BRIGHAM YOUNG

UNIVERSITY

RB - RENOVATE DANCE STUDIOS 270 & 278
DANCE DEPARTMENT

Richards Building

SPECIFICATIONS

FACILITIES PLANNING

240 BRWB PROVO, UTAH 84602
PHONE: (801) 422-5504
FAX: (801) 422-0566

BYU WORK ORDER

M9372

DATE OF RECORD: April 01, 2024

CONSTRUCTION DOCUMENTS

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: Provo, Utah 84602
   2. 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. Name: Keith Austin (Construction Project Manager)
   2. Email: keith_austin@byu.edu
   3. Telephone: (801) 404-1531

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: BYU Facilities Planning
   2. Primary Contact: Keith Martin
      a. Email: keith_martin@byu.edu
      b. Telephone: (801) 623-8894

B. Interior Designer:
   1. Company Name: BYU Facilities Planning
   2. Primary Contact: Corinne Priest
      a. Email: corinne_priest@byu.edu
      b. Telephone: (801) 623-8894

C. Structural Engineer:
   1. Company Name: TBSE Structural Engineers
   2. Primary Contact: Luke Balling
      a. Email: lballing@tbse.us
      b. Telephone: (801) 372-1926

D. Mechanical Engineering:
   1. Company Name: BYU Facilities Planning
   2. Primary Contact: Chris Reynolds
      a. Email: chris_reynolds@byu.edu
      b. Telephone: (801) 367-0588

E. Electrical Engineering:
   1. Company Name: BYU Facilities Planning
   2. Primary Contact: Luke Moore
      a. Email: luke_moore@byu.edu
      b. Telephone: (801) 227-9647

END OF SECTION

BRIGHAM YOUNG UNIVERSITY

STANDARD CONTRACT REQUIREMENTS

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BRIGHAM YOUNG UNIVERSITY

STANDARD CONTRACT REQUIREMENTS

27 March 2024

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

Re: Invitation to Bid – RB Renovate Dance Studios 270 & 278
W.O. M9372

To Whom It May Concern:

You are invited to bid on the above-referenced project. This project consists of renovating existing dance studio rooms 270 & 278 to include a folding partition, millwork, lights, door, and flooring system. The completion date for this project is 31 July 2024.

Plans will be available at the mandatory pre-bid which has been scheduled for 3 April 2024 at 3PM in Room 115 BRWB. Bids will be opened and read aloud on 17 April 2024 at 11AM in Room 115 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: RB Renovate Dance Studios 270 & 278

WORK ORDER NUMBER: M9372

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: 29 April 2024

B. Completion Date: 31 July 2024

SECTION 7--PREBID CONFERENCE

A. Prebid Conference will be:

Date: 3 April 2024

Time: 3PM

Place: Room 115, Brewster Building

SECTION 8--RECEIPT AND OPENING OF BIDS:

A. Bids will be received:

Date: 17 April 2024

Time: 11AM

Place: Room 115, 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 RB Renovate Dance Studios 270 & 278

WORK ORDER NUMBER M9372

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: RB Renovate Dance Studios 270 & 278 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* ($)

Alt. #1 – Specialty Light Fixtures ($)

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

1. The bidder agrees to complete the work on or before 31 July 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 RB Renovate Dance Studios 270 & 278

WORK ORDER NUMBER M9372

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 Dave or Ray or whomever, Title of Reviewer, and approved by Matt Giles, 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 Dave or Ray or whomever, Title of Reviewer, and approved by Matt Giles, 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 Matt Giles.

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
Matt Giles 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 31 July 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 $500 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 $500 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										
13										
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28										
29										
30										
31										
32										
TOTALS										

GENERAL REQUIREMENTS - TABLE OF CONTENTS

SECTION 013000

ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL **UPDATED 26 MARCH 2021**

1.01 SECTION INCLUDES **SEE BOLDED UPATES**

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.
   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, Construction PM 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.

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.

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.

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.

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.

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.** **Updated 26 Mar 2021**

END OF SECTION

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.

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

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. Substitution limitations.

F. Procedures for Owner-supplied products.

G. 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 012500 - Substitution Procedures: Substitutions made during and after the Bidding/Negotiation Phase.

C. Section 014000 - Quality Requirements: Product quality monitoring.

D. 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.

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

PART 3 EXECUTION

3.01 SUBSTITUTION LIMITATIONS

A. See Section 012500 - Substitution Procedures.

3.02 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.

3.03 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.

3.04 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.

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

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.

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

C. 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.

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

E. 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.

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 mis-fabrication.

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.

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.

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.

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.

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.

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

SECTION 017800

CLOSEOUT SUBMITTALS

PART 1 GENERAL **UPDATED 26 MARCH 2021**

1.01 SECTION INCLUDES **SEE BOLDED UPDATES**

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:
   1. Drawings & 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 for maintenance

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.

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 trouble shooting; 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.

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

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. Conveying systems.
   6. Items specified in individual product Sections.

C. Training of Owner personnel in care, cleaning, maintenance, and repair is required for:
   1. Roofing, waterproofing, and other weather-exposed or moisture protection products.
   2. Finishes, including flooring, wall finishes, ceiling finishes.
   3. Fixtures and fittings.
   4. 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.
      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.

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

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SECTION 024100

DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Building demolition excluding removal of hazardous materials and toxic substances.

B. Selective demolition of building elements for alteration purposes.

C. 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

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

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. 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.

C. 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.
   1. Minimum of 5 years of experience.

PART 2 PRODUCTS -- NOT USED

PART 3 EXECUTION

3.01 SCOPE

A. Remove and legally dispose of all materials, being demolished, indicated on plans..

B. Remove other items indicated, for salvage, relocation, recycling, 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, lead, PCB's, and mercury.

