonic occupancy sensors a minimum of 4 feet from air supply ducts or other sources of heavy air flow and as per manufacturer's recommendations, in order to minimize false triggers.

K. Unless otherwise indicated, install power packs for lighting control devices above accessible ceiling or above access panel in inaccessible ceiling near the sensor location.

L. Where indicated, install separate compatible wall switches for manual control interface with lighting control devices or associated power packs.

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M. Unless otherwise indicated, install switches on load side of power packs so that switch does not turn off power pack.

N. Where indicated or required, provide cabinet or enclosure in accordance with Section 260533.16 for mounting of lighting control device system components.

3.04 FIELD QUALITY CONTROL

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

B. Inspect each lighting control device for damage and defects.

C. Test occupancy sensors to verify proper operation, including time delays and ambient light thresholds where applicable. Verify optimal coverage for entire room or area.

D. Test time switches to verify proper operation.

E. Correct wiring deficiencies and replace damaged or defective lighting control devices.

3.05 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

B. Adjust occupancy sensor settings to minimize undesired activations while optimizing energy savings, and to achieve desired function as indicated or as directed by Architect.

C. Adjust position of directional occupancy sensors and outdoor motion sensors to achieve optimal coverage as required.

D. Where indicated or as directed by Architect, install factory masking material or adjust integral blinders on dual technology occupancy sensor lenses to block undesired motion detection.

E. Adjust time switch settings to achieve desired operation schedule as indicated or as directed by Architect.

3.06 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

B. Clean inside of boxes and control enclosures, prior to installing devices, equipment, etc.

3.07 COMMISSIONING

A. See Section 019113 - General Commissioning Requirements for commissioning requirements.

3.08 CLOSEOUT ACTIVITIES

A. See Section 017800 - Closeout Submittals, for closeout submittals.

B. See Section 017900 - Demonstration and Training, for additional requirements.

C. Demonstration: Demonstrate proper operation of lighting control devices to Architect, and correct deficiencies or make adjustments as directed.

D. Training: Train Owner's personnel on operation, adjustment, programming, and maintenance of lighting control devices.

1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
2. Provide minimum of two hours of training.
3. Instructor: Qualified contractor familiar with the project and with sufficient knowledge of the installed lighting control devices.
4. Location: At project site.

END OF SECTION

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SECTION 260936
MODULAR LIGHTING CONTROL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Standalone lighting control systems and associated components:
   1. LED drivers.
   2. Power interfaces.
   3. Main units.
   4. Lighting control modules.
   5. Digital dimming drivers and switching modules.
   6. Control stations.
   7. Low-voltage control interfaces.
   8. Wired sensors.
   9. Accessories.

1.02 RELATED REQUIREMENTS

A. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

B. Section 260923 - Lighting Control Devices.

C. Section 262725 - Wiring Devices:
   1. Finish requirements for wall controls specified in this section.
   2. Accessory receptacles and wallplates, to match lighting controls specified in this section.

D. Section 265100 - Interior Lighting: Luminaires and associated components, for interface with lighting control system.

E. Section 265113 - Luminaires, Ballasts, and Drivers.

1.03 REFERENCE STANDARDS

A. 47 CFR 15 - Radio Frequency Devices; current edition.

B. ASTM D4674 - Standard Practice for Accelerated Testing for Color Stability of Plastics Exposed to Indoor Office Environments; 2002a (Reapproved 2010).

C. IEC 61000-4-2 - Electromagnetic Compatibility (EMC) - Part 4-2: Testing and Measurement Techniques - Electrostatic Discharge Immunity Test; 2008.

D. IEC 61000-4-5 - Electromagnetic Compatibility (EMC) - Part 4-5: Testing and Measurement Techniques - Surge Immunity Test; 2014.

E. IEC 61347-2-3 - Lamp Control Gear - Part 2-3: Particular Requirements for A.C. and/or D.C. Supplied Electronic Control Gear for Fluorescent Lamps; 2011, with Amendments, 2016.

F. IEEE 1789 - IEEE Recommended Practice for Modulating Current in High-Brightness LEDs for Mitigating Health Risks to Viewers; 2015.

G. IEEE C62.41.2 - Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits; 2002 (Cor 1, 2012).

H. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

I. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2010.

J. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts; 2015.

K. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (R2015).

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L. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

M. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances; Current Edition, Including All Revisions.

N. UL 508 - Industrial Control Equipment; Underwriters Laboratories Inc; Current Edition, Including All Revisions.

O. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.

P. UL 1310 - Class 2 Power Units; Current Edition, Including All Revisions.

Q. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.

R. UL 1598C - Light-Emitting Diode (LED) Retrofit Luminaire Conversion Kits; Current Edition, Including All Revisions.

S. UL 2043 - Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces; Current Edition, Including All Revisions.

T. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
1. Coordinate the placement of sensors and wall controls with millwork, furniture, equipment, etc. installed under other sections or by others.
2. Coordinate the placement of wall controls with actual installed door swings.
3. Coordinate the placement of daylight sensors with windows, skylights, and luminaires to achieve optimum operation. Coordinate placement with ductwork, piping, equipment, or other potential obstructions to light level measurement installed under other sections or by others.
4. Coordinate the work to provide luminaires and lamps compatible with the lighting controls to be installed.
5. Notify Architect and Owner's Construction Project Coordinator, of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

B. Pre-Wire Meeting: Conduct on-site meeting with lighting control system manufacturer prior to commencing work as part of manufacturer's standard startup services. Manufacturer to review with installer:
1. Low voltage wiring requirements.
2. Separation of power and low voltage/data wiring.
3. Wire labeling.
4. Control locations.
5. Load circuit wiring.
6. Connections to other equipment.
7. Installer responsibilities.

C. Sequencing:
1. Do not install sensors and wall controls until final surface finishes and painting are complete.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Design Documents: Where Lighting Control Manufacturer Sensor Layout and Tuning service is specified in Part 2 under "LIGHTING CONTROL SYSTEM - GENERAL REQUIREMENTS", Lighting Control Manufacturer to provide plans indicating occupancy/vacancy and/or daylight sensor locations.

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C. Product Data: Include ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
   1. Occupancy/Vacancy Sensors: Include detailed basic motion detection coverage range diagrams.

D. Shop Drawings:
   1. Provide schematic system riser diagram indicating component interconnections. Include requirements for interface with other systems.

E. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

F. Project Record Documents: Record actual installed locations and settings for lighting control system components.

G. Operation and Maintenance Data: Include detailed information on lighting control system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.

H. Warranty: Submit sample of manufacturer's Warranty or Enhanced Warranty as specified in Part 1 under "WARRANTY". Submit documentation of final execution completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications:
   1. Company with not less than ten years of experience manufacturing lighting control systems of similar complexity to specified system.
   2. Qualified to supply specified products and to honor claims against product presented in accordance with warranty.

D. Maintenance Contractor Qualifications: Manufacturer's authorized service representative.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

1.08 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.
   1. System Requirements, Unless Otherwise Indicated:
      a. Ambient Temperature:
         1) Lighting Control System Components, Except Those Listed Below: Between 32 and 104 degrees F.
      b. Relative Humidity: Less than 90 percent, non-condensing.

1.09 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Manufacturer's Standard Warranty, With Manufacturer Start-Up:
   1. Manufacturer Lighting Control System Components, Except Ballasts/Drivers and Ballast Modules:
      a. First Two Years:

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1) 100 percent replacement parts coverage, 100 percent manufacturer labor coverage to troubleshoot and diagnose a lighting issue.

b. Telephone Technical Support: Available 24 hours per day, 7 days per week, excluding manufacturer holidays.

2. Ballasts/Drivers and Ballast Modules: Five years 100 percent parts coverage, no manufacturer labor coverage.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers:
1. Nextlight: Nexlight, Inc, www.nexlight.com.
2. Wattstopper: Legrand/Wattstopper, www.legand.us/wattstopper.aspx
   a. Digital Light Management (DLM) Series

2.02 LIGHTING CONTROL SYSTEM - GENERAL REQUIREMENTS

A. Sensor Layout and Design:
1. Lighting Control Manufacturer to take full responsibility for wired or wireless sensor layout and performance for sensors provided by Lighting Control Manufacturer.
2. Lighting Control Manufacturer to analyze the reflected ceiling plans, via supplied electronic AutoCAD format, and design a detailed sensor layout that provides adequate occupancy sensor coverage and ensures occupancy and daylight sensor performance per agreed upon sequence of operations. Contractor to utilize the layouts for sensor placement.
3. During startup, Lighting Control Manufacturer to direct Contractor regarding sensor relocation, as required, should conditions require a deviation from locations specified in the drawings.

B. Provide products listed, classified, and labeled by Underwriter's Laboratories Inc. (UL) as suitable for the purpose indicated.

C. Unless specifically indicated to be excluded, provide all required equipment, conduit, boxes, wiring, connectors, hardware, supports, accessories, software, system programming, etc. as necessary for a complete operating system that provides the control intent indicated.

D. Design lighting control equipment for 10 year operational life while operating continually at any temperature in an ambient temperature range of 32 degrees F to 104 degrees F and 90 percent non-condensing relative humidity.

E. Device Finishes:
1. Wall Controls: Match finishes specified for Wiring Devices in Section 262725, unless otherwise indicated.

2.03 MAIN UNITS

A. Provide main units with configuration and quantity of zones as indicated or as required to control the loads as indicated.

B. Engrave units with button, zone, and scene descriptions as indicated on the drawings.

C. Preset Lighting Control with Zone Override:
1. Intensity for each zone indicated by means of one illuminated bar graph per zone.
2. User-programmable zone and scene names.
3. Time clock and programmer interface provides access to:
   a. Scene selections.
   b. Fade zone to a level.
   c. Fine-tuning of preset levels with scene raise/lower.
   d. Lock out scenes and zones.
   e. Fine-tuning of light levels with individual zone raise/lower.

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f. Enable/disable wall station.
4. Fade time indicated by digital display for current scene while fading.
5. Integral wide angle infrared receiver.
6. For temporary local overrides, individual raise/lower buttons to allow zones to be adjusted without altering scene values stored in memory.
7. Creates daylighting rows independent of control zones.
8. Capable of re-zoning without re-wiring using programming display on unit.

2.04 LIGHTING CONTROL MODULES

A. Provide lighting control modules as indicated or as required to control the loads as indicated.

B. General Requirements:
1. Listed to UL 508 as industrial control equipment.
2. Delivered and installed as a listed factory-assembled panel.
3. Passively cooled via free-convection, unaided by fans or other means.
4. Mounting: Surface.
5. Connection without interface to wired:
a. Occupancy sensors.
b. Daylight sensors.
c. IR receivers for personal control.
6. LED status indicators confirm communication with occupancy sensors, daylight sensors, and IR receivers.

C. 0-10V Lighting Control Modules:
1. Product(s):
a. Nexlight:
b. Wattstopper:
1) LMRC-200 series.

D. On/Off Room Lighting Controller Modules:
1. Product(s):
a. Nexlight:
b. Wattstopper:
1) LMRC-100 series.

E. Digital Plug Load Controller Modules:
1. Product(s):
a. Nexlight:
b. Wattstopper:
1) LMPL-100/200 series.
2. Low voltage dimming module; capable of controlling following light sources:
a. 0-10V analog voltage signal.
1) Provide Class 2 isolated 0-10 V output signal conforming to IEC 60929.
2) Sink current per IEC 60929.
3. Switching:
a. Rated Life of Relay: Typical of 1,000,000 cycles at fully rated 16 A for all lighting loads.
b. Load switched in manner that prevents arcing at mechanical contacts when power is applied to and removed from load circuits.
c. Fully rated output continuous duty for inductive, capacitive, and resistive loads.

2.05 CONTROL STATIONS

A. Provide control stations with configuration as indicated or as required to control the loads as indicated.

B. Wired Control Stations:

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1. General Requirements:
   a. Power: Class 2 (low voltage).
   b. UL listed.
   c. Provide faceplates with mounting hardware.
   d. Borders, logos, and graduations to use laser engraving or silk-screened graphic process that chemically bonds graphics to faceplate, resistant to removal by scratching and cleaning.
2. Multi-Scene Wired Control:
   a. General Requirements:
      1) Allows control of any devices part of the lighting control system.
      2) Allows for easy reprogramming without replacing unit.
      3) Communications: Utilize wiring for low-voltage communications link.
      4) Engrave keypads with button, zone, and scene descriptions as indicated on the drawings.
      5) Status LEDs:
         (a) Upon button press, LEDs to immediately illuminate.
   b. Wired Keypads:
      1) Products:
         (a) Nexlight:
         (b) Wattstopper:
            (1) LMSW-100 series, wall switches.
      2) Mounting: Wallbox; provide wall plates with concealed mounting hardware.
      3) Design keypads to allow field-customization of button color, configuration, and engraving using field-changeable replacement kits.

C. Handheld Controls:
1. Product(s):
   a. Nexlight, #Handheld Programmer.
   b. Wattstopper, #Wireless Handheld Configuration Tool.
2. Quantity: As indicated on the drawings.
3. Designed for use in conjunction with compatible infrared receiver and lighting control; compatibility dependent on that receiver, not transmitter.
4. Learnable by other variable frequency remote controls.

2.06 PARTITION CONTROL SWITCHES

A. Wired Partition Switches::
1. Products:
   a. Nexlight:
   b. Wattstopper:
      1) LMSW-100 series, wall switches.
2. For reconfigurable lighting controls for operation when movable walls are opened and closed.

2.07 WIRED SENSORS

A. Wired Occupancy Sensors:
1. General Requirements:
   a. Turns off or reduces lighting automatically after reasonable time delay when a room or area is vacated by the last person to occupy the space.
   b. Accommodates all conditions of space utilization and all irregular work hours and habits.
   c. Comply with UL 94.
   d. Power Failure Memory: Settings and learned parameters to be saved in non-volatile memory and not lost should power be interrupted and subsequently restored.

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e. Furnished with all necessary mounting hardware and instructions.
f. Class 2 devices.
g. Ceiling-Mounted Sensors: Indicate viewing directions on mounting bracket.
h. Wall-Mounted Sensors: Provide swivel-mount base.
i. Color: Grey.

2. Wired Dual Technology Sensors:
   a. Passive Infrared: Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.
   b. Ultrasonic: Utilize an operating frequency of 32 kHz or 40 kHz, crystal-controlled to operate within plus/minus 0.005 percent tolerance.
   c. Ceiling-Mounted Sensors: Provide customizable mask to block off unwanted viewing areas.
   d. Products:
      1) Nexlight:
      2) Wattstopper:
         (a) LMDX-100 series, Digital Dual Technology Corner Mount Occupancy Sensor.
         (b) LMDC-100 series, Digital Dual Technology Ceiling Mount Occupancy Sensor.

B. Wired Daylight Sensors:
1. Digital Interior Daylight Sensor:
   a. Open-loop basis for daylight sensor control scheme.
   b. Stable output over temperature from 32 degrees F to 104 degrees F.
   c. Partially shielded for accurate detection of available daylight to prevent fixture lighting and horizontal light component from skewing sensor detection.
   d. Provide linear response from 0 to 500 footcandles.
2. Daylight Control Package:
   a. Product:
      1) Controller:
         (a) Product:
            (1) Nexlight:
            (2) Wattstopper, LMLS-500, Multi-zone, switching and dimming open loop Photosensor.

C. Partition Sensors:
1. Products:
   a. Nexlight:
   b. Wattstopper:
      1) LMPS-104 series.
2. Provide contact closure based on status of the partition wall (open/close) enabling automatic linking of controls.

2.08 SOURCE QUALITY CONTROL

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

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.
B. Verify that ratings and configurations of system components are consistent with the indicated requirements.
C. Verify that mounting surfaces are ready to receive system components.
D. Verify that conditions are satisfactory for installation prior to starting work.

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3.02 INSTALLATION

A. Perform work in a neat and workmanlike manner in accordance with NECA 1 and, where applicable, NECA 130, except for mounting heights specified in those standards.

B. Install products in accordance with manufacturer's instructions.

C. Define each dimmer/relay load type, assign each load to a zone, and set control functions.

D. Sensor Locations:
   1. Sensor locations indicated are diagrammatic. Within the design intent, reasonably minor adjustments to locations may be made in order to optimize coverage and avoid conflicts or problems affecting coverage, in accordance with manufacturer's recommendations.

E. Mount exterior daylight sensors to point due north with constant view of daylight.

F. Ensure that daylight sensor placement minimizes sensor view of electric light sources. Locate ceiling-mounted and luminaire-mounted daylight sensors to avoid direct view of luminaires.

G. LED Light Engine/Array Lead Length: Do not exceed 100 feet.

H. Identify system components in accordance with Section 260553.

3.03 FIELD QUALITY CONTROL

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

B. Manufacturer's Startup Services:
   1. Manufacturer's authorized Service Representative to conduct minimum of two site visits to ensure proper system installation and operation.
   2. Conduct Pre-Installation visit to review requirements with installer as specified in Part 1 under "Administrative Requirements".
   3. Conduct second site visit upon completion of lighting control system to perform system startup and verify proper operation:
      a. Verify connection of power wiring and load circuits.
      b. Verify connection and location of controls.
      c. Verify system operation control by control.
      d. Verify proper operation of manufacturer's interfacing equipment.
      e. Configure initial groupings of ballast for wall controls, daylight sensors and occupancy sensors.
      f. Provide initial rough calibration of sensors; fine-tuning of sensors is responsibility of Contractor unless provided by Lighting Control Manufacturer as part of Sensor Layout and Tuning service where specified in Part 2 under "LIGHTING CONTROL SYSTEM - GENERAL REQUIREMENTS".
      g. Train Owner's representative on system capabilities, operation, and maintenance, as specified in Part 3 under "Closeout Activities".
      h. Obtain sign-off on system functions.
   4. Correct defective work, adjust for proper operation, and retest until entire system complies with contract documents.

3.04 ADJUSTING

A. Sensor Fine-Tuning: Where Lighting Control Manufacturer Sensor Layout and Tuning service is specified in Part 2 under "LIGHTING CONTROL SYSTEM - GENERAL REQUIREMENTS", Lighting Control Manufacturer to provide up to two additional post-startup on-site service visits for fine-tuning of sensor calibration. Where Lighting Control Manufacturer Sensor Layout and Tuning service is not specified, Contractor to provide fine-tuning of sensor calibration.

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3.05 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

B. Clean cabinets of all construction debris, dust and other such materials, prior to installation of lighting control equipment.

3.06 COMMISSIONING

A. See Section 019113 - General Commissioning Requirements, for electrical commissioning requirements.

3.07 CLOSEOUT ACTIVITIES

A. See Section 017800 - Closeout Submittals, for closeout submittals.

B. See Section 017900 - Demonstration and Training, for additional requirements.

C. Submittal:
   1. Provide Owner with a system diagram, including locations of devices.
   2. Provide programming settings of system installed.

D. Demonstration:

E. Training:
   1. Include services of manufacturer's authorized Service Representative to perform on-site training of Owner's personnel on operation, adjustment, and maintenance of lighting control system as part of standard system start-up services.

3.08 PROTECTION

A. Protect installed products from subsequent construction operations.

3.09 MAINTENANCE

A. See Section 017000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.

END OF SECTION

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SECTION 262416
PANELBOARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Power distribution panelboards.

B. Lighting and appliance panelboards.

C. Overcurrent protective devices for panelboards.

1.02 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Concrete equipment pads.

B. **Section 260519 - Low-Voltage Electrical Power Conductors and Cables.**

C. Section 260526 - Grounding and Bonding for Electrical Systems.

D. Section 260529 - Hangers and Supports for Electrical Systems.

E. Section 260548 - Vibration and Seismic Controls for Electrical Systems.

F. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

G. Section 260573 - Power System Studies: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.

H. Section 262200 - Low-Voltage Transformers: Small power centers with integral primary breaker, transformer, and panelboard.

I. Section 262713 - Electricity Metering: For interface with equipment specified in this section.

J. Section 264300 - Surge Protective Devices.

1.03 REFERENCE STANDARDS

A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; Revision E with Supplement 1, 2013.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

C. NECA 407 - Standard for Installing and Maintaining Panelboards; 2015.

D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.

E. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2000, with Errata (2008).

F. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013.

G. NEMA PB 1 - Panelboards; 2011.

H. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less; 2013.

I. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.

J. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

K. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

L. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.

M. UL 67 - Panelboards; Current Edition, Including All Revisions.

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N. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.

O. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.

P. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

Q. UL 1053 - Ground-Fault Sensing and Relaying Equipment; Current Edition, Including All Revisions.

R. UL 1699 - Arc-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
   2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted panelboards where indicated.
   4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
   5. Notify Architect and Owner's construction representative of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.
   1. Include characteristic trip curves for each type and rating of overcurrent protective device.

C. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
   1. Include dimensioned plan and elevation views of panelboards and adjacent equipment with all required clearances indicated.
   2. Include wiring diagrams showing all factory and field connections.
   3. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
   4. Include documentation of listed series ratings.

D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

E. Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.

F. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.
   2. Panelboard Keys: Two of each different key.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

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B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions and NECA 407.

B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

A. Maintain ambient temperature within the following limits during and after installation of panelboards:
   1. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Schneider Electric; Square D Products: www.schneider-electric.us

B. Siemens Industry, Inc: www.usa.siemens.com

C. Source Limitations: Furnish panelboards and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.02 PANELBOARDS - GENERAL REQUIREMENTS

A. Provide products listed, classified, and labeled as suitable for the purpose intended.

B. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
   1. Altitude: Less than 6,600 feet.
   2. Ambient Temperature:
      a. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.

C. Short Circuit Current Rating:
   1. Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location as determined by short circuit study performed in accordance with Section 260573.
   2. Listed series ratings are acceptable only where specifically indicated.
   3. Label equipment utilizing series ratings as required by NFPA 70.

D. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.

E. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.

F. Bussing: Sized in accordance with UL 67 temperature rise requirements.
   1. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
   2. Provide 200 percent rated neutral bus and lugs where indicated, where oversized neutral conductors are provided, or where panelboards are fed from K-rated transformers.
   3. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.

G. Conductor Connectors for Terminations: Suitable for use with the conductors to be installed.

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1. **Copper Conductors Size 8 AWG and Larger: Use mechanical or compression connectors where connections are required.**
2. **Aluminum Conductors: Use compression terminals for all connections.**

H. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
   a. Indoor Clean, Dry Locations: Type 1.
   b. Outdoor Locations: Type 3R.
   c. Hazardous locations, enclosure as specified.
2. Boxes: Galvanized steel unless otherwise indicated.
   a. Provide wiring gutters sized to accommodate the conductors to be installed.
   b. Increase gutter space as required where sub-feed lugs, feed-through lugs, gutter taps, or oversized lugs are provided.
3. Fronts:
   a. Fronts for Surface-Mounted Enclosures: Same dimensions as boxes.
   b. Fronts for Flush-Mounted Enclosures: Overlap boxes on all sides to conceal rough opening.
   c. Finish for Painted Steel Fronts: Manufacturer's standard grey unless otherwise indicated.
4. Lockable Doors: All locks keyed alike unless otherwise indicated.

I. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.

J. Surge Protective Devices: Where externally mounted surge protective devices are provided in accordance with Section 264300, list and label panelboards as a complete assembly including surge protective device.

K. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.
1. Where electronic circuit breakers equipped with integral ground fault protection are used, provide separate neutral current sensor where applicable.
2. Where accessory ground fault sensing and relaying equipment is used, equip companion overcurrent protective devices with ground-fault shunt trips.
   a. Use zero sequence ground fault detection method unless otherwise indicated.
   b. Provide field-adjustable ground fault pick-up and delay settings.

L. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.

M. Multi-Section Panelboards: Provide enclosures of the same height, with feed-through lugs or sub-feed lugs and feeders as indicated or as required to interconnect sections.

N. Provide the following features and accessories where indicated or where required to complete installation:
1. Feed-through lugs.
2. Sub-feed lugs.

2.03 POWER DISTRIBUTION PANELBOARDS

A. Description: Panelboards complying with NEMA PB 1, power and feeder distribution type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.

B. Conductor Terminations:
1. Main and Neutral Lug Material: Copper or aluminum, listed for terminating copper or aluminum conductors.

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2. Main and Neutral Lug Type:
   a. **Provide mechanical or compression lugs for copper conductors.**
   b. **Provide compression lugs for aluminum conductors.**

C. Bussing:
1. Phase and Neutral Bus Material: Aluminum or copper.
2. Ground Bus Material: Aluminum or copper.

D. Circuit Breakers:
1. Provide bolt-on type, unless indicated otherwise.
2. Provide thermal magnetic circuit breakers unless otherwise indicated.
3. Provide electronic trip circuit breakers where indicated.
4. Mechanical restraints indicated or required.

E. Enclosures:
1. Provide flush-mounted enclosures in public areas. Provide surface-mounted enclosures in non-public areas.
2. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
3. Provide clear plastic circuit directory holder mounted on inside of door.

2.04 LIGHTING AND APPLIANCE PANELBOARDS

A. Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.

B. Conductor Terminations:
1. Main and Neutral Lug Material: Copper or aluminum, listed for terminating with copper or aluminum conductors.
2. Main and Neutral Lug Type:
   a. **Provide mechanical or compression lugs for copper conductors.**
   b. **Provide compression lugs for aluminum conductors.**

C. Bussing:
1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
2. Phase and Neutral Bus Material: Aluminum or copper.
3. Ground Bus Material: Aluminum.

D. Circuit Breakers: Thermal magnetic bolt-on type unless otherwise indicated.

E. Enclosures:
1. Provide flush-mounted enclosures in public areas. Provide surface-mounted enclosures in non-public areas.
2. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
3. Provide clear plastic circuit directory holder mounted on inside of door.

2.05 OVERCURRENT PROTECTIVE DEVICES

A. Molded Case Circuit Breakers:
1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
2. Interrupting Capacity:

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a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
   1) 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.
   2) 14,000 rms symmetrical amperes at 480 VAC.
b. Series Rated Systems: Provide circuit breakers listed in combination with upstream devices to provide interrupting rating not less than the short circuit current rating indicated.

3. Conductor Terminations:
   a. **Provide mechanical or compression lugs for copper conductors.**
   b. **Provide compression lugs for aluminum conductors.**
4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
   a. Provide field-adjustable magnetic instantaneous trip setting for circuit breaker frame sizes 250 amperes and larger.
   b. Provide interchangeable trip units where indicated.
5. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.
   a. Provide the following field-adjustable trip response settings:
      1) Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.
      2) Long time delay, as indicated.
      3) Short time pickup and delay, as indicated.
      4) Instantaneous pickup, as indicated.
      5) Ground fault pickup and delay where ground fault protection is indicated.
6. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
7. Provide the following circuit breaker types where indicated:
   a. Ground Fault Circuit Interrupter (GFCI) Circuit Breakers: Listed as complying with UL 943, class A for protection of personnel.
   b. Ground Fault Equipment Protection Circuit Breakers: Designed to trip at 30 mA for protection of equipment.
   c. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Combination type listed as complying with UL 1699.
   d. 100 Percent Rated Circuit Breakers: Listed for application within the panelboard where installed at 100 percent of the continuous current rating. Installed where indicated on the drawings.
8. Provide listed switching duty rated circuit breakers with SWD marking where used for switching loads.
9. Do not use tandem circuit breakers.
10. Do not use handle ties in lieu of multi-pole circuit breakers.
11. Provide multi-pole circuit breakers for multi-wire branch circuits as required by NFPA 70.
12. Provide the following features and accessories where indicated or where required to complete installation:
    a. Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
    b. Handle Pad-Lock Provision: For locking circuit breaker handle in OFF position.

2.06 SOURCE QUALITY CONTROL

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

B. Factory test panelboards according to NEMA PB 1.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

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B. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive panelboards.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).

B. Install products in accordance with manufacturer's instructions.

C. Install panelboards in accordance with NECA 407 and NEMA PB 1.1.

D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

E. Provide required supports in accordance with Section 260529.

F. Provide required seismic controls in accordance with Section 260548.

G. Install panelboards plumb.

H. Install flush-mounted panelboards so that trims fit completely flush to wall with no gaps and rough opening completely covered.

I. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches above the floor or working platform.

J. Mount floor-mounted power distribution panelboards on properly sized 4 inch high concrete pad constructed in accordance with Section 033000.

K. For flush-mounted panelboards, provide six spare 1 inch trade size conduits, into accessible space above ceiling and below floor. Install spare 3/4 inch trade size conduits, into accessible space above and below floor, for all remaining available panel entry space.

L. Provide grounding and bonding in accordance with Section 260526.
   1. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on isolated/insulated ground bus.

M. Install all field-installed branch devices, components, and accessories.

N. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.

O. Multi-Wire Branch Circuits: Group grounded and ungrounded conductors together in the panelboard as required by NFPA 70.

P. Set field-adjustable circuit breaker tripping function settings as determined by overcurrent protective device coordination study performed according to Section 260573.

Q. Set field-adjustable ground fault protection pickup and time delay settings as indicated.

R. Provide filler plates to cover unused spaces in panelboards.

S. Provide circuit breaker lock-on devices to prevent unauthorized personnel from de-energizing essential loads where indicated. Also provide for the following:
   1. Fire detection and alarm circuits.
   2. Intrusion detection and access control system circuits.

T. Identify panelboards in accordance with Section 260553.

3.03 FIELD QUALITY CONTROL

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

B. Inspect and test in accordance with NETA ATS, except Section 4.

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C. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers and circuit breakers larger than 350 amperes. Tests listed as optional are not required.

D. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.
   1. Perform inspections and tests listed in NETA ATS, Section 7.14. The insulation-resistance test on control wiring listed as optional is not required.

E. Test GFCI circuit breakers to verify proper operation.

F. Test AFCI circuit breakers to verify proper operation.

G. Test shunt trips to verify proper operation.

H. Correct deficiencies and replace damaged or defective panelboards or associated components.

3.04 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

B. Adjust alignment of panelboard fronts.

C. Load Balancing: For each panelboard, rearrange circuits such that the difference between each measured steady state phase load does not exceed 20 percent and adjust circuit directories accordingly. Maintain proper phasing for multi-wire branch circuits.

3.05 CLEANING

A. Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

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SECTION 262513
LOW-VOLTAGE BUSWAYS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Feeder busway.

B. Plug-in busway.

C. Plug-in units for plug-in busway.

1.02 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Concrete curbs for busway floor penetrations.

B. Section 078400 - Firestopping.

C. Section 260526 - Grounding and Bonding for Electrical Systems.

D. Section 260529 - Hangers and Supports for Electrical Systems.

E. Section 260548 - Vibration and Seismic Controls for Electrical Systems.
   1. Includes additional criteria for the seismic qualification of equipment specified in this section.

F. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

G. Section 260573 - Power System Studies: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.

H. Section 262100 - Low-Voltage Electrical Service Entrance.

I. Section 262813 - Fuses.
   1. Includes requirements for spare fuses.

J. Section 264300 - Surge Protective Devices: Requirements for surge protective device plug-in units for plug-in busway.

1.03 REFERENCE STANDARDS

A. IEC 60529 - Degrees of Protection Provided by Enclosures (IP Code); 2013-08, with 2015 Corrigendum.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

C. NECA 408 - Standard for Installing and Maintaining Busways; 2015.

D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.

E. NEMA BU 1.1 - General Instructions for Handling, Installation, Operation, and Maintenance of Busway Rated 600 Volts or Less; 2010.

F. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013.

G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.

I. UL 857 - Busways; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the arrangement of busway with structural members, ductwork, piping, equipment and other potential conflicts installed under other sections or by others. Coordinate the work with other trades to avoid installation of obstructions within busway required clearances.

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2. Coordinate arrangement of busway with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate the work with placement of supports, anchors, etc. required for mounting.
4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
5. Where busway extends through roof, coordinate the work with other trades to provide roof penetrations that preserve the integrity of the roofing system and do not void the roof warranty.
6. Notify Architect and Owner's Project Coordinator, of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

B. Preinstallation Meeting: Convene one week prior to performing field measurements for busway fabrication drawings; require attendance of all affected installers. Review proposed routing, sequence of installation, and protection requirements for installed busway.

C. Sequencing:
1. Perform field measurements prior to busway fabrication. Where necessary, perform field measurement for custom lengths after installation of adjacent sections.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for busway system components and accessories. Include dimensions, weight, materials, fabrication details, finishes, and service condition requirements. Indicate voltage and current ratings, short circuit current ratings, configurations, and installed features and accessories.
1. Include busway resistance, reactance, and impedance data and voltage drop ratings.
2. Include characteristic trip curves for each type and rating of circuit breaker plug-in device upon request.
3. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
4. Include documentation of listed series ratings.

C. Shop Drawings: Include dimensioned plan views and sections indicating proposed busway routing, required clearances, and locations and details of supports, fittings, building element penetrations, and equipment connections.

D. Where roof penetrations are provided, certify that work does not void roof warranty.

E. Field Quality Control Test Reports.

F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

G. Project Record Documents: Record actual routing of busway.
1. Include actual installed locations of plug-in units.

H. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 016000 - Product Requirements, for additional provisions.
2. See Section 262813 for requirements for spare fuses and spare fuse cabinets.
3. Hook Stick(s) for Plug-In Units With Hook Stick Operable Handles: One, with length as required for suitable operation of plug-in unit handle from floor or working platform.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

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B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store busway in accordance with manufacturer's instructions, NECA 408, and NEMA BU 1.1.

B. Store products indoors in a clean, dry space having a uniform temperature to prevent condensation (including outdoor busway, which is not weatherproof until completely and properly installed). Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle products carefully to avoid damage to internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

A. Maintain field conditions within required service conditions during and after installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Busway System - Other Acceptable Manufacturers:
   1. Schneider Electric; Square D Products: www.schneider-electric.us
   2. Siemens Industry, Inc: www.usa.siemens.com

B. Source Limitations: Furnish busway system and associated components and accessories produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.02 BUSWAY SYSTEM

A. Provide new busway system consisting of all required components, fittings, devices, supports, accessories, etc. as necessary for a complete operating system.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Description: Prefabricated sectionalized enclosed bus assemblies and associated fittings and devices; listed and labeled as complying with UL 857.

D. Busway General Requirements:
   1. Busway Type: Totally enclosed, non-ventilated; suitable for installation in any mounting orientation the busway is designed for (e.g horizontal flatwise, horizontal edgewise, vertical) without derating.
   2. Temperature Rise: Not exceeding 55 degrees C, when operating at continuous rated current in an ambient temperature of 104 degrees F.
   3. Busbars and stabs to be suitably plated at all electrical contact points.
   4. Busbar Insulation: NEMA Class B, rated 266 degrees F.
   5. Housing: Steel or aluminum, with manufacturer's standard finish unless otherwise indicated.
   6. Provide solidly bonded equipment ground bus throughout the entire busduct system. Provide with suitable lug for terminating equipment grounding conductor.
   7. Single-Bolt Type Joints:
      a. Use torque-indicating bolts with visual indication that proper torque has been applied.
      b. Bolts to be at ground potential to allow adjustment without requiring de-energizing of busway.
      c. Designed such that tightening of joints only requires access to one side of busway.
      d. Allows for length adjustment of plus/minus 0.125 inch.

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E. Service Conditions:
   1. Provide busway system and associated components suitable for operation under the following service conditions without derating:
      a. Altitude: Less than 6,600 feet.
      b. Ambient Temperature:
         1) Busway Lengths and Fittings: Between -22 degrees F and 104 degrees F.
         2) Circuit Breaker Plug-In Units: Between 32 degrees F and 104 degrees F.
         3) Fusible Switch Plug-In Units: Between -22 degrees F and 104 degrees F.
   2. Provide busway system and associated components suitable for operation at indicated ratings under the service conditions at the installed location.

F. Short Circuit Current Rating:
   1. Provide busway system and associated components with listed short circuit current rating not less than the available fault current at the installed location as determined by short circuit study performed in accordance with Section 260573.
   2. Listed series ratings are not acceptable.

2.03 FEEDER BUSWAY

A. General Requirements:
   1. Outdoor Feeder Busway: Weatherproof, NEMA 250 Type 3R, with sealed joint covers and drain holes with removable plugs.
   2. Indoor Feeder Busway: Standard (not splash resistant), with IEC 60529 rating of IP 40.

B. Feeder Busway:
   1. Voltage: As indicated on the drawings.
   2. Ampere Rating: As indicated on the drawings.
   3. Configuration: As indicated on the drawings.
   4. Busbar Material: Copper or aluminum.

2.04 PLUG-IN BUSWAY

A. General Requirements:
   1. Provide cover at each unused plug-in opening.
   2. Provide means for mechanical support and alignment of plug-in units.
   3. IEC 60529 Protection Rating: Standard (not splash resistant), with rating of IP 40.

B. Plug-In Busway:
   1. Voltage: As indicated on the drawings.
   2. Ampere Rating: As indicated on the drawings.
   3. Configuration: As indicated on the drawings.
   4. Busbar Material: Copper or aluminum.
   5. Plug-In Opening Spacing: Whereas indicated on the drawings..

2.05 PLUG-IN UNITS FOR PLUG-IN BUSWAY

A. Description: Plug-in units suitable for use with installed busway; types, ratings, configurations, and features as indicated on the drawings.

B. General Requirements:
   1. Designed to make positive ground connection prior to phase/neutral connections when installed.
   2. Where splash resistant busway is specified, provide splash resistant plug-in units with minimum IEC 60529 rating of IP 54 unless otherwise indicated.

C. Circuit Breaker Plug-In Units:
   1. Provide hook stick operable handle with means for locking in the OFF position.

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2. Provide safety interlock to prevent opening the cover with the unit in the ON position with capability of overriding interlock for testing purposes.
3. Provide mechanical interlock for plug-in units up to 250 A to prevent installation or removal with the unit in the ON position.
4. Conductor Terminations: Suitable for use with the conductors to be installed.
5. Provide insulated 100 percent capacity solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.
6. Provide solidly bonded equipment ground bus with suitable lug for terminating equipment grounding conductor.
7. Provide thermal magnetic circuit breakers unless otherwise indicated.
8. Provide electronic trip circuit breakers where indicated.
9. Provide current limiting circuit breakers where indicated.
10. Molded Case Circuit Breakers:
    a. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489.
    b. Interrupting Capacity:
        1) Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
            (a) 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.
            (b) 14,000 rms symmetrical amperes at 480 VAC.
        2) Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
    c. Conductor Terminations:
        1) Provide mechanical lugs unless otherwise indicated.
        2) Provide compression lugs where indicated.
        3) Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
    d. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
        1) Provide field-adjustable magnetic instantaneous trip setting for circuit breaker frame sizes 225 amperes and larger.
        2) Provide interchangeable trip units where indicated.
    e. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.
        1) Provide the following field-adjustable trip response settings:
            (a) Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.
            (b) Long time delay.
            (c) Short time pickup and delay.
            (d) Instantaneous pickup.
            (e) Ground fault pickup and delay where ground fault protection is indicated.
    f. Current Limiting Circuit Breakers: Without using fusible elements, designed to limit the let-through energy to a value less than the energy of a one-half cycle wave of the symmetrical prospective current when operating within its current limiting range.
    g. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.

D. Fusible Switch Plug-In Units:
    1. Description: Quick-make, quick-break enclosed switch complying with NEMA KS 1 where applicable.

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2. Provide hook stick operable handle with means for locking in the OFF position.
3. Provide safety interlock to prevent opening the cover with the unit in the ON position with capability of overriding interlock for testing purposes.
4. Provide mechanical interlock for plug-in units up to 250 A to prevent installation or removal with the unit in the ON position.
5. Horsepower Rating: Suitable for connected load.
6. Minimum Short Circuit Ratings:
   a. Switches Protected by Class R, Class J, or Class T Fuses: 100,000 rms symmetrical amperes.
7. Provide with switch blade contact position that is visible when the cover is open.
8. Fuse Clips: As required to accept fuses indicated.
   a. Where NEMA Class R fuses are installed, provide rejection feature to prevent installation of fuses other than Class R.
9. Conductor Terminations: Suitable for use with the conductors to be installed.
10. Provide insulated 100 percent capacity solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.
    a. Provide 200 percent capacity neutral assembly where connected to busway with 200 percent capacity neutral.
11. Provide solidly bonded equipment ground bus with suitable lug for terminating equipment grounding conductor.
12. Conductor Terminations:
    a. Provide mechanical lugs unless otherwise indicated.
    b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.

E. Surge Protective Device Plug-In Units:
   1. Comply with Section 264300.
   2. List and label unit as a complete assembly including surge protective device.
   3. Install where indicated on the Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings of busway system components are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive busway and associated supports.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Perform insulation resistance testing on individual current-carrying busway system components prior to installation in accordance with NECA 408 and NEMA BU 1.1.

3.03 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install busway in accordance with NECA 1 (general workmanship), NECA 408, and NEMA BU 1.1.