H. Perform demolition in a manner that maximizes salvage and recycling of materials.
1. Dismantle existing construction and separate materials.
2. Set aside reusable, recyclable, and salvageable materials; store and deliver to collection point or point of reuse.

3.03 EXISTING UTILITIES

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

B. Protect existing utilities to remain from damage.

C. Do not disrupt public utilities without permit from authority having jurisdiction.

D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.

E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without 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.

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. Remove existing work as indicated and as required to accomplish new work.
   1. Remove items indicated on drawings.

D. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, Telecommunications: 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.
   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.

E. 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

SECTION 062000
FINISH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Finish carpentry items.

B. Wood door frames, glazed frames.

C. Wood casings and moldings.

D. Hardware and attachment accessories.

1.02 RELATED REQUIREMENTS

A. Section 061000 - Rough Carpentry: Support framing, grounds, and concealed blocking.

B. Section 064100 - Architectural Wood Casework: Shop fabricated custom cabinet work.

C. Section 064216 - Wood-Veneer Paneling: Shop fabricated custom paneling.

D. Section 081416 - Flush Wood Doors.

E. Section 099123 - Interior Painting: Painting and finishing of finish carpentry items.

F. Section 099300 - Staining and Transparent Finishing: Staining and transparent finishing of finish carpentry items.

1.03 REFERENCE STANDARDS

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.

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. AWPA U1 - Use Category System: User Specification for Treated Wood; 2017.

G. BHMA A156.9 - American National Standard for Cabinet Hardware; 2015.

H. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood; 2016.

I. PS 1 - Structural Plywood; 2009.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with plumbing rough-in, electrical rough-in, and installation of associated and adjacent components.

B. Sequence installation to ensure 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:
   1. Provide data on fire retardant treatment materials and application instructions.
   2. Provide instructions for attachment hardware and finish hardware.

C. 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.

D. Samples: Submit three samples of finish plywood, 12 by 12 inch in size illustrating wood grain and specified finish.

E. Samples: Submit three samples of wood trim 12 inch long.

F. Certificate: Submit labels and certificates required by quality assurance and quality control programs.

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. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.
   2. 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 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.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver factory-fabricated units to project site in original packages, containers or bundles bearing brand name and identification.

B. Store finish carpentry items under cover, elevated above grade, and in a dry, well-ventilated area not exposed to heat or sunlight.

C. Protect work from moisture damage.

D. Handle materials and products to prevent damage to edges, ends, or surfaces.

PART 2 PRODUCTS

2.01 FINISH CARPENTRY ITEMS

A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

B. Surface Burning Characteristics: Provide materials having fire and smoke properties as required by applicable code.

C. Interior Woodwork Items:
   1. Moldings, Bases, Casings, chair rails, and Miscellaneous Trim: As indicated on drawings.
   2. Valance Work: Clear fir; prepare for paint finish.

2.02 LUMBER MATERIALS

A. Hardwood Lumber: red oak, cherry, maple, walnut species as shown on drawings, Sawn as indicated on drawings, maximum moisture content of 6 percent; with vertical grain, of quality suitable for transparent finish.

2.03 SHEET MATERIALS

A. Softwood Plywood, Not Exposed to View: Any face species, medium density fiberboard core; PS 1 Grade A-B, glue type as recommended for application.

B. Softwood Plywood, Exposed to View: Face species as indicated, plain sawn, medium density fiberboard core; PS 1 Grade A-B, glue type as recommended for application.

C. Hardwood Plywood: Face species as indicated, plain sawn, book matched, medium density fiberboard core; HPVA HP-1, Front Face Grade AA, Back Face Grade 1, glue type as recommended for application.

2.04 FASTENINGS

A. Adhesive for Purposes Other Than Laminate Installation: Suitable for the purpose; not containing formaldehyde or other volatile organic compounds.

B. Adhesive for factory-fabricated units: Manufacturer's recommended adhesive for application.

C. Fasteners of size and type to suit application.

D. Fasteners for Exterior Applications: Hot-dipped galvanized steel complying with ASTM A153/A153M; length required to penetrate wood substrate 1-1/2 inch minimum.

E. Concealed Joint Fasteners: Threaded steel.

2.05 ACCESSORIES

A. Lumber for Shimming and Blocking: Softwood lumber of Douglas Fir species.

B. Primer: As specified in Section 099000.

C. Wood Filler: Water base, tinted to match surface finish color.

2.06 HARDWARE

A. Hardware: Comply with BHMA A156.9.

B. Shelf Standards: KV 85 Series style, Anochrome finish; Double Slotted Standards manufactured by Knape and Vogt, KV.

C. Shelf Brackets: KV 185 style, Anochrome finish; Extra Duty Bracket manufactured by Knape and Vogt, KV.

2.07 FABRICATION

A. Shop assemble work for delivery to site, permitting passage through building openings.

B. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.

2.08 SHOP FINISHING

A. Sand work smooth and set exposed nails and screws.

B. Apply wood filler in exposed nail and screw indentations.

C. On items to receive transparent finishes, use wood filler that matches surrounding surfaces and is of type recommended for the applicable finish.

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 - 1, Lacquer, Nitrocellulose.
      b. Stain: As selected by Architect.
      c. Sheen: Satin.

E. Back prime woodwork items to be field finished, prior to installation.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify adequacy of backing and support framing.

B. Verify mechanical, electrical, and building items affecting work of this section are placed and ready to receive this work.

C. See Section 061000 for installation of recessed wood blocking.

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 materials and components in place, plumb and level.

C. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim to conceal larger gaps.

3.03 TOLERANCES

A. Maximum Variation from True Position: 1/16 inch.

B. Maximum Offset from True Alignment with Abutting Materials: 1/32 inch.

END OF SECTION

SECTION 064100

ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL **UPDATED 2/21, FEB 23, JULY 12, NOV 2021, DEC 2023**

1.01 SECTION INCLUDES **SEE CHANGES IN BOLD**

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 088000 - Glazing: Glass for casework.

C. 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.

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.

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.** **Updated July 12, 2021**

C. Glass: Type A as specified in Section 088000.

D. Fasteners: Size and type to suit application.

E. Concealed Joint Fasteners: Threaded steel.

F. Grommets: Standard plastic, painted metal, or rubber grommets for cut-outs, in color to match adjacent surface.

2.05 HARDWARE

A. Hardware: BHMA A156.9, types as indicated for quality grade specified.

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. Updated 2/21.**

1. **Use Deadbolt Style. CompX National Lock C8703-MKKD-14A Updated July 12, 2021**

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.

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** **Updated Nov 2021**
   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.

G. Site glaze glass materials using the Interior Dry method specified in Section 088000.

3.03 ADJUSTING

A. Adjust installed work.

B. Adjust moving or operating parts to function smoothly and correctly.

3.04 CLEANING

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

END OF SECTION

SECTION 079200
JOINT SEALANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Non-sag gun-able 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 078400 - Firestopping: Firestopping sealants.

E. Section 079513 - Expansion Joint Cover Assemblies: Sealants forming part of expansion joint cover assemblies.

F. Section 087100 - Door Hardware: Setting exterior door thresholds in sealant.

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

H. Section 092216 - Non-Structural Metal Framing: Sealing between framing and adjacent construction in acoustical and sound-rated walls and ceilings.

I. Section 093000 - Tiling: Sealant between tile and plumbing fixtures and at junctions with other materials and changes in plane.

J. 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.
   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.

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/#sle.
   2. Sika Corporation; _____: www.usa-sika.com/#sle.
   3. Tremco Commercial Sealants & Waterproofing; ____: www.tremcosealants.com/#sle.

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/#sle.
   2. Sika Corporation; _____: www.usa-sika.com/#sle.
   3. Tremco Commercial Sealants & Waterproofing; ____: www.tremcosealants.com/#sle.

2.02 JOINT SEALANT APPLICATIONS

A. Scope:
   1. Exterior Joints: Seal open joints, whether or not the joint is indicated on drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to, the following items.
      a. Wall expansion and control joints.
      b. Joints between door, window, and other frames and adjacent construction.
      c. Joints between different exposed materials.
      d. Openings below ledge angles in masonry.
      e. Other joints indicated below.
   2. 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.
   3. Do not seal the following types of joints.
      a. Intentional weepholes in masonry.
      b. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
      c. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
      d. Joints where installation of sealant is specified in another section.
      e. Joints between suspended panel ceilings/grid and walls.

B. Exterior Joints: Use non-sag non-staining silicone sealant, unless otherwise indicated.

C. 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/#sle.
      b. Dow Chemical Company; 795 Silicone Building Sealant: consumer.dow.com/en-us/industry/ind-building-construction.html/#sle.
      c. Sika Corporation; Sikasil WS-290: www.usa-sika.com/#sle.
      d. Sika Corporation; Sikasil WS-295: www.usa-sika.com/#sle.
      e. Tremco Commercial Sealants & Waterproofing; Spectrem 1: www.tremcosealants.com/#sle.
      f. Tremco Commercial Sealants & Waterproofing; Spectrem 2: www.tremcosealants.com/#sle.
      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/#sle.
      b. Tremco Commercial Sealants & Waterproofing; Dymeric 240 FC: www.tremcosealants.com/#sle.

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/#sle.
      b. Tremco Commercial Sealants & Waterproofing; Spectrem 900SL: www.tremcosealants.com/#sle.

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.

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. Perform field quality control inspection/testing as specified in PART 1 under QUALITY ASSURANCE article.

B. Non-Destructive Adhesion Testing: If there are any failures in first 100 linear feet, notify Architect immediately.

C. Destructive Adhesion Testing: If there are any failures in first 1000 linear feet, notify Architect immediately.

D. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.

E. Repair destructive test location damage immediately after evaluation and recording of results.

END OF SECTION

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.

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.

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 INSULATING GLAZING

A. Center-Set Style, Thermally-Broken:
   1. Basis of Design: Kawneer.
   2. Vertical Mullion Dimensions: 2 inches wide by 4-1/2 inches deep.

2.02 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)

2.03 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.

2.04 MANUFACTURERS

A. Aluminum-Framed Storefront and Doors:
   1. Kawneer North America; _____: www.kawneer.com

2.05 STOREFRONT

A. Aluminum-Framed Exterior 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: Class I natural anodized.
   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.
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. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.

B. Color: As indicated on drawings.

2.09 HARDWARE

A. For each door, include weatherstripping, sill sweep strip, and threshold.

B. Weatherstripping: Wool pile, continuous and replaceable; provide on all exterior doors.

C. Sill Sweep Strips: Resilient seal type, retracting, of neoprene; provide on all exterior doors.

D. Threshold: Extruded aluminum, one piece per door opening, ribbed surface; provide on all exterior doors.

E. Hinges: Geared type, heavy duty, concealed leaf; continuous.

F. Push/Pull Set: Standard configuration push/pull handles.

G. Exit Devices: Panic type.

H. Door Closers: Exposed overhead.

I. Automatic Door Operators and Actuators: As specified in Section 084229.

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.
   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. Water-Spray Test: Provide water spray quality test of installed storefront components in accordance with AAMA 501.2 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.