C. Unless otherwise indicated, arrange busway to be parallel or perpendicular to building lines.

D. Arrange busway to provide required clearances and maintenance access.

E. Install busway plumb and level, with sections aligned and with horizontal runs at the proper elevation.

F. Unless otherwise indicated, orient horizontal plug-in busway with plug-in openings on sides (edgewise orientation).

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G. Maintain proper phase sequence throughout busway system, accounting for phase transitions where applicable.

H. Provide suitable expansion fittings where busway is subject to movement, including but not limited to:
   1. Where busway crosses structural joints intended for expansion.
   2. Long straight busway runs in accordance with manufacturer's instructions.

I. Provide end closures at unconnected ends of busway runs.

J. Busway Support:
   1. Use manufacturer's recommended hangers and supports, located at intervals complying with NFPA 70 and manufacturer's requirements. Provide required support and attachment components in accordance with Section 260529, where not furnished by busway manufacturer.
   2. Provide required seismic controls in accordance with Section 260548.
   3. Use suitable spring hangers for vertical riser applications where busway penetrates and is supported by building floors.
   4. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
   5. Provide sway bracing as indicated or as required to keep busway runs straight and prevent rotation and movement, accounting for unbalanced weight distribution of plug-in units where applicable.

K. Penetrations:
   1. Provide suitable flanges where busway penetrates building elements. Use weatherproof flanges for exterior wall or roof penetrations. Seal roof penetrations as indicated or as required to preserve integrity of roofing system and maintain roof warranty.
   2. Install firestopping to preserve fire resistance rating of building elements, using materials and methods specified in Section 078400.
   3. Where busway penetrates floor, provide 4 inch high concrete curb constructed in accordance with Section 033000 around openings in accordance with NFPA 70.

L. Outdoor Feeder Busway: Arrange busway to prevent water infiltration through drain holes from rain or snow. Seal joints in accordance with manufacturer's instructions and remove drain hole plugs.

M. Plug-In Units:
   1. Install plug-in units on plug-in busway in accordance with manufacturer's instructions. Provide independent supports where recommended by manufacturer.
   2. Provide fuses complying with Section 262813 for fusible switch plug-in units as indicated or as required by equipment manufacturer's recommendations.
   3. Set field-adjustable circuit breaker tripping function settings as determined by overcurrent protective device coordination study performed in accordance with Section 260573.
   4. Unless otherwise indicated, final connections from plug-in units to loads to be provided by Contractor.

N. Provide grounding and bonding in accordance with Section 260526.
   1. Where integral housing ground is utilized, verify joint covers and other components required for continuity are properly installed.

O. Identify busway in accordance with Section 260553.

3.04 FIELD QUALITY CONTROL

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

B. Provide services of a manufacturer's authorized representative to observe installation and assist in inspection and testing. Include manufacturer's reports with submittals.

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C. Electrically isolate busway system before energizing and perform insulation resistance testing in accordance with NECA 408 and NEMA BU 1.1.
   1. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.

D. Perform infrared scanning of energized busway system under maximum load conditions in accordance with NECA 408.

E. Correct deficiencies and replace damaged or defective busway system components.

F. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.05 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

B. Adjust supports as required to minimize strain on busway and associated components.

3.06 CLEANING

A. Clean dirt and debris from busway enclosure and components in accordance with manufacturer's instructions. Do not use compressed air or a blower in order to prevent debris infiltration.

B. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.07 CLOSEOUT ACTIVITIES

A. See Section 017800 - Closeout Submittals, for closeout submittals.

B. See Section 017900 - Demonstration and Training, for additional requirements.

C. Training: Train Owner's personnel on operation, adjustment, and maintenance of system.
   1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.

3.08 PROTECTION

A. Protect busway system from subsequent construction operations.

END OF SECTION

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SECTION 262725
WIRING DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall switches.

B. Receptacles.

C. Wall plates.

D. Poke-through assemblies.

1.02 RELATED REQUIREMENTS

A. Section 096900 - Access Flooring.

B. Section 260519 - Low-Voltage Electrical Power Conductors and Cables: Manufactured wiring systems for use with access floor boxes with compatible pre-wired connectors.

C. Section 260526 - Grounding and Bonding for Electrical Systems.

D. Section 260533.16 - Boxes for Electrical Systems.

E. Section 260533.23 - Surface Raceways for Electrical Systems: Surface raceway systems, including multioutlet assemblies.

F. Section 260539 - Underfloor Raceways for Electrical Systems.

G. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

H. Section 260583 - Wiring Connections: Cords and plugs for equipment.

I. Section 260923 - Lighting Control Devices: Devices for automatic control of lighting, including occupancy sensors.

J. Section 260936 - Modular Lighting Control Systems: Lighting controls, to match accessory receptacles and wallplates specified in this section.

K. Section 262723 - Indoor Service Poles.

L. Section 262913 - Enclosed Controllers: Manual motor starters and horsepower rated motor-starting switches without overload protection.

M. Section 271005 - Structured Cabling for Voice and Data - Inside-Plant: Voice and data jacks.

1.03 REFERENCE STANDARDS

A. FS W-C-596 - Connector, Electrical, Power, General Specification for; Revision H, 2014.

B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush-mounted (General Specification); Revision G, 2014.

C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

D. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2010.

E. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (R2015).

F. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2016.

G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. UL 20 - General-Use Snap Switches; Current Edition, Including All Revisions.

I. UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.

J. UL 514D - Cover Plates for Flush-Mounted Wiring Devices; Current Edition, Including All Revisions.

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K. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

L. UL 1310 - Class 2 Power Units; Current Edition, Including All Revisions.

M. UL 1449 - Standard for Surge Protective Devices; Current Edition, Including All Revisions.

N. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
   2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.
   3. Coordinate the placement of outlet boxes for wall switches with actual installed door swings.
   4. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.
   5. Coordinate the core drilling of holes for poke-through assemblies with the work covered under other sections.
   6. Notify Architect and Owner's project coordinator, of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

B. Sequencing:
   1. Do not install wiring devices until final surface finishes and painting are complete.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.
   1. Surge Protection Receptacles: Include surge current rating, voltage protection rating (VPR) for each protection mode, and diagnostics information.

C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

D. Operation and Maintenance Data:
   1. GFCI Receptacles: Include information on status indicators.
   2. Surge Protection Receptacles: Include information on status indicators.

E. Project Record Documents: Record actual installed locations of wiring devices.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.
   2. Screwdrivers for Tamper-Resistant Screws: Two for each type of screw.
   3. Extra Keys for Locking Switches: Two of each type.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Products: Listed, classified, and labeled as suitable for the purpose intended.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

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1.07 DELIVERY, STORAGE, AND PROTECTION

A. Store in a clean, dry space in original manufacturer's packaging until ready for installation.

PART 2 PRODUCTS

2.01 WIRING DEVICE APPLICATIONS

A. Provide wiring devices suitable for intended use and with ratings adequate for load served.

B. For single receptacles installed on an individual branch circuit, provide receptacle with ampere rating not less than that of the branch circuit.

C. Provide weather resistant GFCI receptacles with specified weatherproof covers for receptacles installed outdoors or in damp or wet locations.

D. Provide tamper resistant receptacles for receptacles installed in dwelling units and children areas.

E. Provide GFCI protection for receptacles installed within 6 feet of sinks.

F. Provide GFCI protection for receptacles installed in kitchens.

G. Provide GFCI protection for receptacles serving electric drinking fountains.

H. Unless noted otherwise, do not use combination switch/receptacle devices.

2.02 WIRING DEVICE FINISHES

A. Provide wiring device finishes as described below unless otherwise indicated.

B. Wiring Devices, Unless Otherwise Indicated: Gray with stainless steel wall plate.

C. Wiring Devices Installed in Finished Spaces: Gray with stainless steel wall plate.

D. Wiring Devices Installed in Unfinished Spaces: Gray with galvanized steel wall plate.

E. Wiring Devices Installed in Wet or Damp Locations: Gray with specified weatherproof cover.

F. Wiring Devices Installed in ceilings: White with stainless steel wall plate, except for surge protection receptacles.

G. Isolated Ground Convenience Receptacles: Orange with a stainless steel cover plate.

H. Surge Protection Receptacles: Blue with a stainless steel cover plate.

I. Wiring Devices Connected to Emergency Power: Red with wall plate as specified for wiring devices connected to normal power, but engraved "Emergency".

J. Clock Hanger Receptacles: Gray with stainless steel wall plate.

2.03 WALL SWITCHES

A. Manufacturers:
   1. Hubbell Incorporated; _____: www.hubbell.com
   2. Leviton Manufacturing Company, Inc; _____: www.leviton.com
   3. Pass & Seymour, a brand of Legrand North America, Inc; _____: www.legrand.us

B. Wall Switches - General Requirements: AC only, quiet operating, extra heavy duty industrial grade, switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20 and where applicable, FS W-S-896; types as indicated on the drawings.
   1. Wiring Provisions: Terminal screw actuated binding clamp for back and side wiring with separate ground terminal screw.

C. Standard Wall Switches: Industrial specification grade, 20 A, 120/277 V with standard toggle type switch actuator and maintained contacts; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.
   1. Products:
      a. Hubbell,

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b. Leviton,
c. Pass & Seymour,

D. Lighted Wall Switches: Industrial specification grade, 20 A, 120/277 V with clear illuminated standard toggle type switch actuator and maintained contacts; illuminated with load off; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.
1. Products:
a. Hubbell,
b. Leviton,
c. Pass & Seymour,

E. Pilot Light Wall Switches: Industrial specification grade, 20 A, 120/277 V with clear illuminated standard toggle type switch actuator and maintained contacts; illuminated with load on; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.
1. Products:
a. Hubbell,
b. Leviton,
c. Pass & Seymour,
d. _____.

F. Locking Wall Switches: Industrial specification grade, 20 A, 120/277 V with lever type keyed switch actuator and maintained contacts; switches keyed alike; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.
1. Products:
a. Hubbell,
b. Leviton,
c. Pass & Seymour,

G. Momentary Contact Wall Switches: Industrial specification grade, 20 A, 120/277 V with toggle type three position switch actuator and momentary contacts; single pole double throw, off with switch actuator in center position.
1. Products:
a. Hubbell,
b. Leviton,
c. Pass & Seymour,

H. Locking Momentary Contact Wall Switches: Industrial specification grade, 20 A, 120/277 V with lever type keyed three position switch actuator and momentary contacts; switches keyed alike; single pole double throw, off with switch actuator in center position.
1. Products:
a. Hubbell,
b. Leviton,
c. Pass & Seymour,

2.04 RECEPTACLES

A. Manufacturers:
1. Hubbell Incorporated; _____: www.hubbell.com
2. Leviton Manufacturing Company, Inc; _____: www.leviton.com
3. Pass & Seymour, a brand of Legrand North America, Inc; _____: www.legrand.us
4. Source Limitations: Where wall controls are furnished as part of lighting control system, provide accessory matching receptacles and wallplates by the same manufacturer in locations indicated.

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B. Receptacles - General Requirements: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498, and where applicable, FS W-C-596; types as indicated on the drawings.
   1. Wiring Provisions: Terminal screw actuated binding clamp for back wiring with separate ground terminal screw.
   2. NEMA configurations specified are according to NEMA WD 6.
   3. Hospital Grade Receptacles: Listed as complying with UL 498 Supplement SD, with green dot hospital grade mark on device face.

C. Convenience Receptacles:
   1. Standard Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.
      a. Products:
         1) Hubbell,
         2) Leviton,
         3) Pass & Seymour,
   2. Automatically Controlled Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R; controlled receptacle marking on device face per NFPA 70; single or duplex as indicated on the drawings.
      a. Products:
         1) Hubbell,
         2) Leviton,
         3) Pass & Seymour,
   3. Isolated Ground Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, with ground contacts isolated from mounting strap; isolated ground triangle mark on device face; single or duplex as indicated on the drawings.
      a. Products:
         1) Hubbell,
         2) Leviton,
         3) Pass & Seymour,
   4. Weather Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.
      a. Products:
         1) Hubbell,
         2) Leviton,
         3) Pass & Seymour,
   5. Tamper Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type; single or duplex as indicated on the drawings.
      a. Products:
         1) Hubbell,
         2) Leviton,
         3) Pass & Seymour,
         4) _____.
   6. Tamper Resistant and Weather Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type and as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.
      a. Products:
         1) Hubbell,

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2) Leviton,
3) Pass & Seymour,

D. GFCI Receptacles:
1. GFCI Receptacles - General Requirements: Self-testing, with feed-through protection and light to indicate ground fault tripped condition and loss of protection; listed as complying with UL 943, class A.
   a. Provide test and reset buttons of same color as device.
2. Standard GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style.
   a. Products:
      1) Hubbell,
      2) Leviton,
      3) Pass & Seymour,
3. Weather Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations.
   a. Products:
      1) Hubbell,
      2) Leviton,
      3) Pass & Seymour,
      4) _____.
      5) _____.
4. Tamper Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type.
   a. Products:
      1) Hubbell,
      2) Leviton,
      3) Pass & Seymour,
5. Tamper Resistant and Weather Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type and as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations.
   a. Products:
      1) Hubbell,
      2) Leviton,
      3) Pass & Seymour,

E. USB Charging Devices:
1. USB Charging Devices - General Requirements: Listed as complying with UL 1310.
   a. Charging Capacity - Two-Port Devices: 2.1 A, minimum.
   b. Charging Capacity - Four-Port Devices: 4.2 A, minimum.
2. USB Charging/Tamper Resistant Receptacle Combination Devices: Two-port (Type A) USB charging device and receptacle, commercial specification grade, duplex, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type; rectangular decorator style.
   a. Products:
      1) Hubbell,
      2) Leviton,
      3) Pass & Seymour,
3. USB Charging Noncombination Devices: Four-port (Type A); rectangular decorator style.
   a. Products:

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1) Hubbell,
2) Leviton,
3) Pass & Seymour,
4) _____.

F. Surge Protection Receptacles:
1. Surge Protection Receptacles - General Requirements: Listed and labeled as complying with UL 1449, Type 2 or 3.
a. Energy Dissipation: Not less than 240 J per mode.
b. Protected Modes: L-N, L-G, N-G.
c. UL 1449 Voltage Protection Rating (VPR): Not more than 700 V for L-N, L-G modes and 1200 V for N-G mode.
d. Diagnostics:
1) Visual Notification: Provide indicator light to report functional status of surge protection.
2. Standard Surge Protection Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style.
a. Products:
1) Hubbell,
2) Leviton,
3) Pass & Seymour,

G. Clock Hanger Receptacles: See Section 275313 for additional information.

2.05 WALL PLATES

A. Manufacturers:
1. Hubbell Incorporated; _____: www.hubbell-wiring.com
2. Leviton Manufacturing Company, Inc; _____: www.leviton.com
3. Pass & Seymour, a brand of Legrand North America, Inc; _____: www.legrand.us
4. Source Limitations: Where wall controls are furnished as part of lighting control system, provide accessory matching receptacles and wallplates by the same manufacturer in locations indicated.

B. Wall Plates: Comply with UL 514D.
1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.
2. Size: Standard; _____.
3. Screws: Metal with slotted heads finished to match wall plate finish.

C. Stainless Steel Wall Plates: Brushed satin finish, 0.032 inch thick, Type 302/304 stainless steel.

D. Galvanized Steel Wall Plates: Rounded corners and edges, with corrosion resistant screws.

E. Weatherproof Covers for Damp Locations: Gasketed, cast aluminum, with self-closing hinged cover and corrosion-resistant screws; listed as suitable for use in wet locations with cover closed.

F. Weatherproof Covers for Wet Locations: Gasketed, cast aluminum, with hinged lockable cover and corrosion-resistant screws; listed as suitable for use in wet locations while in use with attachment plugs connected and identified as extra-duty type.

2.06 FLOOR BOX SERVICE FITTINGS

A. Manufacturers:
1. Hubbell Incorporated; _____: www.hubbell.com
2. Thomas & Betts Corporation; _____: www.tnb.com
3. Wiremold, a brand of Legrand North America, Inc; _____: www.legrand.us

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B. Description: Service fittings compatible with floor boxes provided under Section 260533.16 with components, adapters, and trims required for complete installation.

C. Above-Floor Service Fittings:
   1. Coverplate configuration as shown on the drawings.
   2. Single Service Pedestal Furniture Feed:
   3. Dual Service Pedestal Combination Outlets:
      a. Provide barrier to separate line and low voltage compartments.

D. Flush Floor Service Fittings:
   1. Single Service Flush Convenience Receptacles:
      a. Cover: Round.
      b. Configuration: One standard convenience duplex receptacle(s) with duplex flap opening(s).
   2. Single Service Flush Communications Outlets:
      a. Cover: Round.
      b. Configuration: As shown on the drawings.
      c. Voice and Data Jacks: As specified in Section 271005.
   3. Single Service Flush Furniture Feed:
      a. Cover: Round.
      b. Configuration: One 2-1/8 inch by 3/4 inch combination threaded opening(s).
   4. Dual Service Flush Combination Outlets:
      a. Cover: Round.
      b. Configuration:
         1) Power: One standard convenience duplex receptacle(s) with duplex flap opening(s).
         2) Voice and Data Jacks: As specified in Section 271005.
   5. Dual Service Flush Furniture Feed:
      a. Cover: Round.
      b. Configuration:
         1) Power: One 2-1/8 inch by 3/4 inch combination threaded opening(s).
         2) Communications: One 2-1/8 inch by 1 inch combination threaded opening(s).
   6. Accessories:
      a. Tile Rings: Finish to match covers; configuration as required to accommodate specified covers.
      b. Carpet Flanges: Finish to match covers; configuration as required to accommodate specified covers.

2.07 POKE-THROUGH ASSEMBLIES

A. Manufacturers:
   1. Hubbell Incorporated; _____: www.hubbell.com
   2. Thomas & Betts Corporation; _____: www.tnb.com
   3. Wiremold, a brand of Legrand North America, Inc; _____: www.legrand.us
   4. Substitutions: See Section 016000 - Product Requirements.

B. Description: Assembly comprising floor service fitting, poke-through component, fire stops and smoke barriers, and junction box for conduit termination; fire rating listed to match fire rating of floor and suitable for floor thickness where installed.

C. Above-Floor Service Fittings:
   1. Single Service Pedestal Convenience Receptacles:
      a. Configuration: One standard convenience duplex receptacle.
   2. Single Service Pedestal Communications Outlets:
      a. Configuration: One 1 inch bushed opening.
      b. Voice and Data Jacks: As specified in Section 271005.

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3. Single Service Pedestal Furniture Feed:
   a. Configuration: One 3/4 inch knockout.
4. Dual Service Pedestal Combination Outlets:
   a. Configuration:
      1) Power: One standard convenience duplex receptacle.
      2) Communications: One 1 inch bushed opening.
      3) Voice and Data Jacks: As specified in Section 271005.
   b. Provide barrier to separate line and low voltage compartments.

D. Flush Floor Service Fittings:
1. Single Service Flush Convenience Receptacles:
   a. Configuration: One standard convenience duplex receptacle(s) with duplex flap opening(s).
2. Single Service Flush Communications Outlets:
   a. Configuration: _____.
   b. Voice and Data Jacks: As specified in Section 271005.
3. Single Service Flush Furniture Feed:
   a. Configuration: One 2 inch by 1-1/4 inch combination threaded opening(s).
4. Dual Service Flush Combination Outlets:
   a. Cover: Hinged door(s).
   b. Configuration:
      1) Power: One standard convenience duplex receptacle(s).
      2) Communications: _____.
      3) Voice and Data Jacks: As specified in Section 271005.
5. Dual Service Flush Furniture Feed:
   a. Configuration:
      1) Power: One 3/4 inch threaded opening(s).
      2) Communications: One 1-1/4" threaded opening(s).
6. Accessories:
   a. Closure Plugs: Size and fire rating as required to seal unused core hole and maintain fire rating of floor.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.

C. Verify that wall openings are neatly cut and will be completely covered by wall plates.

D. Verify that final surface finishes are complete, including painting.

E. Verify that floor boxes are adjusted properly.

F. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

G. Verify that core drilled holes for poke-through assemblies are in proper locations.

H. Verify that openings in access floor are in proper locations.

I. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

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3.03 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.