C. 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.

D. 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

SECTION 088300

MIRRORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Glass mirrors.
   1. Annealed float glass.

1.02 SUBMITTALS

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

B. Product Data on Mirror Types: Submit structural, physical and environmental characteristics, size limitations, special handling and installation requirements.

C. Samples: Submit two samples, 12 x12 inch in size, illustrating mirrors design, edging, and coloration.

D. Manufacturer's Certificate: Certify that mirrors, meets or exceeds specified requirements.

E. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.

1.03 QUALITY ASSURANCE

A. Fabricate, store, transport, receive, install, and clean mirrors in accordance with recommendations of GANA (TIPS).

1.04 FIELD CONDITIONS

A. Do not install mirrors when ambient temperature is less than 50 degrees F.

B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.05 WARRANTY

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

B. Provide five year manufacturer warranty for reflective coating on mirrors and replacement of same.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Mirrors:
   1. Binswanger Mirror/ACI Distribution; ____: www.binswangerglass.com/#sle.
   2. Trulite Glass and Aluminum Solutions; _____: www.trulite.com/#sle.
   3. Substitutions: See Section 016000 - Product Requirements.

2.02 MATERIALS

A. Mirror Design Criteria: Select materials and/or provide supports as required to limit mirror material deflection to 1/200, or to the flexure limit of glass, with full recovery of glazing materials, whichever is less.

B. Mirror Glass; Type 1: Clear, annealed float glass; ASTM C1036, with copper and silver coatings, and protective overcoating. Size: 18" by 36".
   1. Thickness: 1/4 inch.
   2. Edges: Flat Pencil Polished.
   3. Size: As noted on drawings.

2.03 ACCESSORIES

A. Mirror Adhesive: Silicone pre-polymer based, chemically compatible with mirror coating and wall substrate per manufacturer's written instructions; provide 1/16" by 3/8" 3M Mirror tape, run vertically 1/2" in from each vertical edge.

B. Channel Frame: One piece, channel frame, stainless steel, Type 430, satin finish, 1/2 inch by 1/2 inch by 3/8 inch deep with 90 degree mitered corners.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces of mirror frames or recesses are clean, free of obstructions, and ready for installation of mirrors.

3.02 PREPARATION

A. Clean contact surfaces with solvent and wipe dry.

B. Prepare installation in accordance with ASTM C1193 for solvent release sealants, and install sealant in accordance with manufacturer's instructions.

3.03 INSTALLATION

A. Install mirrors in accordance with GANA (TIPS) and manufacturers recommendations.

B. Set mirrors plumb and level, and free of optical distortion.

C. Set mirrors with edge clearance of 1 1/2" free of surrounding construction including countertops or backsplashes.

D. Frameless Mirrors: Set mirrors in proper place with adhesive, applied in accordance with adhesive manufacturer's instructions.

3.04 CLEANING

A. Remove labels after work is complete.

B. Clean mirrors and adjacent surfaces.

END OF SECTION

SECTION 092116

GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL **UPDATED 2/21, 10/21**

1.01 SECTION INCLUDES **SEE CHANGES IN BOLD**

A. Performance criteria for gypsum board assemblies.
B. Metal stud wall framing.
C. Metal channel ceiling framing.
D. Acoustic insulation.
E. Gypsum sheathing.
F. Cementitious backing board.
G. Gypsum wallboard.
H. Joint treatment and accessories.
I. Acoustic (sound-dampening) wall and ceiling board.

1.02 RELATED REQUIREMENTS

A. Section 016116 - Volatile Organic Compound (VOC) Content Restrictions.
B. Section 072100 - Thermal Insulation: Acoustic insulation.
C. Section 072500 - Weather Barriers: Water-resistive barrier over sheathing.
D. Section 078400 - Firestopping: Top-of-wall assemblies at fire rated walls.
E. Section 093000 - Tiling: Tile backing board.

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. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2010 (Reaffirmed 2016).
C. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 1999 (Reaffirmed 2016).
D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
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 A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members; 2015.
G. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2015.
H. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2014.
I. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.
J. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2017.
K. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2016.

L. 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.

M. 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.

N. ASTM C1047 - Standard Specification for Accessories For Gypsum Wallboard and Gypsum Veneer Base; 2014a.

O. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2013.

P. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel; 2013.

Q. ASTM C1280 - Standard Specification for Application of Exterior Gypsum Panel Products for Use as Sheathing; 2013a.

R. ASTM C1288 - Standard Specification for Discrete Non-Asbestos Fiber-Cement Interior Substrate Sheets; 2014.

S. ASTM C1325 - Specification for Non-Asbestos Fiber-Mat Reinforced Cementitious Backer Units; 2017.

T. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2014a.

U. ASTM C1629/C1629M - Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels; 2015.

V. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2016.

W. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009 (Reapproved 2016).

X. GA-216 - Application and Finishing of Gypsum Board; 2016.

Y. GA-226 - Application of Gypsum Board to Form Curved Surfaces; Gypsum Association; 2016.

Z. GA-600 - Fire Resistance Design Manual; 2015.

AA. UL (FRD) - Fire Resistance Directory; current edition.

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.

E. Submit structural calculations and details stamped by a structural engineer licensed in the state of Utah showing the design of the members and their attachment to each other and to the building structure. THE STRUCTURAL DESIGN MUST BE REVIEWED AND APPROVED BY THE STRUCTURAL ENGINEER OF RECORD.

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.

C. Shaft Walls at HVAC Shafts: Provide completed assemblies with the following characteristics:
   1. Air Pressure Within Shaft: Sustained loads of 5 lb./sq ft with maximum mid-span deflection of L/240.
   2. Acoustic Attenuation: STC of 35-39 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.

D. Fire Rated Assemblies: Provide completed assemblies with the following characteristics:
   1. Fire Rated Partitions: UL listed assembly No. _____; ___ hour rating.
   2. Fire Rated Ceilings and Soffits: One (1) hour fire rating.
   3. Fire Rated Structural Column Framing: UL listed assembly No. _____; ___ hour rating.
   4. Fire Rated Structural Beam Framing: UL listed assembly No. _____; ___ hour rating.
   5. Fire Rated Shaft Walls: UL listed assembly No. _____; ___ hour rating.
   6. Fire Rated Area Separation Walls: UL listed assembly No. _____; 1 hour rating.
   7. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL (FRD).

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** **Updated 2/21**

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. Shaft Wall Studs and Accessories: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 and specified performance requirements.
   1. Products:
      a. Same manufacturer as other framing materials.

D. Area Separation Wall Studs and Accessories: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with specified performance requirements.

E. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.

F. Partition Head To Structure Connections: Provide track fastened to structure with legs of sufficient length to accommodate deflection, for friction fit of studs cut short and fastened as indicated on drawings.

G. Non-Loadbearing Framing Accessories:
   1. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
   2. Partial Height Wall Framing Support: Provides stud reinforcement and anchored connection to floor.
      a. Materials: ASTM A36/A36M formed sheet steel support member with factory-welded ASTM A1003/A1003M steel plate base.
   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. _____: 1/4 inch.
      d. 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.

C. Abuse Resistant Wallboard:
   1. Application: High-traffic areas indicated.
   2. Surface Abrasion: Level 2, minimum, when tested in accordance with ASTM C1629/C1629M.
   3. Indentation: Level 1, minimum, when tested in accordance with ASTM C1629/C1629M.
   4. Soft Body Impact: Level 1, minimum, when tested in accordance with ASTM C1629/C1629M.
   5. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   6. Paper-Faced Type: Gypsum wallboard as defined in ASTM C1396/C1396M.
   7. Type: Fire resistance rated Type X, UL or WH listed.
   8. Thickness: 5/8 inch.
   9. Edges: Tapered.
   10. Paper-Faced Products:
      a. American Gypsum Company; M-Bloc AR Type X.
      b. CertainTeed Corporation; Extreme Abuse Resistant Drywall with M2Tech.
      c. Continental Building Products; Protecta AR 100 Type X with Mold Defense.
      d. Georgia-Pacific Gypsum; ToughRock Fireguard X Mold Guard Abuse-Resistant.
      e. National Gypsum Company; Gold Bond Hi-Abuse XP Gypsum Board.

11. Products:
    a. American Gypsum Company; M-Bloc AR Type X.
    b. Continental Building Products; Protecta AR 100 Type X with Mold Defense.
    c. Continental Building Products; Rapid Deco Level 5 Type X with Protecta.
    d. Georgia-Pacific Gypsum; ToughRock Fireguard X Mold Guard Abuse-Resistant.
    e. National Gypsum Company; Gold Bond Hi-Abuse XP Gypsum Board.

D. Impact Resistant Wallboard:
1. Application: High-traffic areas indicated.
2. Surface Abrasion: Level 3, minimum, when tested in accordance with ASTM C1629/C1629M.
3. Indentation: Level 1, minimum, when tested in accordance with ASTM C1629/C1629M.
4. Soft Body Impact: Level 3, minimum, when tested in accordance with ASTM C1629/C1629M.
5. Hard Body Impact: Level 2, minimum, when tested in accordance with ASTM C1629/C1629M.
6. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
7. Paper-Faced Type: Gypsum wallboard as defined in ASTM C1396/C1396M.
8. Type: Fire resistance rated Type X, UL or WH listed.
9. Thickness: 5/8 inch.
10. Edges: Tapered.
11. Products:
    a. American Gypsum Company; M-Bloc IR Type X.
    b. Continental Building Products; Protecta HIR 300 Type X with Mold Defense.
    c. National Gypsum Company; Gold Bond HI-Impact XP Gypsum Board.
    d. Substitutions: See Section 016000 - Product Requirements.

E. Backing Board For Wet Areas: One of the following products:
1. Application: Surfaces behind tile in wet areas including tub and shower surrounds and shower ceilings.
2. Application: Horizontal surfaces behind tile in wet areas including countertops.
3. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
4. ANSI Cement-Based Board: Non-gypsum-based; aggregated Portland cement panels with glass fiber mesh embedded in front and back surfaces complying with ANSI A118.9 or ASTM C1325.
    a. **Thickness: 5/8 inch.** **Update 10/21**
    b. Products:
        1) National Gypsum Company; PermaBase Cement Board: www.nationalgypsum.com
        2) USG Corporation: www.usg.com
5. ASTM Cement-Based Board: Non-gypsum-based, cementitious board complying with ASTM C1288.
    a. **Thickness: 5/8 inch.** **Update 10/21**
    b. Products:
        1) James Hardie Building Products, Inc; HardiBacker: www.jameshardie.com
        2) USG Durock Cement Board.
        3) Substitutions: See Section 016000 - Product Requirements.
6. **Glass Mat Faced Board: Coated glass mat water-resistant gypsum backing panel as defined in** ASTM C1178/C1178M**.** **Update 10/21**
    a. **Regular Type: Thickness 5/8 inch. (16 mm).**
    b. **Fire-Resistance-Rated Type: Type X core, thickness 5/8 inch. (16 mm).**
    c. **Products:**
        1) **CertainTeed Corporation; Diamondback Tile Backer: www.certainteed.com**
        2) **CertainTeed Corporation; Diamondback Type X Tile Backer: www.certainteed.com**
        3) **Georgia-Pacific Gypsum; DensShield Tile Backer: www.gpgypsum.com**