B. Coordinate locations of outlet boxes provided under Section 260533.16 as required for installation of wiring devices provided under this section.
   1. Mounting Heights: Unless otherwise indicated, as follows:
      a. Wall Switches: 48 inches above finished floor.
      b. Receptacles: 18 inches above finished floor or 6 inches above counter.
      c. All box height measurements are to the top of the box.
   2. Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.
   3. Where multiple receptacles or wall switches are installed at the same location and at the same mounting height, gang devices together under a common wall plate.
   4. Locate wall switches on strike side of door with edge of wall plate 8 inches from edge of door frame. Where locations are indicated otherwise, notify Architect to obtain direction prior to proceeding with work.
   5. Locate receptacles for electric drinking fountains concealed behind drinking fountain according to manufacturer's instructions.

C. Install wiring devices in accordance with manufacturer's instructions.

D. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

E. Where required, connect wiring devices using pigtails not less than 12 inches long. Do not connect more than one conductor to wiring device terminals.

F. Connect wiring devices by inserting conductors into back of device and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.

G. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

H. For isolated ground receptacles, connect wiring device grounding terminal only to identified branch circuit isolated equipment grounding conductor. Do not connect grounding terminal to outlet box or normal branch circuit equipment grounding conductor.

I. Provide GFCI receptacles with integral GFCI protection at each location indicated. Do not use feed-through wiring to protect downstream devices.

J. Where split-wired duplex receptacles are indicated, remove tabs connecting top and bottom receptacles.

K. Install wiring devices plumb and level with mounting yoke held rigidly in place.

L. Install wall switches with OFF position down.

M. Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left.

N. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.

O. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.

P. Identify wiring devices and circuiting, in accordance with Section 260553.

Q. Install poke-through closure plugs in each unused core holes to maintain fire rating of floor.

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3.04 FIELD QUALITY CONTROL

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

B. Inspect each wiring device for damage and defects.

C. Operate each wall switch, wall dimmer, and fan speed controller with circuit energized to verify proper operation.

D. Test each receptacle to verify operation and proper polarity.

E. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.

F. Inspect each surge protection receptacle to verify surge protection is active.

G. Correct wiring deficiencies and replace damaged or defective wiring devices.

3.05 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

3.06 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION

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SECTION 262813
FUSES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fuses.

B. Spare fuse cabinet.

1.02 RELATED REQUIREMENTS

A. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

B. Section 260573 - Power System Studies: Additional criteria for the selection of protective devices specified in this section.

C. Section 262419 - Motor-Control Centers: Fusible switches.

D. Section 262513 - Low-Voltage Busways: Fusible switches.

E. Section 262816.16 - Enclosed Switches: Fusible switches.

F. Section 262913 - Enclosed Controllers: Fusible switches.

1.03 REFERENCE STANDARDS

A. NEMA FU 1 - Low Voltage Cartridge Fuses; 2012.

B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

C. UL 248-1 - Low-Voltage Fuses - Part 1: General Requirements; Current Edition, Including All Revisions.

D. UL 248-4 - Low-Voltage Fuses - Part 4: Class CC Fuses; Current Edition, Including All Revisions.

E. UL 248-8 - Low-Voltage Fuses - Part 8: Class J Fuses; Current Edition, Including All Revisions.

F. UL 248-10 - Low-Voltage Fuses - Part 10: Class L Fuses; Current Edition, Including All Revisions.

G. UL 248-12 - Low-Voltage Fuses - Part 12: Class R Fuses; Current Edition, Including All Revisions.

H. UL 248-15 - Low-Voltage Fuses - Part 15: Class T Fuses; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate fuse clips furnished in equipment provided under other sections for compatibility with indicated fuses.
   a. Fusible Switches for Motor Control Centers: See Section 262419.
   b. Fusible Switches for Busway: See Section 262513.
   c. Fusible Enclosed Switches: See Section 262816.16.
   d. Fusible Switches for Enclosed Motor Controllers: See Section 262913.
2. Coordinate fuse requirements according to manufacturer's recommendations and nameplate data for actual equipment to be installed.
3. Notify Owner's Project Coordinator and Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard data sheets including voltage and current ratings, interrupting ratings, time-current curves, and current limitation curves.

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1. Spare Fuse Cabinet: Include dimensions.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.
   2. Extra Fuses: Three set(s) of three for each type and size installed.
   3. Fuse Pullers: One set(s) compatible with each type and size installed.
   4. Spare Fuse Cabinet Keys: Two.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Bussmann, a division of Eaton Corporation; _____: www.cooperindustries.com

B. Littelfuse, Inc; _____: www.littelfuse.com

C. Mersen; _____: ep-us.mersen.com

2.02 APPLICATIONS

A. Feeders:
   1. Fusible Switches up to 600 Amperes: Class RK1, time-delay.
   2. Fusible Switches Larger Than 600 Amperes: Class L, time-delay.

B. Individual Motor Branch Circuits: Class RK1, time-delay.

C. In-Line Protection for Pole-Mounted Luminaires: Class CC, time-delay.

D. Primary Protection for Control Transformers: Class CC, time-delay.

2.03 FUSES

A. Provide products listed, classified, and labeled as suitable for the purpose intended.

B. Unless specifically indicated to be excluded, provide fuses for all fusible equipment as required for a complete operating system.

C. Provide fuses of the same type, rating, and manufacturer within the same switch.

D. Comply with UL 248-1.

E. Unless otherwise indicated, provide cartridge type fuses complying with NEMA FU 1, Class and ratings as indicated.

F. Voltage Rating: Suitable for circuit voltage.

G. Class R Fuses: Comply with UL 248-12.
   1. Class RK1, Time-Delay Fuses:
   2. Class RK1, Fast-Acting, Non-Time-Delay Fuses:
   3. Class RK5, Time-Delay Fuses:
   4. Class RK5, Fast-Acting, Non-Time-Delay Fuses:

H. Class J Fuses: Comply with UL 248-8.
   1. Class J, Time-Delay Fuses:
   2. Class J, Fast-Acting, Non-Time-Delay Fuses:

I. Class L Fuses: Comply with UL 248-10.
   1. Class L, Time-Delay Fuses:
   2. Class L, Fast-Acting, Non-Time-Delay Fuses:

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J. Class T Fuses: Comply with UL 248-15.

K. Class CC Fuses: Comply with UL 248-4.
   1. Class CC, Time-Delay Fuses:
   2. Class CC, Fast-Acting, Non-Time-Delay Fuses:

L. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.

M. Provide the following accessories where indicated or where required to complete installation:
   1. Fuseholders: Compatible with indicated fuses.
   2. Fuse Reducers: For adapting indicated fuses to permit installation in switch designed for fuses with larger ampere ratings.

2.04 SPARE FUSE CABINET

A. Description: Wall-mounted sheet metal cabinet with shelves and hinged door with cylinder lock, suitably sized to store spare fuses and fuse pullers specified.

B. Finish: Manufacturer's standard, factory applied grey finish unless otherwise indicated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that fuse ratings are consistent with circuit voltage and manufacturer's recommendations and nameplate data for equipment.

B. Verify that mounting surfaces are ready to receive spare fuse cabinet.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Do not install fuses until circuits are ready to be energized.

B. Install fuses with label oriented such that manufacturer, type, and size are easily read.

C. Install spare fuse cabinet where indicated.

D. Identify spare fuse cabinet in accordance with Section 260553.

END OF SECTION

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SECTION 262816.13

ENCLOSED CIRCUIT BREAKERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Enclosed circuit breakers.

1.02 RELATED REQUIREMENTS

A. Section 260526 - Grounding and Bonding for Electrical Systems.

B. Section 260529 - Hangers and Supports for Electrical Systems.

C. Section 260548 - Vibration and Seismic Controls for Electrical Systems.

D. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

E. Section 260573 - Power System Studies: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.

F. Section 262513 - Low-Voltage Busways: Circuit breaker busway plug-in units.

1.03 REFERENCE STANDARDS

A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; Revision E with Supplement 1, 2013.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.

D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.

E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

F. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

G. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.

H. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.

I. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.

J. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

K. UL 1053 - Ground-Fault Sensing and Relaying Equipment; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted enclosed circuit breakers where indicated.
4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.

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5. Notify Owner's Construction Project Manager and Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for circuit breakers, enclosures, and other installed components and accessories.
   1. Include characteristic trip curves for each type and rating of circuit breaker upon request.

C. Shop Drawings: Indicate outline and support point dimensions, voltage and current ratings, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
   1. Include dimensioned plan and elevation views of enclosed circuit breakers and adjacent equipment with all required clearances indicated.
   2. Include wiring diagrams showing all factory and field connections.
   3. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
   4. Include documentation of listed series ratings upon request.

D. Field Quality Control Test Reports.

E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

F. Project Record Documents: Record actual installed locations of enclosed circuit breakers.

G. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed circuit breaker internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

A. Maintain ambient temperature between 23 degrees F and 104 degrees F during and after installation of enclosed circuit breakers.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Schneider Electric; Square D Products; _____: www.schneider-electric.us

B. Siemens Industry, Inc; _____: www.usa.siemens.com

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C. Source Limitations: Furnish enclosed circuit breakers and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.02 ENCLOSED CIRCUIT BREAKERS

A. Description: Units consisting of molded case circuit breakers individually mounted in enclosures.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
   1. Altitude: Less than 6,600 feet.
   2. Ambient Temperature: Between 23 degrees F and 104 degrees F.

D. Short Circuit Current Rating:
   1. Provide enclosed circuit breakers with listed short circuit current rating not less than the available fault current at the installed location as determined by short circuit study performed in accordance with Section 260573.
   2. Label equipment utilizing series ratings as required by NFPA 70.

E. Enclosed Circuit Breakers Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.

F. Conductor Terminations: Suitable for use with the conductors to be installed.

G. Provide thermal magnetic circuit breakers unless otherwise indicated.

H. Provide electronic trip circuit breakers where indicated.

I. Provide insulated, groundable fully rated solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.

J. Provide solidly bonded equipment ground bus in each enclosed circuit breaker, with a suitable lug for terminating each equipment grounding conductor.

K. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
   1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
      a. Indoor Clean, Dry Locations: Type 1.
      b. Outdoor Locations: Type 3R.
   2. Finish for Painted Steel Enclosures: Manufacturer's standard, factory applied grey unless otherwise indicated.
   3. Provide surface-mounted enclosures unless otherwise indicated.

L. Provide externally operable handle with means for locking in the OFF position.

M. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.
   1. Where electronic circuit breakers equipped with integral ground fault protection are used, provide separate neutral current sensor where applicable.
   2. Where accessory ground fault sensing and relaying equipment is used, equip companion circuit breakers with ground-fault shunt trips.
      a. Use zero sequence ground fault detection method unless otherwise indicated.
      b. Provide test panel and field-adjustable ground fault pick-up and delay settings.
      c. Provide zone selective interlocking capability where indicated, capable of communicating with other electronic trip circuit breakers and external ground fault sensing systems to control ground fault delay functions for system coordination purposes.

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N. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.

2.03 MOLDED CASE CIRCUIT BREAKERS

A. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.

B. Interrupting Capacity:
   1. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
      a. 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.
      b. 14,000 rms symmetrical amperes at 480 VAC.
   2. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.

C. Conductor Terminations:
   1. Provide mechanical lugs unless otherwise indicated.
   2. Provide compression lugs where indicated.
   3. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.

D. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
   1. Provide field-adjustable magnetic instantaneous trip setting for circuit breaker frame sizes 225 amperes and larger.
   2. Provide interchangeable trip units where indicated.

E. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.
   1. Provide the following field-adjustable trip response settings:
      a. Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.
      b. Long time delay.
      c. Short time pickup and delay.
      d. Instantaneous pickup.
      e. Ground fault pickup and delay where ground fault protection is indicated.
   2. Provide zone selective interlocking capability where indicated, capable of communicating with other electronic trip circuit breakers and external ground fault sensing systems to control short time delay and ground fault delay functions for system coordination purposes.

F. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.

G. Provide the following circuit breaker types where indicated:
   1. Ground Fault Circuit Interrupter (GFCI) Circuit Breakers: Listed as complying with UL 943, class A for protection of personnel.
   2. Ground Fault Equipment Protection Circuit Breakers: Designed to trip at 30 mA for protection of equipment.
   3. Current Limiting Circuit Breakers: Without using fusible elements, designed to limit the let-through energy to a value less than the energy of a one-half cycle wave of the symmetrical prospective current when operating within its current limiting range.

H. Provide listed switching duty rated circuit breakers with SWD marking for all branch circuits serving fluorescent lighting.

I. Provide the following features and accessories where indicated or where required to complete installation:
   1. Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.

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PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings of the enclosed circuit breakers are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive enclosed circuit breakers.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide required supports in accordance with Section 260529.

E. Provide required seismic controls in accordance with Section 260548.

F. Install enclosed circuit breakers plumb.

G. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed circuit breakers such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.

H. Provide grounding and bonding in accordance with Section 260526.

I. Set field-adjustable circuit breaker tripping function settings as determined by overcurrent protective device coordination study performed according to Section 260573.

J. Set field-adjustable ground fault protection pickup and time delay settings as indicated.

K. Identify enclosed circuit breakers in accordance with Section 260553.

3.03 FIELD QUALITY CONTROL

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

B. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.

C. Test GFCI circuit breakers to verify proper operation.

D. Test shunt trips to verify proper operation.

E. Correct deficiencies and replace damaged or defective enclosed circuit breakers.

3.04 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

A. Clean dirt and debris from circuit breaker enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

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SECTION 262816.16
ENCLOSED SWITCHES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Enclosed safety switches.

1.02 RELATED REQUIREMENTS

A. Section 260526 - Grounding and Bonding for Electrical Systems.

B. Section 260529 - Hangers and Supports for Electrical Systems.

C. Section 260548 - Vibration and Seismic Controls for Electrical Systems.

D. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

E. Section 260573 - Power System Studies: Additional criteria for the selection of equipment and associated protective devices specified in this section.

F. Section 262513 - Low-Voltage Busways: Fusible switch busway plug-in units.

G. Section 262813 - Fuses.

H. Section 262913 - Enclosed Controllers: Manual motor controllers.

I. Section 263600 - Transfer Switches: Automatic and non-automatic switches listed for use as transfer switch equipment.

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.

C. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013.

D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

E. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

F. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.

G. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
4. Notify Architect and Owner's construction coordinator, of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

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B. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.

C. Shop Drawings: Indicate outline and support point dimensions, voltage and current ratings, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
   1. Include dimensioned plan and elevation views of enclosed switches and adjacent equipment with all required clearances indicated.
   2. Include wiring diagrams showing all factory and field connections.

D. Field Quality Control Test Reports.

E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

F. Project Record Documents: Record actual locations of enclosed switches.

G. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.
   2. See Section 262813 for requirements for spare fuses and spare fuse cabinets.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed switch internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

A. Maintain ambient temperature between -22 degrees F and 104 degrees F during and after installation of enclosed switches.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Schneider Electric; Square D Products; _____: www.schneider-electric.us

B. Siemens Industry, Inc; _____: www.usa.siemens.com

C. Source Limitations: Furnish enclosed switches and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.02 ENCLOSED SAFETY SWITCHES

A. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the drawings.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

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C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
   1. Altitude: Less than 6,600 feet.
   2. Ambient Temperature: Between -22 degrees F and 104 degrees F.

D. Horsepower Rating: Suitable for connected load.

E. Voltage Rating: Suitable for circuit voltage.

F. Short Circuit Current Rating:
   1. Provide enclosed safety switches, when protected by the fuses or supply side overcurrent protective devices to be installed, with listed short circuit current rating not less than the available fault current at the installed location as determined by short circuit study performed in accordance with Section 260573.
   2. Minimum Ratings:
      a. Switches Protected by Class H Fuses: 10,000 rms symmetrical amperes.
      b. Heavy Duty Single Throw Switches Protected by Class R, Class J, Class L, or Class T Fuses: 200,000 rms symmetrical amperes.

G. Provide with switch blade contact position that is visible when the cover is open.

H. Fuse Clips for Fusible Switches: As required to accept fuses indicated.
   1. Where NEMA Class R fuses are installed, provide rejection feature to prevent installation of fuses other than Class R.

I. Conductor Terminations: Suitable for use with the conductors to be installed.

J. Provide insulated, groundable fully rated solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.

K. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.

L. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
   1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
      a. Indoor Clean, Dry Locations: Type 1.
      b. Outdoor Locations: Type 3R.
   2. Finish for Painted Steel Enclosures: Manufacturer's standard, factory applied grey unless otherwise indicated.

M. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.

N. Variable Frequency Drives, provide auxiliary interlocks for shutdown of variable frequency drive unit, when disconnect is opened.

O. Heavy Duty Switches:
   1. Comply with NEMA KS 1.
   2. Conductor Terminations:
      a. Provide mechanical lugs unless otherwise indicated.
      b. Provide compression lugs where indicated.
      c. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
   3. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.
      a. Provide means for locking handle in the ON position where indicated.

P. Provide the following features and accessories where indicated or where required to complete installation:

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1. Hubs: As required for environment type; sized to accept conduits to be installed.
2. Integral fuse pullers.
3. Auxiliary Switch: SPDT switch suitable for connection to system indicated, with auxiliary contact operation before switch blades open and after switch blades close.
4. Interlocked Receptacle: Integral pre-wired three phase, three wire, grounded type receptacle interlocked with switch mechanism to prevent insertion or removal of plug with switch in the ON position and to prevent switch from being placed in the ON position without matching plug inserted. Provide receptacle configuration as required to accept plug as indicated on the drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.
B. Verify that the ratings of the enclosed switches are consistent with the indicated requirements.
C. Verify that mounting surfaces are ready to receive enclosed safety switches.
D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.
B. Perform work in accordance with NECA 1 (general workmanship).
C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
D. Provide required supports in accordance with Section 260529.
E. Provide required seismic controls in accordance with Section 260548.
F. Install enclosed switches plumb.
G. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.
H. Provide grounding and bonding in accordance with Section 260526.
I. Provide fuses complying with Section 262813 for fusible switches as indicated or as required by equipment manufacturer's recommendations.
J. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
K. Identify enclosed switches in accordance with Section 260553.

3.03 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.
B. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

3.04 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

A. Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.
B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

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SECTION 264300
SURGE PROTECTIVE DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surge protective devices for service entrance locations.

B. Surge protective devices for distribution locations.

C. Surge protective devices for branch panelboard locations.

1.02 RELATED REQUIREMENTS

A. Section 260526 - Grounding and Bonding for Electrical Systems.

B. Section 262300 - Low-Voltage Switchgear.

C. Section 262413 - Switchboards.

D. Section 262416 - Panelboards.

E. Section 262419 - Motor-Control Centers.

F. Section 262513 - Low-Voltage Busways.

G. Section 262726 - Wiring Devices: Receptacles with integral surge protection.

H. Section 271005 - Structured Cabling for Voice and Data - Inside-Plant: Protectors for communications service entrance.

1.03 ABBREVIATIONS AND ACRONYMS

A. EMI/RFI: Electromagnetic Interference/Radio Frequency Interference.

B. SPD: Surge Protective Device.

1.04 REFERENCE STANDARDS

A. MIL-STD-220 - Method of Insertion Loss Measurement; Revision C, 2009.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.

D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.

E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

F. UL 1283 - Standard for Electromagnetic Interference Filters; Current Edition, Including All Revisions.

G. UL 1449 - Standard for Surge Protective Devices; Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate size and location of overcurrent device compatible with the actual surge protective device and location to be installed. Notify Architect and Owner's Construction Coordinator of any conflicts or deviations from the contract documents to obtain direction prior to ordering equipment.

1.06 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Include detailed component information, voltage, surge current ratings, repetitive surge current capacity, voltage protection rating (VPR) for all protection modes, maximum continuous operating voltage (MCOV), nominal discharge current (I-n), short circuit current rating (SCCR),

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connection means including any required external overcurrent protection, enclosure ratings, outline and support point dimensions, weight, service condition requirements, and installed features.
1. SPDs with EMI/RFI filter: Include noise attenuation performance.

C. Shop Drawings: Include wiring diagrams showing all factory and field connections with wire and circuit breaker/fuse sizes.

D. Certificates: Manufacturer's documentation of listing for compliance with the following standards:
1. UL 1449.
2. UL 1283 (for Type 2 SPDs).

E. Field Quality Control Test Reports.

F. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

G. Operation and Maintenance Data: Include information on status indicators and recommended maintenance procedures and intervals.

H. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.

I. Project Record Documents: Record actual connections and locations of surge protective devices.

1.07 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

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

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.08 DELIVERY, STORAGE, AND PROTECTION

A. Store in a clean, dry space in accordance with manufacturer's written instructions.

1.09 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.10 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Manufacturer's Warranty: Provide minimum five year warranty covering repair or replacement of surge protective devices showing evidence of failure due to defective materials or workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Field-installed, Externally Mounted Surge Protective Devices - Other Acceptable Manufacturers:
1. Current Technology; a brand of Thomas & Betts Power Solutions; _____: www.tnbpowersolutions.com
2. Schneider Electric; Square D Brand Surgelogic Products; _____: www.surgelogic.com
3. Liebert.