4) **Georgia-Pacific Gypum; DensShield Fireguard Tile Backer; www.gpgypsum.com**

5) **Substitutions: See Section 016000 - Product Requirements.**

F. Exterior Sheathing Board: Sizes to minimize joints in place; ends square cut.
1. Application: Exterior sheathing, unless otherwise indicated.
2. Glass Mat Faced Sheathing: Glass mat faced gypsum substrate as defined in ASTM C1177/C1177M.
3. Paper-Faced Sheathing: Gypsum sheathing board as defined in ASTM C1396/C1396M, moisture resistant type with water repellent paper faces.
4. 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.
5. **Core Type: Regular and Type X, as indicated. Update 10/21**
6. Type X Thickness: 5/8 inch.
7. **Regular Board Thickness: 5/8 inch. Update 10/21**
8. Edges: Square.
9. **Glass Mat Faced Products: Update 10/21**
   a. **American Gypsum Company; M-Glass Exterior Sheathing Type X. www.americangypsum.com.**
   b. **American Gypsum Company; M-Glass 5/8" Exterior Sheathing: www.americangypsum.com**
   c. **CertainTeed Corporation; GlasRoc 5/8" Exterior Sheathing: www.certainteed.com**
   d. **CertainTeed Corporation; GlasRoc Type X Exterior Sheathing: www.certainteed.com**
   e. **Georgia-Pacific Gypsum; DensGlass Sheathing.**
   f. **Georgia-Pacific Gypsum; DensGlass Fireguard Sheathing.**
   g. **USG Corporation; USG Securock Brand Ultralight Glass-Mat Sheathing: www.usg.com**
   h. **USG Corporation; USG Securock Brand Ultralight Glass-Mat Sheathing Firecode X: www.usg.com**
   i. **Substitutions: See Section 016000 - Product Requirements.**
10. Paper-Faced Products:
    a. American Gypsum Company; Exterior Gypsum Sheathing.
    b. CertainTeed Corporation; Type X Sheathing Treated Core.
    c. Substitutions: See Section 016000 - Product Requirements.

2.04 ACCESSORIES

A. **Acoustic Insulation: As specified in Section 072100. Updated 10/21**

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:
      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 SHAFT WALL INSTALLATION

A. Shaft Wall Framing: Install in accordance with manufacturer's installation instructions.
   1. Fasten runners to structure with short leg to finished side, using appropriate power-driven fasteners at not more than 24 inches on center.
   2. Install studs at spacing required to meet performance requirements.

B. Shaft Wall Liner: Cut panels to accurate dimension and install sequentially between special friction studs.

3.03 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. Acoustic Furring: Install resilient channels at maximum 24 inches on center. Locate joints over framing members.

G. Furring for Fire Ratings: Install as required for fire resistance ratings indicated.

H. 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.

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.**
Updated 10/21

B. Fire-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.

C. Exposed Gypsum Board in Interior Wet Areas: Seal joints, cut edges, and holes with water-resistant sealant.

D. **Exterior Sheathing: Comply with** ASTM C1280**. Install sheathing vertically, with edges butted tight and ends occurring over firm bearing. Updated 10/21**
   1. Paper-Faced Sheathing: Immediately after installation, protect from weather by application of water-resistive barrier.

E. Cementitious Backing Board: Install over steel framing members and plywood substrate where indicated, in accordance with ANSI A108.11 and manufacturer's instructions.

F. Installation on Metal Framing: Use screws for attachment of gypsum board.

G. Curved Surfaces: Apply gypsum board to curved substrates in accordance with GA-226.

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. Exterior Soffit Vents: Install according to manufacturer's written instructions and in locations indicated on drawings. Provide vent area specified.

E. Exposed finished raw edges are not allowed.

F. All metal fittings to be bedded and finished to designated finish level.

3.07 JOINT TREATMENT

A. Glass Mat Faced Gypsum Board and Exterior Glass Mat Faced Sheathing: Use fiberglass joint tape, bedded and finished with chemical hardening type joint compound.

B. 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.

C. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
   1. Level 5: Walls and ceilings to receive semi-gloss or gloss paint finish and other areas specifically indicated.
   2. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
   3. Level 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.

D. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
   1. Feather coats of joint compound so that camber is maximum 1/32 inch.
   2. Taping, filling, and sanding is not required at surfaces behind adhesive applied ceramic tile and fixed cabinetry.

E. Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.

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

AUDIOSEAL SOUND BARRIER (OR SIMILAR)

AudioSeal® Sound Barrier is a mass loaded vinyl (mlv) sound barrier used to reduce the amount of airborne sound from transmitting through walls, floors and ceilings. It can be added to various construction assemblies to increase STC (Sound Transmission Loss) of the structure. It is a limp-mass material made of high-temperature fused vinyl and no lead fillers. Audioseal® Sound Barrier is very dense, weighing one to two pounds per square foot. AudioSeal® is commonly used in new construction and also to correct noise problems in existing spaces.

Audioseal® Sound Barrier is a non-reinforced version for wall and ceiling installations. AudioSeal® is tear resistant, yet easy to cut with a utility knife. Its available in 48″ or 54″ widths and various lengths to provide the best utilization for your project.

Usually installed direct to the studs, vinyl sound barrier may also be installed between layers of drywall. Often, the mass loaded barrier is used in combination with other materials to create a soundproof system. Combining it with layers of sheet rock with Green Glue and resilient clips

and channels will improve the sound transmission loss of the complete assembly. Reading about **Soundproofing a Wall** and **Soundproofing a Garage** may provide you with further insight on the uses of mass loaded vinyl in certain construction assemblies.