B. Source Limitations: Furnish surge protective devices produced by a single manufacturer and obtained from a single supplier.

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2.02 SURGE PROTECTIVE DEVICES - GENERAL REQUIREMENTS

A. Description: Factory-assembled surge protective devices (SPDs) for 60 Hz service; listed, classified, and labeled as suitable for the purpose intended; system voltage as indicated on the drawings.

B. Unless otherwise indicated, provide field-installed, externally-mounted or factory-installed, internally-mounted SPDs.

C. List and label as complying with UL 1449, Type 1 when connected on line side of service disconnect overcurrent device and Type 1 or 2 when connected on load side of service disconnect overcurrent device.

D. Protected Modes:
   1. Wye Systems: L-N, L-G, N-G, L-L.
   2. Delta Systems: L-G, L-L.
   3. Single Split Phase Systems: L-N, L-G, N-G, L-L.

E. UL 1449 Voltage Protection Ratings (VPRs):
   1. 208Y/120V System Voltage: Not more than 1,000 V for L-N, L-G, and N-G modes and 1,200 V for L-L mode.
   2. 240/120V System Voltage: Not more than 1,000 V for L-N, L-G, and N-G modes and 1,200 V for L-L mode.
   3. 480Y/277V System Voltage: Not more than 1,500 V for L-N, L-G, and N-G modes and 2,000 V for L-L mode.
   4. 480V Delta System Voltage: Not more than 1,800 V for L-G mode and 3,000 V for L-L mode.

F. UL 1449 Maximum Continuous Operating Voltage (MCOV): Not less than 115% of nominal system voltage.

G. Enclosure Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
   1. Indoor clean, dry locations: Type 1.
   2. Outdoor locations: Type 3R.

H. Mounting for Field-installed, Externally Mounted SPDs: Unless otherwise indicated, as specified for the following locations:
   1. Provide surface-mounted SPD where mounted in non-public areas or adjacent to surface-mounted equipment.
   2. Provide flush-mounted SPD where mounted in public areas or adjacent to flush-mounted equipment.
   3. Factory-installed, Internally Mounted SPD's are not permitted.

2.03 SURGE PROTECTIVE DEVICES FOR SERVICE ENTRANCE LOCATIONS

A. Unless otherwise indicated, provide field-installed, externally mounted SPDs.

B. List and label as complying with UL 1449, Type 1 when connected on line side of service disconnect overcurrent device and Type 1 or 2 when connected on load side of service disconnect overcurrent device.

C. Provide SPDs utilizing only field-replaceable modular protection circuits.

D. Surge Current Rating: Not less than 120 kA per mode/240 kA per phase.

E. Repetitive Surge Current Capacity: Not less than 5,000 impulses.

F. UL 1449 Nominal Discharge Current (I-n): 20 kA.

G. UL 1449 Short Circuit Current Rating (SCCR): Not less than the available fault current at the installed location as indicated on the drawings.

H. Diagnostics:

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1. Protection Status Monitoring: Provide indicator lights to report the protection for each phase.
2. Surge Counter: Provide surge event counter with manual reset button, surge count retention upon power loss, and six digit LCD display that indicates quantity of surge events.

I. Provide surge rated integral disconnect switch for SPDs not connected to a dedicated circuit breaker or fused switch or not direct bus connected.

2.04 SURGE PROTECTIVE DEVICES FOR DISTRIBUTION LOCATIONS

A. Distribution locations include SPDs connected to distribution panelboards, motor control centers, and busway.

B. Unless otherwise indicated, provide field-installed, externally mounted SPDs.

C. List and label as complying with UL 1449, Type 1 or Type 2.

D. Distribution locations include SPDs connected to distribution panelboards, motor control centers, and busway.

E. Provide SPDs utilizing only field-replaceable modular protection circuits.

F. Surge Current Rating: Not less than 80 kA per mode/160 kA per phase.

G. Repetitive Surge Current Capacity: Not less than 3,500 impulses.

H. UL 1449 Nominal Discharge Current (I-n): 20 kA.

I. UL 1449 Short Circuit Current Rating (SCCR): Not less than the available fault current at the installed location as indicated on the drawings.

J. Diagnostics:
1. Protection Status Monitoring: Provide indicator lights to report the protection status for each phase.
2. Surge Counter: Provide surge event counter with manual reset button, surge count retention upon power loss, and six digit LCD display that indicates quantity of surge events.

K. Provide surge rated integral disconnect switch for SPDs not connected to a dedicated circuit breaker or fused switch or not direct bus connected.

2.05 SURGE PROTECTIVE DEVICES FOR BRANCH PANELBOARD LOCATIONS

A. Unless otherwise indicated, provide field-installed, externally mounted SPDs.

B. List and label as complying with UL 1449, Type 1 or Type 2.

C. Provide SPDs utilizing field-replaceable modular or non-modular protection circuits.

D. Surge Current Rating: Not less than 60 kA per mode/120 kA per phase.

E. Repetitive Surge Current Capacity: Not less than 2,000 impulses.

F. UL 1449 Nominal Discharge Current (I-n): 20 kA.

G. UL 1449 Short Circuit Current Rating (SCCR): Not less than the available fault current at the installed location as indicated on the drawings.

H. Diagnostics:
1. Protection Status Monitoring: Provide indicator lights to report the protection status.
2. Surge Counter: Provide surge event counter with manual reset button, surge count retention upon power loss, and six digit LCD display that indicates quantity of surge events.

I. Provide surge rated integral disconnect switch for SPDs not connected to a dedicated circuit breaker or fused switch or not direct bus connected.

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PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the service voltage and configuration marked on the SPD are consistent with the service voltage and configuration at the location to be installed.

C. Verify that electrical equipment is ready to accept connection of the SPD and that installed overcurrent device is consistent with requirements of drawings and manufacturer's instructions.

D. Verify system grounding and bonding is in accordance with Section 260526, including bonding of neutral and ground for service entrance and separately derived systems where applicable. Do not energize SPD until deficiencies have been corrected.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).

B. Service entrance, distribution boards and surface mounted panelboards: Install surge protective device, external to equipment enclosure. Internally mounted surge protective devices are not permitted.

C. Recessed mounted panelboards. Install surge protective device external to panelboard.

D. Install products in accordance with manufacturer's instructions.

E. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

F. Unless indicated otherwise, connect service entrance surge protective device on load side of service disconnect main overcurrent device.

G. Provide conductors with minimum ampacity as indicated on the drawings, as required by NFPA 70, and not less than manufacturer's recommended minimum conductor size.

H. Install conductors between SPD and equipment terminations as short and straight as possible, not exceeding manufacturer's recommended maximum conductor length. Breaker locations may be reasonably rearranged in order to provide leads as short and straight as possible. Twist conductors together to reduce inductance.

I. Do not energize SPD until bonding of neutral and ground for service entrance and separately derived systems is complete in accordance with Section 260526 where applicable. Replace SPDs damaged by improper or missing neutral-ground bond.

J. Disconnect SPD prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPD connected.

3.03 FIELD QUALITY CONTROL

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

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Procure services of a qualified manufacturer's representative to observe installation and assist in inspection, testing, and adjusting. Include manufacturer's reports with field quality control submittals.

3.04 CLEANING

A. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

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SECTION 265013
LUMINAIRE SCHEDULE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Specific requirements for individual luminaire types.

1.02 RELATED REQUIREMENTS

A. Section 265100 - Interior Lighting: General requirements applicable to products specified in this section.

B. Section 265537 - Obstruction and Landing Lights: General requirements applicable to products specified in this section.

C. Section 265561 - Theatrical Lighting: General requirements applicable to products specified in this section.

D. Section 265600 - Exterior Lighting: General requirements applicable to products specified in this section.

1.03 REFERENCE STANDARDS

A. ANSI C136.10 - American National Standard for Roadway and Area Lighting Equipment - Locking-Type Photocontrol Devices and Mating Receptacles - Physical and Electrical Interchangeability and Testing; 2010.

B. IES RP-8 - Roadway Lighting; 2014.

PART 2 PRODUCTS

2.01 LUMINAIRE TYPES

A. Furnish products as specified below.

B. LUTRON IVALO COLLECTION; SILVUS FAMILY----->

C. Recessed Troffer.

1. Products:
   a. Lithonia Lighting.
      1) 2BLTBA Series
   b. Phillips Lighting.
      1) FluxGrid Series
   c. Columbia Lighting
      1) LCAT Series
   d. Deco Lighting
      1) GO-LED Series
   e. Eaton
      1) 22/24CZ
   f. No substitutions permitted.
2. Housing: Steel, painted white.
3. Nominal Size: 1x4 ft, 2x2 ft and 2x4 ft.
4. LED light source: 4000K (80 CRI). 3500K (80 and 90 CRI), 4000K (90 CRI) and 5000K (80 and 90 CRI) may be used only upon approval by the Owner.
5. Light Output:
   a. Lithonia:
      1) The following lumen configurations are recommended by the owner:
         (a) 1 x 4 foot fixture: 20L, 30L, 40L, 48L and 60L.

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(b) 2 x 2 foot fixture: 20L, 33L and 40L.
(c) 2 x 4 foot fixture: 30L, 40L, 48L, 60L and 72L.

2) The following lumen configurations are not recommended due to additional cost and delay in shipping:
(a) No lumen packages not permitted at this time.

b. Phillips:
1) The following lumen configurations are recommended by the owner:
(a) 1 x 4 foot fixture: 38L, 45L and 41B.
(b) 2 x 2 foot fixture: 38L, 38B and 47L.
(c) 2 x 4 foot fixture: 42B, 43L, 48L, 5L and 74L.
2) The following lumen configurations are not recommended due to additional cost and delay in shipping:
(a) 30L (2 x 4 foot fixture) and 38L (2 x 4 foot fixture).

c. Deco:
1) The following lumen configurations are recommended by the owner:
(a) 2 x 2 foot fixture: 2340, 3250 and 4410.
(b) 2 x 4 foot fixture: 3500, 4280 and 5800
2) The following lumen configurations are not recommended due to additional cost and delay in shipping:
(a) No lumen packages not permitted at this time.

d. Eaton
1) The following lumen configurations are recommended by the owner:
(a) 1 x 4 foot fixture: 20, 25, 29, 35, 39, 44
(b) 2 x 2 foot fixture: 20, 24, 32, 39, 44
(c) 2 x 4 foot fixture: 30, 35, 40, 45, 50, 55, 60, 65
2) The following lumen configurations are not recommended due to additional cost and delay in shipping:
(a) No lumen packages not permitted at this time.

6. Diffuser: Diffuse and ribbed.
a. Lithonia: "ADP", Curved, linear prisms.
b. Philips: "D", Diffuse, Ribbed.
c. Columbia: "R", Rectangular, linear prisms.
d. Deco: "N" Architectural Narrow Lens
e. Eaton: "blank", Ribbed, frosted acrylic
7. Voltage: Universal 120-277 V.
8. LED drivers: Provide LED drivers as recommended by the manufacturer.
9. Dimming Options: Provide 0-10v dimming options for all fixtures. Other dimming options are not permitted, unless directed by the Owner.
10. Provide emergency power supply unit in luminaires designated with "EM" on the drawings.
a. Emergency battery packs are only permitted where no generator or inverter power is available.
11. Mounting: Lay-in, grid ceiling.

D. Flat Panel LED
1. Products:
a. Lithonia
1) EPANL Series
b. Komee
1) KMLP Series
c. Philips

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1) FXP Series
d. Metalux
1) FP Series
e. Deco
1) CFP Series
f. Sylvania
1) PanelF1A Series
g. RAB
1) EZPAN
h. No substitutions permitted.
2. Housing: Aluminum bezel with steel back plate.
3. Nominal Size: 1'x4', 2'x2', and 2'x4'
4. LED light source: 4000K (80 CRI)
5. Light Output:
a. Lithonia:
1) The following lumen configurations are recommended by the owner:
(a) 1 x 4 foot fixture: 1500L, 3000L, 4000L, 48000L, 6000L
(b) 2 x 2 foot fixture: 2000L, 3400L, 4000L, 4800L
(c) 2 x 4 foot fixture: 3000L, 4000L, 4800L, 5400L, 6000L, 6800L
2) The following lumen configurations are not recommended due to additional cost and delay in shipping:
(a) No lumen packages not permitted at this time.
b. Phillips.
1) The following lumen configurations are recommended by the owner:
(a) 2 x 2 foot fixture: 3800L
(b) 2 x 4 foot fixture: 4200L
2) The following lumen configurations are not recommended due to additional cost and delay in shipping:
(a) No lumen packages not permitted at this time.
c. Komee:
1) The following lumen configurations are recommended by the owner:
(a) 2 x 2 foot fixture: 4160L, 4800L
(b) 2 x 4 foot fixture: 6500L, 6700L
2) The following lumen configurations are not recommended due to additional cost and delay in shipping:
(a) No lumen packages not permitted at this time.
d. Metalux:
1) The following lumen configurations are recommended by the owner:
(a) 1 x 4 foot fixture: 3176L, 4389L
(b) 2 x 2 foot fixture: 2551L, 3560L, 4567L
(c) 2 x 4 foot fixture: 3608L, 4858L, 6611L
2) The following lumen configurations are not recommended due to additional cost and delay in shipping:
(a) No lumen packages not permitted at this time.
e. Deco
1) The following lumen configurations are recommended by the owner:
(a) 1 x 4 foot fixture: 30, 35
(b) 2 x 2 foot fixture: 30, 35
(c) 2 x 4 foot fixture: 30, 35

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2) The following lumen configurations are not recommended due to additional cost and delay in shipping:
(a) No lumen packages not permitted at this time.

f. Sylvania
1) The following lumen configurations are recommended by the owner:
(a) 1 x 4 foot fixture: 3300
(b) 2 x 2 foot fixture: 3500
(c) 2 x 4 foot fixture: 3300, 4200
2) The following lumen configurations are not recommended due to additional cost and delay in shipping:
(a) No lumen packages not permitted at this time.

g. RAB
1) The following lumen configurations are recommended by the owner:
(a) 2 x 2 foot fixture: 3000, 4135
(b) 2 x 4 foot fixture: 4286, 5902
2) The following lumen configurations are not recommended due to additional cost and delay in shipping:
(a) No lumen packages not permitted at this time.

6. Diffuser: Satin white lens
7. Voltage: Universal 120-277 V.
8. LED drivers: Provide LED drivers as recommended by the manufacturer.
9. Dimming Options: Provide 0-10V, 1% dimming options for all fixtures. Other dimming options are not permitted, unless directed by the Owner.
10. Provide emergency power supply unit in luminaires designated with "EM" on the drawings.
a. Emergency battery packs are only permitted where generator or inverter power is not available.
11. Provide with the following features/accessories:
a. Surface mount troffer kit
12. Mounting: Lay-in, grid ceiling.

E. Linear Suspended Pendant (rectangular 7" x 2" nominal, up/down light)
1. Products:
a. Litecontrol
1) SAE 104 Series
b. Lithonia Lighting
1) GRAD Series
c. Ledalite
1) 7406 Series
d. Corelite
1) J2 Series
e. Substitutes not permitted.
2. Housing: Steel, painted white.
3. Maximum Section Length in Row: 8 feet.
4. LED light source: 4000K color temperature.
5. Light Output:1300 Lumens/ft (nominal)
6. CRI: 80min.
7. Distribution: 20% Up, 80% Down
8. Voltage: Universal 120-277 V.
9. LED drivers: Provide LED drivers as recommended by the manufacturer.

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10. Dimming Options: Provide 0-10V (1%) dimming options for all fixtures. Other dimming options are not permitted, unless directed by the Owner.
11. Provide with the following features/accessories:
    a. Dust cover.
12. Mounting: Suspended.

F. Linear Suspended Pendant (Square 4" x 4" nominal, down light)
1. Products:
    a. Prudential
        1) P40 Series
    b. Pinnacle
        1) EDGE EX4 Series
    c. Substitutes not permitted.
2. Housing: Aluminum, painted white.
3. Maximum Section Length in Row: 8 feet.
4. LED light source: 4000K color temperature.
5. Light Output:394 Lumens/ft (nominal)
6. CRI: 80min.
7. Distribution: 100% down
8. Lens: Satine
9. Voltage: Universal 120-277 V.
10. LED drivers: Provide LED drivers as recommended by the manufacturer.
11. Dimming Options: Provide 0-10V (1%) dimming options for all fixtures. Other dimming options are not permitted, unless directed by the Owner.
12. Mounting: Suspended.

G. General purpose strip.
1. Products:
    a. Philips Lighting.
        1) Fluxtream Series.
    b. Lithonia.
        1) ZL1D Series.
    c. Metalux.
        1) 4SNLED Series.
    d. Deco Lighting
        1) DACH-LED Series.
    e. Substitutes not permitted.
2. Housing: Steel, painted white.
3. Nominal Length: 4 feet.
4. LED light source: 4000K.
5. Light Output:
    a. Phillips:
        1) The following lumen configurations are recommended by the owner:
            (a) 2 foot fixture: 20L and 30L.
            (b) 3 foot fixture: 30L.
            (c) 4 foot fixture: 30L, 40L 55L and 70L.
        2) The following lumen configurations are not recommended due to additional cost and delay in shipping:
            (a) No lumen packages not permitted at this time.
    b. Lithonia:
        1) The following lumen configurations are recommended by the owner:

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(a) 2 foot fixture: 2500LM and 3500LM.
(b) 4 foot fixture: 3000LM, 5000LM and 7000LM.

2) The following lumen configurations are not recommended due to additional cost and delay in shipping:
(a) No lumen packages not permitted at this time.

c. Metalux:
1) The following lumen configurations are recommended by the owner:
(a) 2 foot fixture: 20SL and 30SL.
(b) 4 foot fixture: 30SL, 41SL, and 50SL.
2) The following lumen configurations are not recommended due to additional cost and delay in shipping:
(a) No lumen packages not permitted at this time.

d. Deco:
1) The following lumen configurations are recommended by the owner:
(a) 2 foot fixture: 2350.
(b) 4 foot fixture: 2560, 4550, 5980.
2) The following lumen configurations are not recommended due to additional cost and delay in shipping:
(a) No lumen packages not permitted at this time.

e. Sylvania:
1) The following lumen configurations are recommended by the owner:
(a) 2 foot fixture: 1900.
(b) 4 foot fixture: 4000, 6200.
2) The following lumen configurations are not recommended due to additional cost and delay in shipping:
(a) No lumen packages not permitted at this time.

6. Reflector: None.
7. Lens: Frosted acrylic.
8. Voltage: Universal 120-277 V.
9. LED drivers: Provide LED drivers as recommended by the manufacturer.
10. Dimming Options: Provide 0-10v dimming options for all fixtures. Other dimming options are not permitted, unless directed by the Owner.
11. Provide emergency power supply unit in luminaires designated with "EM" on the drawings.
a. Emergency battery packs are only permitted where not generator or inverter power is available.
12. Provide with the following features/accessories:
a. Fusing: Fast blow type.
b. Wireguard(s), where installed in areas where fixture may be damaged.
13. Mounting: Surface, Ceiling or Suspended.

H. Vaper Tight Luminaire
1. Products:
a. Philips Lighting
1) V3W Series
b. Lithonia Lighting
1) VAP Series
c. Eaton
1) 4VT3
d. Substitutes not permitted.
2. Housing: Frosted polycarbonate with closed-cell gasket, wet location listed.

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3. Lens: Clear Polycarbonate.
4. Nominal Length: 4 feet.
5. LED light source: 4000K, 80 CRI.
6. Light Output:
   a. Lithonia
      1) 4000, 6000, 8000, 12000, and 15000 lumens
   b. Philips
      1) 3500, 4300, 5100, 7000, 8000, and 10000 lumens
   c. Eaton
      1) 4000, 6000 and 80000 lumens
   d. The following lumen configurations are not recommended due to additional cost and delay in shipping:
      1) No lumen packages not permitted at this time.
7. Reflector: None.
8. Voltage: Universal 120-277 V.
9. LED drivers: Provide LED drivers as recommended by the manufacturer.
10. Dimming Options: Provide 0-10v dimming options for all fixtures. Other dimming options are not permitted, unless directed by the Owner.
11. Mounting: Surface, Ceiling or Suspended._____.

I. Food Processing Troffers
1. Products:
   a. Kurtzon.
      1) FP Series.
   b. No substitutions permitted.
2. Listing: NSF2, IP66, ETL
3. Housing: Steel, painted white.
4. Nominal Size: 1x4 ft, 2x2 ft and 2x4 ft.
5. LED light source: 4000K (80 CRI). 3500K (80 and 90 CRI), 4000K (90 CRI) and 5000K (80 and 90 CRI) may be used only upon approval by the Owner.
6. Light Output:
   a. Kurtzon:
      1) The following lumen configurations are recommended by the owner:
         (a) 1 x 4 foot fixture: 20L, 30L, 40L, 48L and 60L.
         (b) 2 x 2 foot fixture: 20L, 33L and 40L.
         (c) 2 x 4 foot fixture: 30L, 40L, 48L, 60L and 72L.
      2) The following lumen configurations are not recommended due to additional cost and delay in shipping:
         (a) No lumen packages not permitted at this time.
7. Door: Steel, flush, white. Bottom access. Gasketed.
8. Lens: P12 prismatic pattern inverted, 0.135" virgin acrylic, gasketed.
9. Voltage: Universal 120-277 V.
10. LED drivers: Provide LED drivers as recommended by the manufacturer.
11. Dimming Options: Provide 0-10v dimming options for all fixtures. Other dimming options are not permitted, unless directed by the Owner.
12. Provide emergency power supply unit in luminaires designated with "EM" on the drawings.
   a. Operate two lamp(s) at a minimum of 1350 lumens unless otherwise indicated with indicated illumination evenly divided between the lamps.
   b. Emergency battery packs are only permitted where not generator or inverter power is available.

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13. Provide with the following features/accessories:
    a. Fusing: Fast blow type.
14. Mounting: Lay-in, grid ceiling.

J. Recessed compact downlight.
1. Products:
    a. Gotham Lighting:
        1) Incito Series.
        2) EVO Series.
    b. Prescolite:
        1) LF6SL Series.
    c. Lightolier:
        1) EasyLyte or LyteProfileSeries
    d. Halo:
        1) HC6 Series
    e. No Substitutes permitted.
2. Reflector Finish: Semi-specular, clear.
3. Trim: Match reflector finish.
4. Voltage: Universal 120-277 V.
5. Provide emergency power supply unit in luminaires designated with "EM" on the drawings.
6. Provide sloped ceiling adapters suitable for the installed location where required.
7. Provide with the following features/accessories:
    a. Fusing.
8. Mounting: Recessed.
9. Listings:
    a. Non-IC Rated: Not suitable for direct contact with insulation and combustible materials.

K. Exit sign.
1. Products:
    a. Dual-Lite.
        1) Generator/Inverter Power Operation:
            (a) Single face #SESGW
            (b) Double face #SEDGW
        2) Emergency Battery Operation:
            (a) Single face #SESGWE
            (b) Double face #SEDGWE
    b. No alternate manufacturers permitted.
2. Lamps: LED.
3. Housing: Die cast aluminum.
4. Finish: White.
5. Mounting Type: Universal.
6. Number of Faces: As specified.
7. Letter Color: Green.
8. Emergency Operation: For use only where generator or inverter power is not available..
    a. Battery: Nickel cadmium.
    b. Only permitted in areas where no generator or inverter power is available.
9. Voltage: Dual 120/277 V.
10. Mounting:
    a. Ceiling-mounted: _____.
    b. Wall-mounted: _____.

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L. High bay luminaire.
  1. Products:
    a. GE Lighting.
      1) Albeo #ABV3 series
    b. Lithonia.
      1) I-beam, LBG
    c. Metalux
      1) OHB Series

M. Under counter lighting.
  1. Products:
    a. H.E. Williams.
      1) 1SF Series.
    b. Nora Lighting.
      1) NUD-88 Series
    c. EELP
      1) VLUC Series.
    d. Eaton
      1) HU30
    e. Housing: Steel, painted white.
    f. Correlated Color Temperature: 4,100 K.
    g. Voltage: Universal 120-277 V.
    h. Provide with the following features/accessories:
      1) Built-in on/off rocker switch
      2) End to end connectors
    i. Mounting: Surface mount to bottom of cabinet.

N. Tape Light
  1. Products
    a. Sylvania Osram
    b. Q-Tran

O. Wall mounted strip
  1. Products
    a. Lithonia Lighting
      1) #WL4 Series
    b. Philips Lighting
      1) Fluxstream #FSW Series

P. Wall wash linear
  1. Products
    a. ELP
      1) AKTB LED Series

Q. Track Lighting
  1. Products
    a. Track
      1) Halo
        (a) L650 Series
      2) LSI (Lighting Services Inc.)
        (a) Surface Track (120V).
    b. Heads
      1) Philips Lightolier

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(a) Corepro Mini Cylinder Series, #LT-H-08--
(1) Beam spread, CRI/CCT, and finish color to be determined per project.

2) LSI (Lighting Services Inc.)
(a) LED light sourced track heads.

3) Halo
(a) L808

R. Pole mounted LED area Luminaire.

1. Configuration: As required for proper illumination per Illumination Engineering Society of North America (IESNA).
2. Luminaire (Fixture Heads):
   a. Products:
      1) Kim Lighting
      2) Substitutions are not permitted.
   b. Housing: Aluminum.
   c. Finish: Painted
      1) Academic Campus Areas: Custom Color "CC" - PMS 462 Gloss Brown.
      2) Heritage Housing Areas: Custom Color "CC" - RAL 7008.
   d. Luminaire Head Shape: Rectilinear.
   e. Illumination Source LED.
   f. Shielding: Flat glass lens.
   g. Lighting Distribution per IES RP-8:
      1) Lateral Distribution: Types II, III, IV and V.
      2) Cutoff Category: Full cutoff.
   h. Voltage: Multi-tap 120/208/240/277 V.
   i. Driver: Provide LED driver per manufacturer's recommendations.
   j. Pole Mounting: Standard arm suitable for mounting on specified pole, finish to match luminaire.
   k. Building/Wall Mounting: Standard arm suitable for wall-mounting.
   l. Provide with the following features/accessories:
      1) Fusing.
      2) Integral locking receptacle for photo control complying with ANSI C136.10.
      3) House-side shield, external, if required for critical areas.
   m. Listings:
      1) Suitable for wet locations.
3. Pole:
   a. Products:
      1) Kim Lighting:
         (a) Roadway and Parking Areas: #PAR25-6188.
         (b) Walkways and Sidewalks: #PAR14-4188.
         (c) License Plate Readers: #PRA12-6250.
      2) Substitutions are not permitted.
   b. Material: Aluminum.
   c. Shape: Round straight.
   d. Finish: Match luminaire finish.
   e. Mounting Height: _____. Height dictated by area of use, described above.
   f. Mounting: _____. Mount on Owner standard concrete base.
   g. Provide with the following features/accessories:
      1) Top cap.
      2) Handhole, per manufacture size.

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3) Anchor base cover.
4) Provision for pole-mounted weatherproof GFI receptacle, where indicated on the drawings.

4. Type Pole Mounted LED Flood/Spot Lights: _____.
   a. Configuration: Single Luminaire(s) orientation as shown on Drawings.
   b. Luminaire(s):
      1) Products:
      2) Kim Lighting.
      3) Housing: Aluminum.
      4) Finish: Match pole light color. .
      5) Illumination Source: LED.
      6) Shielding: Flat glass lens.
      7) Lighting Distribution: As shown on Drawings. .
      8) Voltage: Multi-tap 120/208/240/277 V.
      9) Driver: Provide LED driver per manufacturer's recommendations.
      10) Mounting Provision: Yoke mount.
      11) Mounting: Pole-top bracket suitable for mounting on specified pole, finish to match pole.
      12) Provide with the following features/accessories:
         (a) Fusing.
         (b) Integral locking receptacle for photo control complying with ANSI C136.10.
      13) Listings:
         (a) Suitable for wet locations.

S. Wall-mounted Exterior LED luminaire.
   1. Products:
      a. Kim:
         1) Wall Director - Small: #WD14 Series:
         2) Wall Director - Large: #WD18 Series:
      b. Sylvania:
         1) Small Wall Pack: #SMWL-1N-015-UNV-7-50-NC-BZ.
         2) Medium Wall Pack: #WALPAK-(Generation)-(Wattage)-UNV-7-NC-BZ-(Options).
            (a) Generation:1N, 2N or 3N.
            (b) Wattage: 030 (30 watts), 050 (50 watts), 075 (75 watts), 105 (105 watts).
            (c) Options: P (Photocontrol); (E) Emergency Battery Pack.
      c. Eaton
         1) Medium Wall Pak: DPMLED
            (a) Options: P (Photocontrol)
   2. Substitutions not permitted.
   3. Housing: Aluminum.
   4. Finish: Color by Architect. _____.
   5. Shape: Rectangular.
   6. Lamp: _____.
   7. Shielding: Clear tempered glass lens.
   8. Lighting Distribution:
      a. Lateral Distribution: Forward throw.
      b. Cutoff Category: Full cutoff.
   9. Voltage: Multi-tap 120/208/240/277 V.
   10. Driver: Provide LED driver per manufacturer's recommendations.
   11. Mounting: _____. Surface mount on building/structure.

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12. Provide emergency power supply unit in luminaires designated with "EM" on the drawings.
13. Provide with the following features/accessories:
    a. Wireguard as specified on Drawings.
14. Listings:
    a. Suitable for wet locations.

T. LED Bollard Luminaire.
1. Products:
    a. Philips Lighting, "BRM832".
    b. Substitutions not permitted.
2. Housing: Aluminum.
3. Finish: _____.
    a. Academic Campus Areas: Custom Color "CC" - PMS 462 Gloss Brown.
    b. Heritage Housing Areas: Standard Color - "BZ" (Bronze).
    c. Athletic Areas: Custom Color "CC" - RAL 5002.
4. Shape: Round.
5. Nominal Size: 8 inches (diameter).
6. Nominal Height: "42" - 42 inches high.
7. Illumination Characteristics: _____.
    a. Quantity of LEDs: "108L" - 36 led's per louver with 360 degree distribution.
    b. LED Drive Current: "58" - 58 mA drive current.
    c. LED Color Generation: "CW-G2" - Cool White, 5000K, 70 CRI, Generation 2.
8. Surge Protection: 10 kA (Standard Option).
9. Lighting Distribution: Symmetrical.
10. Voltage: Multi-tap 120/208/240/277 V.
11. Mounting: Mount on Owner approved concrete base..
12. Provide with the following features/accessories:
    a. Fusing.
    b. Anchor bolts.
    c. _____.
13. Listings:
    a. Suitable for wet locations.
    b. _____.
14. _____.

U. Light Fixture manufacturers NOT permitted on campus.
1. Spectrum Lighting. All light fixtures manufactured by Spectrum Lighting.

END OF SECTION

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SECTION 265100
INTERIOR LIGHTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Interior luminaires.
B. Emergency lighting units.
C. Exit signs.
D. Ballasts and drivers.
E. Emergency power supply units.
F. Lamps.
G. LED retrofit luminaire conversion kits.
H. Luminaire accessories.

1.02 RELATED REQUIREMENTS

A. Section 260529 - Hangers and Supports for Electrical Systems.
B. Section 260533.16 - Boxes for Electrical Systems.
C. Section 260548 - Vibration and Seismic Controls for Electrical Systems.
D. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
E. Section 260923 - Lighting Control Devices: Automatic controls for lighting including occupancy sensors, outdoor motion sensors, time switches, outdoor photo controls, and daylighting controls.
F. Section 262725 - Wiring Devices: Manual wall switches and wall dimmers.
G. Section 265013 - Luminaire Schedule.
H. Section 265561 - Theatrical Lighting: Stage lighting units and associated controls.
I. Section 265600 - Exterior Lighting.
J. Section 275129.13 - Area of Refuge/Rescue Assistance Systems: Area of refuge/rescue assistance signage.

1.03 REFERENCE STANDARDS

A. ANSI C82.11 - American National Standard for Lamp Ballasts - High Frequency Fluorescent Lamp Ballasts - Supplements; 2011.
B. IEC 60529 - Degrees of Protection Provided by Enclosures (IP Code); 2013-08, with 2015 Corrigendum.
C. IEEE C62.41.2 - Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits; 2002 (Cor 1, 2012).
D. IES LM-63 - IESNA Standard File Format for Electronic Transfer of Photometric Data and Related Information; 2002 (Reaffirmed 2008).
E. IESNA LM-63 - ANSI Approved Standard File Format for Electronic Transfer of Photometric Data and Related Information; 2002 (Reaffirmed 2008).
F. IES LM-79 - Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products; 2008.
G. IES LM-80 - Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays, and Modules; 2015.

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H. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

I. NECA/IESNA 500 - Standard for Installing Indoor Commercial Lighting Systems; 2006.

J. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems; 2006.

K. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts; 2015.

L. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility; 2012.

M. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

N. NFPA 101 - Life Safety Code; 2015.

O. UL 844 - Luminaires for Use in Hazardous (Classified) Locations; Current Edition, Including All Revisions.

P. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.

Q. UL 935 - Fluorescent-Lamp Ballasts; Current Edition, Including All Revisions.

R. UL 1598 - Luminaires; Current Edition, Including All Revisions.

S. UL 1598C - Light-Emitting Diode (LED) Retrofit Luminaire Conversion Kits; Current Edition, Including All Revisions.

T. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the installation of luminaires with mounting surfaces installed under other sections or by others. Coordinate the work with placement of supports, anchors, etc. required for mounting. Coordinate compatibility of luminaires and associated trims with mounting surfaces at installed locations.
   2. Coordinate the placement of luminaires with structural members, ductwork, piping, equipment, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.
   3. Coordinate the placement of exit signs with furniture, equipment, signage or other potential obstructions to visibility installed under other sections or by others.
   4. Notify Architect and Owner's Construction Project Coordinator, of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings:
   1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
   2. Provide photometric calculations where luminaires are proposed for substitution upon request.

C. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.
   1. LED Luminaires:
   2. Ballasts/Drivers: Include wiring diagrams and list of compatible lamp configurations.
   3. Lamps: Include rated life, color temperature, color rendering index (CRI), and initial and mean lumen output.

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4. Emergency Power Supply Unit: Include list of compatible lamp configurations and associated lumen output.
5. LED Retrofit Luminaire Conversion Kits: Include list of compatible luminaires and/or criteria for compatibility.

D. Certificates for Dimming Drivers: Manufacturer's documentation of compatibility with dimming controls to be installed.

E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

F. Operation and Maintenance Data: Instructions for each product including information on replacement parts.

G. Project Record Documents: Record actual connections and locations of luminaires and any associated remote components.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting), NECA/IESNA 502 (industrial lighting), and manufacturer's written instructions.

B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.08 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.09 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Provide five year manufacturer warranty for all LED luminaires, including drivers.

PART 2 PRODUCTS

2.01 LUMINAIRE TYPES

A. Furnish products as indicated in luminaire schedule included on the drawings.

B. Substitutions: See Section 016000 - Product Requirements, except where individual luminaire types are designated with substitutions not permitted.

2.02 LUMINAIRES

A. Provide products that comply with requirements of NFPA 70.

B. Provide products that are listed and labeled as complying with UL 1598, where applicable.

C. Provide products listed, classified, and labeled as suitable for the purpose intended.

D. Provide products complying with Federal Energy Management Program (FEMP) requirements.

E. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.

F. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.

G. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.

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H. Recessed Luminaires:
   1. Ceiling Compatibility: Comply with NEMA LE 4.
   2. Luminaires Recessed in Insulated Ceilings: Listed and labeled as IC-rated, suitable for direct contact with insulation and combustible materials.
   3. Luminaires Recessed in Sloped Ceilings: Provide suitable sloped ceiling adapters.

I. Hazardous (Classified) Location Luminaires: Listed and labeled as complying with UL 844 for the classification of the installed location.

J. Fluorescent Luminaires:
   1. Provide ballast disconnecting means complying with NFPA 70 where required.

K. LED Luminaires:
   1. Components: UL 8750 recognized or listed as applicable.
   2. Tested in accordance with IES LM-79 and IES LM-80.
   3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.

L. LED Tape Lighting Systems: Provide all power supplies, drivers, cables, connectors, channels, covers, mounting accessories, and interfaces as necessary to complete installation.
   1. LED Tape - General Requirements:
      a. Listed.
      b. Designed for field cutting in accordance with listing.
      c. Wet Location Applications: IEC 60529, IP 68 (waterproof) rated.

M. Track Lighting Systems: Provide track compatible with specified track heads, with all connectors, power feed fittings, dead ends, hangers and canopies as necessary to complete installation.

N. Luminaires Mounted in Continuous Rows: Provide quantity of units required for length indicated, with all accessories required for joining and aligning.

2.03 EMERGENCY LIGHTING UNITS

A. See Section 263323: Central Battery Equipment for Emergency Lighting Units.

2.04 EXIT SIGNS

A. Description: Internally illuminated exit signs with LEDs unless otherwise indicated; complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
   1. Number of Faces: Single or double as indicated or as required for the installed location.
   2. Directional Arrows: As indicated or as required for the installed location.

B. Self-Powered Exit Signs:
   1. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.
   2. Battery: Sealed maintenance-free nickel cadmium unless otherwise indicated.
   3. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.
   4. Provide low-voltage disconnect to prevent battery damage from deep discharge.

C. Photoluminescent Exit Signs: Powder-coated sheet aluminum with photoluminescent pigmented material, are not permitted for use on this project.

D. Accessories:
   1. Provide compatible accessory high impact polycarbonate vandal shields where indicated.
   2. Provide compatible accessory wire guards where indicated.

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2.05 BALLASTS AND DRIVERS

A. Ballasts/Drivers - General Requirements:
   1. Provide drivers based upon luminaire manufacture's recommendations.
   2. Provide ballasts containing no polychlorinated biphenyls (PCBs).
   3. Minimum Efficiency/Efficacy: Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.
   4. Electronic Ballasts/Drivers: Inrush currents not exceeding peak currents specified in NEMA 410.

B. Dimmable LED Drivers:
   1. Dimming Range: Continuous dimming from 100 percent to five percent relative light output unless dimming capability to lower level is indicated, without flicker.
   2. Control Compatibility: Fully compatible with the dimming controls to be installed.
      a. Lighting Controls: See Section 260923.
      b. Lighting Control Systems: See Section 260936.

2.06 EMERGENCY POWER SUPPLY UNITS

A. Manufacturers:
   1. Iota Engineering, LLC; _____: www.iotaengineering.com
   2. Philips Emergency Lighting/Bodine; _____: www.bodine.com

B. Description: Self-contained emergency power supply units suitable for use with indicated luminaires, complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.

C. Compatibility:
   1. Driver: Compatible with electronic, energy saving, and dimming LED driver.

D. Operation: Upon interruption of normal power source, solid-state control automatically switches connected lamp(s) to the fluorescent emergency power supply for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.

E. Battery: Sealed maintenance-free high-temperature nickel cadmium unless otherwise indicated.

F. Diagnostics: Provide accessible and visible multi-chromatic combination test switch/indicator light to display charge, test, and diagnostic status and to manually activate emergency operation.

G. Operating Temperature: From 32 degrees F to 122 degrees F unless otherwise indicated or required for the installed location.

2.07 LED RETROFIT LUMINAIRE CONVERSION KITS

A. Manufacturers:
   1. OSRAM Sylvania, Inc; _____: www.osram.us/ds
   2. Where a specific manufacturer or model is indicated elsewhere on the drawings, substitutions are not permitted unless explicitly indicated.

B. Description: Light-emitting diode (LED) retrofit luminaire conversion kits, including but not limited to LED lamps and arrays, control modules, drivers, power supplies, wiring, lampholders, brackets, wire connectors, reflectors, and diffusers, intended for replacement of existing light sources in existing luminaires; listed as complying with UL 1598C; suitable for installation in luminaire to be converted.

2.08 ACCESSORIES

A. Stems for Suspended Luminaires: Steel tubing, size as indicated, factory finished to match luminaire or field-painted as directed.

B. Threaded Rods for Suspended Luminaires: Zinc-plated steel, size as indicated.

C. Provide accessory plaster frames for luminaires recessed in plaster ceilings.

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PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.

C. Verify that suitable support frames are installed where required.

D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

A. Coordinate locations of outlet boxes provided under Section 260533.16 as required for installation of luminaires provided under this section.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Install products in accordance with manufacturer's instructions.

D. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting) and NECA 502 (industrial lighting).