TECHNICAL INFORMATION FOR AUDIOSEAL® SOUND BARRIER:

- **Roll Widths:** 48″, 54″
- **Roll Lengths:** Various lengths up to 60′ (l)
- **Thickness:** 1/8″ (1 lb. / sq. ft.), 1/4″ (2 lb. / sq. ft.)
- **Color:** Black
- **Sold by:** The Roll
- **Type:** Non-reinforced
- **Weight:** 1 lb. / sq. ft. (1/8″), 2 lb. / sq. ft. (1/4″)
- **Tensile Strength:** 400 PSI
- **Tear Strength:** 70 lbs./in.
- **Ultimate Elongation:** 200%
- **Flammability:** SE “O” in./min.
- **Service Temperature:** -40 deg. F to 180 deg. F
- **STC:** 26, 31

SOUND TRANSMISSION LOSS (HZ)							
Non-Reinforced Barrier							
Weight	125	250	500	1000	2000	4000	STC
1 lb. / sq. ft.	16	17	22	27	31	36	26
2 lb. / sq. ft.	16	22	26	32	35	40	31

SECTION 093000

TILING (THIN-BRICK)

PART 1 GENERAL **UPDATED FEB 23, 2021, NOV 2021**

1.01 SECTION INCLUDES **SEE BOLD FOR UPDATES**

A. Faux brick for wall applications

B. Cementitious backer board as tile substrate

C. Tile accessories

D Non-ceramic trim

1.02 RELATED REQUIREMENTS

A. Section 079200 - Joint Sealants: Sealing joints between tile work and adjacent construction and fixtures.

1.03 REFERENCE STANDARDS

A. ANSI A108/A118/A136.1 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium); 2017.

B. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar; 2014.

C. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy; 1999 (Reaffirmed 2010).

D. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout; 1999 (Reaffirmed 2010).

E. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2010 (Reaffirmed 2016).

F. ANSI A108.11> ANSI A108/A118/A136.1 - American National Standard for Interior of Cementitious Backer Units; 2010 (Revised).

G. ANSI A118.3 - American National Standard Specifications for Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy and Water Cleanable Tile-Setting Epoxy Adhesive; 2013 (Revised).

H. ANSI A118.7 - American National Standard Specifications for High Performance Cement Grouts for Tile Installation; 2010 (Revised).

I. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 1999 (Reaffirmed 2016).

J. ANSI A118.9>ANSI A108/A118/A136.1 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 1999 (Reaffirmed 2010).

K. ANSI A118.10 - American National Standard Specifications for Load Bearing, Bonded, Waterproof Membranes For Thin-Set Ceramic Tile And Dimension Stone Installation; 2014.

L. ANSI A118.12 - American National Standard Specifications for Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation; 2014.

M. ANSI A118.15 - American National Standard Specifications for Improved Modified Dry-Set Cement Mortar; 2012.

N. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2013.1.

O. ANSI A137.2 - American National Standard Specifications for Glass Tile; 2013.

P. ASTM C373 - Standard Test Method for Water Absorption, Bulk Density, Apparent Porosity, and Apparent Specific Gravity of Fired Whiteware Products, Ceramic Tiles, and Glass Tiles; 2014a.

Q. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel; 2013.

R. ASTM D4068 - Standard Specification for Chlorinated Polyethylene (CPE) Sheeting for Concealed Water-Containment Membrane; 2015.

S. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2016.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting a reasonable time before starting work of this section; require attendance by affected installers. **Updated Feb 23, 2021**

1.05 SUBMITTALS

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

B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives as well as cleaning instructions.

C. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, ceramic accessories, and setting details.

D. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 016000 - Product Requirements, for additional provisions.
2. Extra Tile: 1 percent of each size, color, and surface finish combination, but not less than 10 square feet of each type.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum five years of documented experience.

B. Installer Qualifications: Company specializing in performing tile installation, with minimum of five years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.08 FIELD CONDITIONS

A. Do not install solvent-based products in an unventilated environment.

B. Maintain minimum ambient and substrate temperature of 50 degrees F during installation of mortar materials.

PART 2 PRODUCTS

2.01 TILE

A. Manufacturers:
1. American Olean Corporation: www.americanolean.com
2. Dal-Tile Corporation: www.daltile.com
3. **Marazzi Tile & Stone: www.marazziusa.com** **Updated Feb 23, 2021**
4. **Old Mill Thin Brick Systems: www.oldmillbrick.com**

B. Thin Brick
1. Composition: Kiln-fired clay brick
2. Single Brick:
   a. Size: As indicated on Architectural Drawings.
3. Color(s): As indicated on drawings.

2.02 TRIM AND ACCESSORIES

A. Non-Ceramic Trim: Satin natural anodized extruded aluminum, style and dimensions as indicated on drawings, for setting using tile mortar or adhesive.
   1. Applications:
      a. Open edges of floor tile.
      b. Wall corners, outside where bullnose is not used.
      c. Transition between floor finishes of different heights.
      d. Thresholds at door openings.
      e. Expansion and control joints, floor and wall.
      f. Borders and other trim as indicated on drawings.
      g. Balcony and terrace edge trim and fascia.
      h. **Stair nosings.** **Updated Feb 23, 2021**
   2. Manufacturers:
      a. Schluter-Systems: www.schluter.com. No substitutions.

2.03 SETTING MATERIALS

A. Manufacturers:
   1. ARDEX Engineered Cements; _____: www.ardexamericas.com
   2. Bostik Inc; _____: www.bostik-us.com
   3. Custom Building Products; _____: www.custombuildingproducts.com.
   4. LATICRETE International, Inc; _____: www.laticrete.com
   5. Merkrete, by Parex USA, Inc; _____: www.merkrete.com
   6. TEC, an H.B. Fuller Construction Products Brand; ____: www.tecspecialty.com
   7. Mapei: http://www.mapei.com
   8. Substitutions: See Section 016000 - Product Requirements.