E. Provide required support and attachment in accordance with Section 260529.

F. Provide required seismic controls in accordance with Section 260548.

G. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.

H. Suspended Ceiling Mounted Luminaires:
   1. Do not use ceiling tiles to bear weight of luminaires.
   2. Do not use ceiling support system to bear weight of luminaires unless ceiling support system is certified as suitable to do so.
   3. Fixture length shall not exceed 12 ft.
   4. Secure surface-mounted, recessed, and pendant-mounted luminaires to framing members or to building structure.
   5. Secure lay-in luminaires to ceiling support channels using listed safety clips at four corners.
   6. In addition to ceiling support wires, provide two galvanized steel safety wire(s), minimum 12 gage, connected from opposing corners of each recessed luminaire to building structure.
   7. See appropriate Division 9 section where suspended grid ceiling is specified for additional requirements.

I. Recessed Luminaires:
   1. Install trims tight to mounting surface with no visible light leakage.
   2. Non-IC Rated Luminaires: Maintain required separation from insulation and combustible materials according to listing.
   3. Luminaires Recessed in Fire-Rated Ceilings: Install using accessories and firestopping materials to meet regulatory requirements for fire rating.

J. Suspended Luminaires:
   1. Unless otherwise indicated, specified mounting heights are to bottom of luminaire.
   2. Install using the suspension method indicated, with support lengths and accessories as required for specified mounting height.

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3. Provide minimum of two supports for each luminaire equal to or exceeding 4 feet nominal length, with no more than 12 feet between supports, as per manufacture recommendations.
4. Install canopies tight to mounting surface.
5. Unless otherwise indicated, support pendants from swivel hangers.

K. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to bottom of luminaire.

L. Install accessories furnished with each luminaire.

M. Bond products and metal accessories to branch circuit equipment grounding conductor.

N. Emergency Lighting Units:
1. Unless otherwise indicated, connect unit to unswitched power from circuit indicated. Bypass local switches, contactors, or other lighting controls.

O. Exit Signs:
1. Unless otherwise indicated, connect unit to unswitched power from circuit indicated. Bypass local switches, contactors, or other lighting controls.

P. Emergency Power Supply Units:
1. For field-installed units, install inside luminaire unless otherwise indicated. Where installation inside luminaire is not possible, install on top of luminaire.
2. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal ballast(s) in luminaire. Bypass local switches, contactors, or other lighting controls.
3. Remote Power Supply Units: Install in accessible location as indicated or as required to complete installation, using conductors per manufacturer's recommendations not exceeding manufacturer's recommended maximum conductor length to luminaire.

Q. Identify luminaires connected to emergency power system in accordance with Section 260553.

3.04 FIELD QUALITY CONTROL

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

B. Inspect each product for damage and defects.

C. Operate each luminaire after installation and connection to verify proper operation.

D. Test self-powered exit signs, emergency lighting units, and emergency power supply units to verify proper operation upon loss of normal power supply.

E. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy generator transfer device as determined by Architect.

3.05 ADJUSTING

A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect. Secure locking fittings in place.

B. Aim and position adjustable emergency lighting unit lamps to achieve optimum illumination of egress path as required or as directed by Architect or authority having jurisdiction.

C. Exit Signs with Field-Selectable Directional Arrows: Set as indicated or as required to properly designate egress path as directed by Architect or authority having jurisdiction.

3.06 CLEANING

A. Clean surfaces according to NECA 500 (commercial lighting), NECA 502 (industrial lighting), and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.07 CLOSEOUT ACTIVITIES

A. See Section 017800 - Closeout Submittals, for closeout submittals.

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B. See Section 017900 - Demonstration and Training, for additional requirements.

C. Demonstration: Demonstrate proper operation of luminaires to Architect, and correct deficiencies or make adjustments as directed.

D. Just prior to Substantial Completion, LED drivers or boards that have failed.

3.08 PROTECTION

A. Protect installed luminaires from subsequent construction operations.

END OF SECTION

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SECTION 271005

STRUCTURED CABLING FOR VOICE AND DATA - INSIDE-PLANT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Communications system design requirements.

B. Communications pathways.

C. Communications grounding and bonding.

D. Communications identification.

1.02 RELATED REQUIREMENTS

A. Section 078400 - Firestopping. Provides information for Firestopping that applies to structured cabling.

B. Section 260526 - Grounding and Bonding for Electrical Systems. Provide information on grounding and bonding for structured cabling.
   1. Includes intersystem bonding termination.
   2. Includes bonding jumpers for bonding of communications systems and electrical system grounding.

C. Section 260533.13 - Conduit for Electrical Systems. Provide information on pathways for structured cabling.

D. Section 260536 - Cable Trays for Electrical Systems.

E. Section 260533.16 - Boxes for Electrical Systems. Provide information on boxes for structured cabling.

F. Section 260553 - Identification for Electrical Systems: Identification products.

G. Section 262725 - Wiring Devices.

H. Section 337119 - Electrical Underground Ducts, Ductbanks, and Manholes.

1.03 REFERENCE STANDARDS

A. EIA/ECA-310 - Cabinets, Racks, Panels, and Associated Equipment; Revision E, 2005.

B. FM (AG) - FM Approval Guide; current edition.

C. ICEA S-83-596 - Indoor Optical Fiber Cables; 2016.

D. ICEA S-90-661 - Category 3, 5, & 5e Individually Unshielded Twisted Pair Indoor Cables (With or Without An Overall Shield) For Use in General Purpose and LAN Communications Wiring Systems Technical Requirements; 2012.

E. NECA/BICSI 568 - Standard for Installing Commercial Building Telecommunications Cabling; 2006.

F. F. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.

G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. H. NFPA 780 - Standard for the Installation of Lightning Protection Systems; 2017.

I. TIA-455-21 - FOTP-21 - Mating Durability of Fiber Optic Interconnecting Devices; Rev A, 1988 (R2012).

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J. TIA-492AAAA-B - Detail Specification for 62.5-um Core Diameter/125-um Cladding Diameter Class IA Graded-Index Multimode Optical Fibers; Rev B, 2009.

K. TIA-492CAAA - Detail Specification for Class IVa Dispersion-Unshifted Single-Mode Optical Fibers; 1998 (R 2002).

L. TIA-492CAAB - Detail Specification for Class IVa Dispersion-Unshifted Single-Mode Optical Fibers with Low Water Peak; Telecommunications Industry Association; 2000 (R2005).

M. TIA-526-7 - Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant; Rev A, 2015.

N. TIA-526-14 - Optical Power Loss Measurement of Installed Multimode Fiber Cable Plant; Rev C, 2015.

O. TIA-568 (SET) - Commercial Building Telecommunications Cabling Standard Set; 2016.

P. TIA-606 - Administration Standard for Telecommunications Infrastructure; 2017c.

Q. TIA-568-C.2 - Balanced Twisted-Pair Telecommunications Cabling and Components Standards; Rev C, 2009 (with Addenda; 2016).

R. TIA-568-C.3 - Optical Fiber Cabling Components Standard; Rev C, 2008 (with Addenda; 2011).

S. TIA-569-D - Telecommunications Pathways and Spaces; Rev D, 2015.

T. TIA-598-D - Optical Fiber Cable Color Coding; Rev D, 2014.

U. TIA-606-B - Administration Standard for Telecommunications Infrastructure; Rev B, 2012 (with Addenda; 2015).

V. TIA-607-C - Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises; Rev C, 2015.

W. UL 444 - Communications Cables; Current Edition, Including All Revisions.

X. UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.

Y. UL 1651 - Fiber Optic Cable; Current Edition, Including All Revisions.

Z. UL 1863 - Communications-Circuit Accessories; Current Edition, Including All Revisions.

AA. UL 5B - Strut-Type Channel Raceways and Fittings; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. All submittals, RFIs, Scope Changes, etc. that impact Network or AV systems must be reviewed and approved by the Office of IT.
   2. Coordinate requirements for service entrance and entrance facilities with BYU's Physical Facilities coordinator and Office of IT.
   3. Coordinate the work with other trades to avoid placement of other utilities or obstructions within the spaces dedicated for communications equipment.
   4. Coordinate arrangement of communications equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   5. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
   6. Coordinate the work with other trades to provide additional framing and materials required for installation.
   7. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.

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8. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
9. Notify Architect and Owner's Construction Project Coordinator, of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

B. Sequencing:
1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 033000.

1.05 CONTRACTOR QUALIFICATIONS

A. Approved Contractors
1. Cache Valley Electric
2. Wasatch Electric
3. Linx

B. Approved contractors shall have a minimum (1) RCDD certified employee on-staff and participating in this project.

C. Approved contractors shall have BICSI certified installers or equivalent.

D. Approved contractors shall have personnel trained and certified in fiber optic cabling, termination and testing. Personnel trained in copper cabling, termination and testing. Personnel trained in pathways and support for horizontal and backbone cabling.

E. Approved contractors shall be certified by the cabling manufacturer in best practices and be able to provide the manufacturer warranty.

1.06 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.

C. Shop Drawings:
1. Show compliance with requirements on isometric schematic diagram of network layout, showing cable routings, telecommunication closets, rack and enclosure layouts and locations, service entrance, and grounding, prepared and approved by BICSI Registered Communications Distribution Designer (RCDD).
2. Indicate proposed arrangement for signal reference grids. Include locations of items to be bonded and methods of connection.
3. Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.

D. Evidence of qualifications for installer.

E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and operation of product.

F. Test Plan: Complete and detailed plan, with list of test equipment, procedures for inspection and testing, and intended test date; submit at least 60 days prior to intended test date.

G. Field Test Reports.

H. Project Record Documents: Prepared and approved by BICSI Registered Communications Distribution Designer (RCDD).
1. Record actual locations of outlet boxes and distribution frames.
2. Show as-installed color coding, pair assignment, polarization, and cross-connect layout.
3. Identify distribution frames and equipment rooms by room number on as-built drawings.

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I. Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of project record documents.

1.07 QUALITY ASSURANCE

A. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

B. Most parts are indicated below, but for parts that are not stated then the manufacturer qualification is at least 3 years' experience manufacturing products of the type needed.

C. Products: Listed, classified, and labeled as suitable for the purpose intended.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Keep stored products clean and dry.

1.09 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Correct defective Work within a 2 year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 SYSTEM DESIGN

A. Provide a complete, permanent system of cabling and pathways for voice and data communications, including cables, conduits and wireways, pull wires, support structures, enclosures and cabinets, and outlets.
   1. Provide fixed cables and pathways that comply with NFPA 70 and TIA-607-C and are UL listed or third party independent testing laboratory certified.
   2. Provide connection devices that are rated for operation under conditions of 32 to 140 degrees F at relative humidity of 0 to 95 percent, noncondensing.
   3. In this project, the term plenum is defined as return air spaces above ceilings, inside ducts, under raised floors, and other air-handling spaces.

B. Main Distribution Frame (MDF): Centrally located support structure for terminating horizontal cables that extend to telecommunications outlets, functioning as point of presence to external service provider.
   1. For the entire campus, there is one main distribution frame.
   2. For each building, there is a building distribution frame (BDF) that functions as the main distribution frame (MDF) for that building.
   3. Locate main distribution frame (MDF) as indicated on the drawings. Main distribution frame (MDF) shall be located such that no communication cable exceeds 295'.
   4. Capacity: As required to terminate all cables required by design criteria plus minimum 25 percent spare space for future cable termination and not to include the bottom 10U of a floor rack.

C. Intermediate Distribution Frames (IDF's): Support structures for terminating horizontal cables that extend to telecommunications outlets.
   1. Locate intermediate distribution frames (IDF) as indicated on the drawings.
   2. Intermediate distribution frames (IDFs) shall be located such that no communication cable exceeds 295'.

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D. Backbone Cabling: Cabling, pathways, and terminal hardware connecting intermediate distribution frames (IDF's) with main distribution frame (MDF).

E. Cabling to Outlets: Specified horizontal cabling, wired in star topology, to distribution frame; also referred to as "links".

2.02 PATHWAYS

A. Conduit: As specified in Section 260533.13; provide nylon pull strings in all spare conduits.

B. Cable Trays: As specified in Section 260536.

2.03 GROUNDING AND BONDING COMPONENTS

A. Comply with TIA-607-C.

B. Comply with Section 260526 - Grounding and Bonding of Electrical Systems.

C. Comply with Section 260536 - Cable trays for Electrical Systems.

2.04 IDENTIFICATION PRODUCTS

A. Comply with TIA-606.

B. Comply with TIA-606-B.

C. Comply with Section 260553 - Identification for Electrical Systems.

D. Comply with Campus labeling standard.

2.05 SOURCE QUALITY CONTROL

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

B. Factory test cables according to TIA-568B.

2.06 DATA LOCATIONS WITH BOXES

A. General Requirements:
   1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
   2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
   3. Provide products listed, classified, and labeled as suitable for the purpose intended.
   4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

B. Standard Format Data Boxes:
   1. Standard metal data boxes:
      a. Approved outlet boxes for communication outlets include 5 Square (5” x 5” x 2 7/8”) or 4 11/16” x 2 7/8” with a double gang mud ring.

C. Large Format Data Box: For use with conduits 1-1/2” to 2” conduits.
   1. Data box manufacturer:
      a. Hubbell Wiring Systems.
   2. Description. Model number #HBL263, 4-11/16” high, 7-3/4” wide and 3-1/4” deep. 1/2” to 2” knockouts each on sides and 1/2" to 1-1/4” knockouts on the back. No approved equivalent boxes.
   3. Extension rings.
      a. Three gang extension ring. Hubbell Wiring Systems. No approved equivalent boxes. Single gang extensions are not approved. Use the following extension rings based upon sheetrock thickness.
         1) 1/2" height, Hubbell, #HBL792.

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2) 3/4" height, Hubbell, #HBL793.
3) 1-1/4" height, Hubbell, #HBL794.

4. Low voltage partition.
   a. Hubbell, #HBL981. Compatible with 1/2", 3/4" and 1-1/4" mud ring depths.

2.07 HORIZONTAL COPPER CABLE REQUIREMENTS

A. Materials:
1. Horizontal Cabling - CommScope **2091SDB** Cat6A Plenum cabling in white jacket.
2. Work Area Outlet - Siemon CT8-FP-SS (double gang faceplate) with Siemon CTE-MXA-02-04 (angled CT adapter) with Siemon Z6A-04 (keystone ZMAX in gray). And Siemon CT-BLNK-04 (CT gray blank) where needed.
3. Patch Panel - Belden AX103115 (empty 48-port) for horizontal cabling. Load patch panels with Siemon Z6A-K01 (keystone ZMAX in black) based on the number of cables to be terminated.
4. Above Ceiling Outlets - Siemon MX-SMZ1-02 (housing for simplex locations) and Siemon MX-SMZ2-02 (housing for duplex locations). MX-SMZ1-02-M and MX-SMZ2-02-M includes magnets. Load with Siemon Z6A-04 (keystone ZMAX in gray).

2.08 INTRA-BUILDING COPPER BACKBONE CABLING

A. Materials:
1. Copper Cabling - CommScope CS37P Cat6 Plenum cabling in blue or CommScope **2091SDB** Cat6A Plenum cabling in white can be used.
2. Patch Panel - Belden AX103114 (empty 24-port) for copper backbone. Load patch panel with Siemon Z6A-K01 (keystone ZMAX in black) based on the number of cables to be terminated.

2.09 INTRA-BUILDING FIBER OPTIC BACKBONE/HORIZONTAL CABLING

A. Materials:
1. Fiber Cabling - Corning 012E88-33131-D3 (12-strand single mode plenum plastic armored) and Corning 024E88-33131-D3 (24-strand single mode plenum plastic armored).
2. Fiber Housing (LIU) - Corning CCH-04U to be installed in BDF/MDF and Corning CCH-02U to be installed in each IDF.
3. Fiber Cassettes - Corning CCH-CS12-D9-P00RE (12-strand APC) to be used for 12-strand backbone and Corning CCH-CS24-B3-P00 (24-strand APC) to be used for 24-strand backbone.

2.10 RACKS, LADDER TRAY AND IDF LAYOUT

A. Floor Racks:
1. Materials:
   a. Rack - CPI 55053-703 (7' rack)
   b. Horizontal Cable Managers - CPI 35431-702 **(one side is solid, the other side has pass-through ports)** (2U cable manager) and CPI 35432-703 **(both sides are solid)** (3U cable manager) **Updated Oct 2022**
   c. Vertical Cable Managers - CPI 32620-703 (Double sided cable manager)

B. Ladder Tray:
1. Materials:
   a. Ladder Tray - CPI 14300-718 (18" tray)
   b. Accessories - CPI 11421-718 (Wall angle kit) and CPI 10595-718 (Top plate) and CPI 10506-706 (Elevation kit 4"-6") and CPI 14304-718 (Tool-less radius drop).

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

A. Grounding and Bonding: Perform in accordance with TIA-607-C, NFPA 70 and Section 260526.

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B. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 078400.

C. Line all IDF/BDF walls with AC grade or better, void-free ¾" plywood. Install 8" AFF and 8' high with the grade A surface exposed. Mounting hardware must be flush and secured sufficiently to support attached equipment. Plywood to be **fire-treated and painted with standard white paint, or non-fire-treated and** painted with fire-retardant white paint, on all sides, including cutout areas.

3.02 INSTALLATION OF DATA LOCATIONS

A. Data Locations in Fire Walls:
   1. Provide a metal data box with conduit from box to either below floor or above ceiling.
   2. Outlet boxes are only required in non-drywall locations, with the exception where a box is required in drywall to maintain fire ratings.

B. Metal Data Boxes:
   1. Where data boxes are specified and identified as requiring a metal box. Provide a box as specified. If the box is not specified, provide a box appropriate for the required data cables.

C. Data Locations (No Box installation):
   1. Steel data boxes not required for regular data locations.
   2. Stub conduit down wall near communication open double gang mud ring. Stub conduits between 1" to 4" to within the mud ring opening.
   3. No box installed, unless otherwise indicated.
   4. Outlet locations in drywall do not require a box but if a box is not provided, then it must have a double gang mud ring.
   5. Outlet locations in drywall shall have the conduit located within at least 3 inches of the opening and must not intrude into the opening.

3.03 INSTALLATION OF PATHWAYS

A. Install pathways with the following minimum clearances:
   1. 48 inches from motors, generators, frequency converters, transformers, x-ray equipment, and uninterruptible power systems.
   2. 12 inches from power conduits, cables and panelboards.
   3. 5 inches from fluorescent and high frequency light fixtures.
   4. 6 inches from flues, hot water pipes, and steam pipes.

B. Conduit, in Addition to Requirements of Section 260533.13:
   1. All structured cabling conduits shall be at least 1" trade size conduit diameter.
   2. Electrical contractor shall install bushings and provide pull string with at least 200 lbs. tensile strength at each conduit. Both must be in place before cabling is installed.
   3. Conduit from tray to above ceiling locations, for the following equipment, i.e. Wireless Access Point (WAP), security cameras, etc., is required. A conduit is not required for a Wireless Access Point (WAP) if the location is within 10' of cable tray AND in the same room as the cable tray.
   4. Flexible conduit not permitted on this project for data/communication raceways.
   5. When installing in conduit, do not use lubricants and do not chafe or damage outer jacket.
   6. Arrange conduit to provide no more than the equivalent of two 90-degree bend(s) between pull points. Three 90-degree bends are acceptable, if one 90-degree bend is located within 5 feet of the first or last box.
   7. Boxes cannot be used as a 90-degree bend. Boxes must be installed before or after a 90-degree bend.
   8. Conduit Bends: Inside radius not less than 10 times conduit internal diameter.
   9. Arrange conduit to provide no more than 100 feet between pull points.

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10. Do not use conduit bodies. C style conduit bodies are acceptable for pull points.
11. Minimum Cover - Underground Service Entrance: Comply with 1 and Communications Service Provider requirements.

3.04 INSTALLATION OF CABLING

A. General Practices:
   1. Do not bend cable at radius less than manufacturer's recommended bend radius; for unshielded, twisted pair cable, use bend radius of not less than 4 times cable diameter.
   2. Do not over-cinch or crush cables.
   3. Cable ties are not permitted. Velcro ties only.
   4. Do not exceed manufacturer's recommended cable pull tension.
   5. Painted cabling will not be accepted, per manufacturer standards.
   6. Cabling that gets wet, at any point in the installation, will not be accepted per manufacturer standards.
   7. Service Loops (Slack or Excess Length): Provide the following minimum extra length of cable, looped neatly:
      a. At Distribution Frames: Horizontal cabling should follow the longest path provided by cable and ladder tray, within the MDF/IDF. Fiber backbone shall have 10 feet of service loop mounted on the wall and not stored in the cable or ladder tray.
      b. At the Premise: Horizontal cabling shall have an 8-inch to 12-inch service loop, attached at the point where the cable enters the conduit after exiting the cable tray. No service loops are to be stored in the cable tray. Where space is a challenge, the service loop can be stored under the cable tray.

B. Horizontal Copper Cabling:
   1. Each work area data outlet shall be directly connected to an IDF with no splices or intermediate terminations.
   2. For 4-pair cables in conduit, do not exceed 25 pounds pull tension.
   3. Cable length from the IDF to the work area outlet cannot exceed 295 feet.
   4. Use T568B wiring configuration.

C. Intra-Building Copper Backbone Cabling:
   1. BYU OIT will provide the number of 4-pair copper cables to be installed, between the BDF/MDF and each IDF. This number may vary from IDF to IDF and will be installed in the IDF on a dedicated patch panel.
   2. No horizontal cabling shall be terminated on the patch panel dedicated for copper backbone.
   3. Support vertical cable at intervals as recommended by manufacturer.
   4. Each backbone cable shall be directly connected to an IDF with no splices or intermediate terminations.

D. Intra-Building Fiber Optic Backbone/Horizontal Cabling:
   1. All fiber backbone shall be single mode with APC SC connectors.
   2. If needed, any horizontal fiber cabling will be specified to the contractor by BYU OIT.
   3. Support vertical cable at intervals as recommended by the manufacturer.
   4. Each backbone cable shall be directly connected to an IDF with no intermediate terminations.
   5. All terminations shall be spliced on cassettes, defined in the parts list.

3.05 RACKS, LADDER TRAY, AND IDF LAYOUT

A. See Appendix 1 with the general IDF layout. Coordinate final layout with BYU OIT. BDF/IDFs have a 2 rack minimum.

B. See Appendix 2 for the general rack(s) layout.

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C. Wall-Mounted Racks and Enclosures (if approved):
   1. Install to plywood backboards unless otherwise indicated.
   2. Mount so height of topmost panel does not exceed 78 inches above floor.
   3. Parts:
      a. To be furnished by BYU OIT, to the installer, as needed. The installer to install all equipment, per manufacturers and BYU OIT's recommendations.

D. Ladder Tray
   1. Ladder tray shall be installed to provide cable path from the cable tray in the IDF to the racks where the cable will be terminated.
   2. Ladder tray shall be 18" wide unless otherwise stated.
   3. Ladder tray shall use elevation kit.

3.06 LABELING AND IDENTIFICATION

A. Campus labeling standard is "IDF Identifier-Patch Panel Identifier & Port". The "IDF Identifier" will be furnished to the contractor by BYU OIT. Patch panels are labeled A-Z, top to bottom, left to right. The alpha assigned to the patch panel determines the "patch panel identifier". An example of a cable label is 2B-A13.
   1. Drawings with jack numbers are to be provided to BYU OIT for review before a contractor begins installation/labeling.
   2. Use cable markers to identify cables at each end. Use the campus labeling standard to label horizontal cables. BYU OIT will furnish names for the backbone cables. Backbone cables are to be labeled on both ends of the cable with this identification.
   3. Provide permanent printed labels, black text on white backing, at all work area outlets and patch panels. No handwritten labels are permitted.
   4. Label the inside and outside of the LIU door with the cable ID, number of strands, and the room number of the IDF that the fiber is destined to.

3.07 INSTALLATION OF GROUNDING AND BONDING

A. Grounding and Bonding: Perform in accordance with TIA-607-C and NFPA 70.

B. Each rack shall be grounded to the IDF ground system with an insulated #6 AWG copper ground wire and shall be bonded to the rack with an approved physical connector.

C. Ladder tray shall be grounded to the IDF ground system with an insulated #6 AWG copper ground wire and shall be bonded to the tray with an approved physical connector.

D. All communication cables with shields shall be tied to the BDF/MDF ground system.

E. All pathway grounds for conduit and cable tray to be completed by the electrical sub according to section 26.

3.08 FIELD QUALITY CONTROL

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

B. Comply with inspection and testing requirements of specified installation standards.

C. Visual Inspection:
   1. Inspect cable jackets for certification markings.
   2. Inspect cable terminations for color coded labels of proper type.
   3. Inspect outlet plates and patch panels for complete labels.
   4. Inspect patch cords for complete labels.

D. Testing - Copper Cabling:

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1. Test all horizontal cables with a Fluke cable analyzer or equivalent tester. Save all test results. Results are to be provided to the cable manufacturer and BYU OIT at the conclusion of the installers work.
2. Test backbone cables after termination but before cross-connection.
3. Test backbone cables for DC loop resistance, shorts, opens, intermittent faults, and polarity between connectors and between conductors and shield, if cable has overall shield.

E. Testing - Fiber Optic Cabling:
1. Backbone: Perform optical fiber end-to-end attenuation test using an optical time domain reflectometer (OTDR) and manufacturer's recommended test procedures; perform verification acceptance tests and factory reel tests.

3.09 ACCEPTANCE

A. The installer will provide a minimum of 2 copies of the As-Built drawings for horizontal and backbone cabling to BYU OIT within 2 days of completion. This shall be done in accordance to EIA/TIA 606, standard for the administration of building telecommunications systems.

B. Provide an electronic copy of all test results in the original test format to BYU OIT within 10 days of completion.

C. The installer shall submit for the CommScope 15-year system warrantee and provide the certification for warrantee to BYU OIT within 90 days of completion.

END OF SECTION

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SECTION 284050

CONDUCTORS AND CABLES FOR FIRE DETECTION AND ALARM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. 1. Fire alarm wire and cable.

B. 2. Single mode optical fiber cabling.

C. 3. Identification products.

1.02 RELATED REQUIREMENTS

A. Section 016000 - Product Requirements: Fundamental product requirements, substitutions and product options, delivery, storage, and handling.

B. Section 260519 - Low-Voltage Electrical Power Conductors and Cables.

C. Section 260526 - Grounding and Bonding for Electrical Systems.

D. Section 260533.13 - Conduit for Electrical Systems.

E. Section 260533.16 - Boxes for Electrical Systems.

F. Section 260536 - Cable Trays for Electrical Systems.

G. Section 260533 - Identification for Electrical Systems.

H. Section 284600 - Fire Detection and Alarm.

1.03 DEFINITIONS

A. BICSI: Building Industry Consulting Service International.

B. EMI: Electromagnetic interference.

C. IDC: Insulation displacement connector.

D. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.

E. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).

F. RCDD: Registered Communications Distribution Designer.

1.04 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.

B. FM (AG) - FM Approval Guide; current edition.

C. ITS (DIR) - Directory of Listed Products; current edition.

D. NEMA MG 1 - Motors and Generators; 2016.

E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

C. Provide allowable pulling tension of cable.

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D. Provide cable connectors and terminations information, recommended by the manufacturer.

E. Project Record Documents: Record actual locations of all fire alarm junction boxes.

1.06 QUALITY ASSURANCE

A. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

B. Copies of Documents at Project Site: Maintain at the project site a copy of each referenced document that prescribes execution requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Do not install conductors and cables that are wet, moisture damaged, or mold damaged.
   1. Indications that wire and cables are wet or moisture damaged include, but are not limited to, discoloration and sagging of factory packing materials.

B. Environmental Limitations: Do not deliver or install optical fiber and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.08 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Correct defective Work within a three month period after Date of Substantial Completion.

C. Fire alarm system shall be completely installed, per contract documents, and operating per manufacture's recommendations, prior to the commencement of the warranty period.

D. Upon Date of Substantial Completion, the contractor shall provide a document stating the date commencing the system warranty.

E. Provide five year manufacturer warranty for entire system.

PART 2 PRODUCTS

2.01 PATHWAYS

A. Pathways for fire alarm cabling and conductors, see Specification Section 260533.16 for additional requirements.

2.02 SOURCE QUALITY CONTROL

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

B. According to BICSI ITSIM, telecommunications cables should be tested upon receipt. Low-voltage wires and cables do not normally require testing before installation.

C. Test cables upon receipt at Project site.
   1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical fiber flashlight or optical loss test set.
   2. Test optical fiber cable on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector; include the loss value of each. Retain test data and include the record in maintenance data.

2.03 FIRE ALARM CONDUCTORS AND CABLE

A. Conductor and Cable Manufacturers:
   1. Omni
   2. Beldon.
   3. Genesis.

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4. Windy City Wire; www.smartwire.com, 801-633-0651.

B. Non-Power-Limited Circuits:
   1. Copper conductors with 600-V rated, 75 deg C, color-coded insulation.
      a. Low-Voltage Circuits: No. 16 AWG, minimum.
      b. Line-Voltage Circuits: No. 12 AWG, minimum.

C. Fire Alarm-Circuit Conductor Identification, 600 V or Less: For conductors in pull boxes, junction boxes and enclosures. Use factory colored cables and conductors to identify the individual circuits.
   1. Fire alarm device constant power (24 VDC):
      a. Install conductors throughout each trunk line, i.e., water bugs, control modules, etc.
      b. Conductor colors:
         1) Red (+), #12, CU.
         2) Black (-), #12, CU.
   2. Fire Alarm Remote (NAC) Horn Strobe Booster Panel Sync Circuit:
      a. Install conductors from main fire alarm panel to each horn strobe booster panel.
      b. Conductor colors:
         1) Purple (+), #12, CU.
         2) Yellow (-), #12, CU.
   3. Color-Coding for fire alarm Signal Line Circuits (SLC) circuits. Use colors listed below. All conductors shall be Red and Black, #16, twisted pair, CU; enclosed in a non-shielded cable.
      a. SLC Circuit #1. Grey cable with red (+) and black (-) conductors; Cable shall not be stripped.
      b. SLC Circuit #2. Grey cable with red (+) and black (-) conductors; Provide cable with a black stripe.
      c. SLC Circuit #3. Grey cable with red (+) and black (-) conductors; Provide cable with a red stripe.
      d. SLC Circuit #4. Grey cable with red (+) and black (-) conductors; Provide cable with a purple stripe.
      e. SLC Circuit #5. Grey cable with red (+) and black (-) conductors; Provide cable with a brown stripe.
      f. SLC Circuit #6. Grey cable with red (+) and black (-) conductors; Provide cable with a yellow stripe.
      g. SLC Circuit #7. Grey cable with red (+) and black (-) conductors; Provide cable with a white stripe.
      h. SLC Circuit #8. Grey cable with red (+) and black (-) conductors; Provide cable with a green stripe.
      i. SLC Circuit #9. Grey cable with red (+) and black (-) conductors; Provide cable with a pink stripe.
      j. SLC Circuit #10. Grey cable with red (+) and black (-) conductors; Provide cable with a blue stripe.
   4. Color-Coding for fire alarm speaker circuits. Use colors listed below. Cable conductor colors shall be Red and Black, #16, TSP, CU.
      a. Speaker Circuit #1. Grey PVC jacket with red (+) and black (-) conductors; Provide cable with an orange stripe.
      b. Speaker Circuit #2. Grey PVC jacket with red (+) and black (-) conductors; Provide cable with orange and black stripes.
      c. Speaker Circuit #3. Grey PVC jacket with red (+) and black (-) conductors; Provide cable with orange and red stripes.

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d. Speaker Circuit #4. Grey PVC jacket with red (+) and black (-) conductors; Provide cable with orange and purple stripes.

5. Color-Coding for fire alarm horn and horn/strobes. Use colors listed below. All conductors shall be Blue and Grey, #12, CU, stranded.
   a. Strobe Circuit #1. Conductors shall be blue (+) and grey (-), with no stripes.
   b. Strobe Circuit #2. Conductors shall be blue (+) and grey (-), with a black stripe.
   c. Strobe Circuit #3. Conductors shall be blue (+) and grey (-), with a red stripe.
   d. Strobe Circuit #4. Conductors shall be blue (+) and grey (-), with a purple stripe.
   e. Strobe Circuit #5. Conductors shall be blue (+) and grey (-), with a brown stripe.
   f. Strobe Circuit #6. Conductors shall be blue (+) and grey (-), with a yellow stripe.
   g. Strobe Circuit #7. Conductors shall be blue (+) and grey (-), with a white stripe.
   h. Strobe Circuit #8. Conductors shall be blue (+) and grey (-), with a green stripe.
   i. Strobe Circuit #9. Conductors shall be blue (+) and grey (-), with a pink stripe.
   j. Strobe Circuit #10. Conductors shall be blue (+) and grey (-), with a black and red stripe.
   k. Strobe Circuit #11. Conductors shall be blue (+) and grey (-), with a purple and brown stripe.
   l. Strobe Circuit #12. Conductors shall be blue (+) and grey (-), with a yellow and white stripe.
   m. Strobe Circuit #13. Conductors shall be blue (+) and grey (-), with a green and pink stripe.
   n. Strobe Circuit #14. Conductors shall be blue (+) and grey (-), with a black, red and purple stripe.
6. Color-Coding for fire alarm sounder bases. Use colors listed below. Provide two (2) white, #12, CU, (24 VDC power) in each cable.
   a. Sounder Base Circuit #1. Conductors shall be red (+) stripe conductor and black (-) stripe conductor.
7. Door Holding Circuiting: #12, CU
   a. Brown "-" door holder power.
   b. Orange "+" door holder power.
8. The SLC cable and the four (4) #12 conductors (constant power and door holder circuits) are to be installed in every main 3/4" trunk line, for present and/or future use.
9. Never install more than eight conductors in a conduit.
10. Identification of Fire Alarm Cables on Multiple Building Floors:
    a. Do not intermix fire alarm cabling between floors. Provide dedicated fire alarm circuiting for each floor.
    b. For each floor, start with Circuiting #1 conductors/cables.

D. BACKBOARDS
   1. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches. Comply with requirements for plywood backing panels in Section 061000.

2.04 FIRE ALARM FIBER OPTIC CABLES

A. Fiber Optic Cable:
   1. Manufacturers:
      a. Corning Cable Systems.
   2. Description: Single mode, 6 fiber, tight buffer, optical fiber cable.
      a. Comply with ICEA S-83-596 for mechanical properties.
      b. Comply with TIA/EIA-568-B.3 for performance specifications.
      c. Flame-retardant and UV-retardant.
      d. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
         1) Riser Rated: Type OFNR, complying with UL 1666.

e. Maximum Attenuation: 0.65 dB/km at 1310 nm; 0.65 dB/km at 1383 and 0.05 dB/km at 1550 nm.
f. Model Number: #006E8F-31131-29.

3. Cable Colors:
   a. Tight Buffer Colors: First pair, Blue and Orange; second pair, Green and Brown; third pair (spare), Slate and White.
4. Jacket:
   a. Jacket Color: Black.
   b. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-B.
   c. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

B. Fiber Optic Cable Hardware:
1. Manufacturers:
   a. Corning Cable Systems.
2. Cable Connecting Hardware: Comply with the Fiber Optic Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.
   a. Quick-connect, simplex and duplex, Type SC connectors. Insertion loss not more than 0.75 dB.
   b. Cable Connection Boxes (Coupler Panel):
      1) Corning, #SPH-01P.
3. Patch cables:
   a. For LC Connections, provide patch cables with white/yellow and yellow/white cables.
   b. For SC Connections, provide patch cables with black/red and red/black cables.

PART 3 EXECUTION

3.01 INSTALLATION OF PATHWAYS

A. Cable Trays: Comply with NEMA VE 2 and TIA-569-B. Cable tray in non-plenum areas.

B. Comply with TIA-569-B for pull-box sizing and length of conduit and number of bends between pull points.

C. Comply with requirements in Sections 260533.13, for installation of conduits and wireways.

D. Install manufactured conduit sweeps and long-radius elbows whenever possible.

3.02 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements in Section 260529, for installation of supports for pathways, conductors and cables.

3.03 INSTALLATION OF CONDUCTORS AND CABLES

A. Comply with NECA 1.

B. Conductors: Size according to system manufacturer's written instructions unless otherwise indicated.

C. General Requirements for Cabling:
1. Comply with TIA/EIA-568-B.1.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.

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5. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
6. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
7. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
8. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
9. Fire-Rated Cables: Use of 2-hour, fire-rated fire alarm cables, NFPA 70, Types MI and CI, shall not be permitted.

3.04 FIRE ALARM WIRING INSTALLATION

A. Comply with NECA 1 and NFPA 72.

B. Raceway Method: Install wiring and cabling in metal raceway according to Sections 260519 and 260533.16.
   1. Minimum conduit size shall be 3/4 inch.
   2. Fire alarm circuits and equipment control wiring associated with the fire alarm system shall be installed in a dedicated raceway system. This raceway system shall not be used for any other type of systems.
   3. Install wiring in metal raceways and wireways.
   4. Install fiber optic cable in raceways or cable trays. In cable trays, cable only permitted in non-plenum areas.
   5. Conceal raceway and wiring except in unfinished spaces. Surface raceways shall not be permitted in finished areas, unless finished surface is concrete, block or other hard surface. Coordinate such finished areas with campus electrical engineer.
   6. Control and data transmission wiring shall not share conduit with other building wiring systems.
   7. Cables and raceways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable.
   8. Signaling Line Circuits:
      a. Power-limited fire alarm cables shall not be installed in the same cable or raceway as signaling line circuits.
      b. Voice annunciation. Provide a dedicated conduit for voice/speaker cabling.
      c. Strobe cabling shall be installed with the voice/speaker cabling.

C. Fiber Optic Cabling Method:
   1. Route fiber cable from nearest campus fire alarm communication gateway, to the fire alarm coupler panel. Do not extend fiber cabling into the fire alarm panel.
   2. Route fiber cable between the fire alarm coupler panel and the annunciator panel.
   3. Final connection between the fire alarm panel and coupler panel shall be by a SC to LC patch cable. Extend patch cable to NCM (Network Control Module) located in main fire alarm panel.
   4. Final connection in annunciator panel shall be by a SC to LC patch cable. No coupler panel required for annunciator panels.

D. All new power limited cabling shall be installed in EMT conduit. Wire is to be provided by the electrical contractor and closely coordinated so as to insure proper codes and U.L. requirements are met, as well as the BYU color codes.

E. Box extensions. Provide no more than one box extension for each junction or pull boxes.

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F. All cable splices at the main panel shall be made in the wire gutter. Only wire to be connected to fire alarm system shall be pulled in the fire alarm control panel. All wire is to be terminated properly, most devices have wire clamps. Use terminal forks when clamps are missing.

G. All terminations to field devices shall be attached to proper terminal points.

H. Run a #12 AWG green ground wire to the main service connection, and in all 120 VAC branch circuits.

I. Wiring color code shall be maintained throughout the installation.

J. All wiring "passing through" junction boxes shall be un-broken and looped out of each junction box 8"+ (When cut for future use, each resulting wire will be 8" long). Where such installation is especially difficult, the wires may be cut and wire nuts installed. The addressable loop cable will be installed un-broken as much as possible. (Intent: Wires are to be broken only at their points of termination.) Leave minimum of 12" loop or 8" wire slack in all junction & pull boxes where wire is feeding through to provide capability for future connection at that point.

K. Connection of wire to wire: Use wire nuts on all connections including the speaker drain wire. Drain wire and metal sheathing in speaker cable must be taped with no metal exposed, and drain wire length is to be 2" or longer. When taping the drain, put the wire nut on, fold back on sheathed cable and tape both cables together with folded drain.

L. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

M. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

3.05 GROUNDING

A. For communications wiring, comply with ANSI-J-STD-607-A and with BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. For low-voltage wiring and cabling, comply with requirements in Section 260526.

3.06 FIELD QUALITY CONTROL

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

3.07 SYSTEM STARTUP

A. Provide manufacturer's field representative to perform systems startup.

B. Prepare and start equipment and systems in accordance with manufacturers' instructions and recommendations.

C. Adjust for proper operation within manufacturer's published tolerances.

3.08 CLOSEOUT ACTIVITIES

A. See Section 017800 - Closeout Submittals, for closeout submittals.

B. See Section 017900 - Demonstration and Training, for additional requirements.

C. Demonstrate proper operation of equipment to Owner's designated representative.

D. Demonstration: Demonstrate operation of system to Owner's personnel.
   1. Use operation and maintenance data as reference during demonstration.

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2. Conduct walking tour of project.
3. Briefly describe function, operation, and maintenance of each component.

E. Training: Train Owner's personnel on operation and maintenance of system.
1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
2. Provide minimum of two hours of training.
3. Instructor: Manufacturer's training personnel.
4. Location: At project site.

END OF SECTION

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