B. Improved Latex-Portland Cement Mortar Bond Coat: ANSI A118.15.
   1. Applications: Use this type of bond coat where indicated and where no other type of bond coat is indicated.
   2. Products:
      a. Mapei: LFT, Ultra Flex 3, Ultra Flex LFT: www.mapei.com
      b. Substitutions: See Section 016000 - Product Requirements.

C. Epoxy Adhesive and Mortar Bond Coat: ANSI A118.3.
   1. Applications: Where indicated on drawings **or otherwise noted herein.**
   2. **Stairways: Epoxy adhesive is required on all stairways which will receive a tiled finish. Updated Feb 23, 2021**
   3. Products:
      a. **Mapei; Planicrete - W: www.mapei.com** **Updated Feb 23, 2021**
      b. Substitutions: See Section 016000 - Product Requirements.

D. Mortar Bed Materials: Pre-packaged mix of Portland cement, sand, latex additive, and water.
   1. Products:
      a. ARDEX Engineered Cements; A 38: www.ardexamericas.com
      b. LATICRETE International, Inc; LATICRETE 3701 Fortified Mortar Bed: www.laticrete.com
      c. Merkrete, by Parex USA, Inc; Merkrete Underlay C: www.merkrete.com
      d. Proflex Products, Inc; MSI - Mud Set Installation: www.proflex.us
      e. Mapei; 4 to 1 Mud Bed Mix, Modified Mortar Bed: www.mapei.com
      f. Substitutions: See Section 016000 - Product Requirements.

2.04 GROUTS

A. Manufacturers:
   1. Mapei: www.mapei.com

B. High Performance Polymer Modified Grout: ANSI A118.7 polymer modified cement grout.
   1. Applications: Use this type of grout where indicated and where no other type of grout is indicated.
   2. Color(s): As selected by Architect from manufacturer's full line.
   3. Products:
      a. Mapei; Ultracolor FA; www.mapei.com
      b. Mapei; Ulta Flex CQ; www.mapei.com

C. Epoxy Grout: ANSI A118.3 chemical resistant and water-cleanable epoxy grout.
   1. Applications: Kitchen walls and floors, restroom floors, showers, laboratories.
   2. Color(s): As selected by Architect from manufacturer's full line.
   3. Products:
      a. Mapei; Kerapoxy **CQ**; www.mapei.com **Updated Feb 23, 2021**

2.05 MAINTENANCE MATERIALS

A. Tile Sealant: Gunnable, silicone, siliconized acrylic, or urethane sealant; moisture and mildew resistant type.
   1. Applications: Between tile and plumbing fixtures, movable joints.
   2. Color(s): As selected by Architect from manufacturer's full line.
   3. Products:
      a. Mapei; Mapesil: www.mapei.com

B. Tile Sealer: Stain protection for natural stone.
   1. Products:
      a. Mapei sealant
      b. XL North
      c. Substitutions: See Section 016000 - Product Requirements.

C. Grout Release: Temporary, water-soluble pre-grout coating.
   1. Products:
      a. Custom Building Products; Aqua Mix Grout Release: www.custombuildingproducts.com
      b. Mapei; Ultra Care: www.mapei.com
      c. Substitutions: See Section 016000 - Product Requirements.

2.06 ACCESSORY MATERIALS

A. Concrete Floor Slab Crack Isolation Membrane: Material complying with ANSI A118.12; not intended as waterproofing.
   1. Type: Fluid Applied or Sheet.
   2. Thickness: 20 mils, maximum.
   3. Crack Resistance: No failure at 1/16 inch gap, minimum.
   4. Preparation: Compatible primer by manufacturer.
   5. Products:
      a. Mapei; Mapeguard 2: www.mapei.com

B. Backer Board: Cementitious type complying with ANSI A118.9; high density, glass fiber reinforced, 5/8 inch thick; 2 inch wide coated glass fiber tape for joints and corners.
   1. Products:

a. Custom Building Products; WonderBoard Lite Backerboard: www.custombuildingproducts.com
b. HardiBacker Cement Board.
c. Substitutions: See Section 016000 - Product Requirements.

C. Backer Board: Coated glass mat type complying with ASTM C1178/C1178M; inorganic fiberglass mat on both surfaces and integral acrylic coating vapor retarder.
1. Standard Type: Thickness 5/8 inch.
2. Products:
a. Denshield
b. Substitutions: See Section 016000 - Product Requirements.

D. Mesh Tape: 2 inch wide self-adhesive fiberglass mesh tape.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that sub-floor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.

B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.

C. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of setting materials to sub-floor surfaces.

D. Verify that concrete sub-floor surfaces are ready for tile installation by testing for moisture emission rate and alkalinity; obtain instructions if test results are not within limits recommended by tile manufacturer and setting materials manufacturer.

E. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

A. Protect surrounding work from damage.

B. Vacuum clean surfaces and damp clean.

C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.

D. Install backer board in accordance with ANSI A108.11 and board manufacturer's instructions. Tape joints and corners, cover with skim coat of setting material to a feather edge.

E. Prepare substrate surfaces for adhesive installation in accordance with adhesive manufacturer's instructions.

3.03 INSTALLATION - GENERAL

A. Install tile, thresholds, and stair treads and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.13, manufacturer's instructions, and TCNA (HB) recommendations.

B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.

C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.

D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.

E. Form internal angles square and external angles bullnosed.

F. Install ceramic accessories rigidly in prepared openings.

G. Install non-ceramic trim in accordance with manufacturer's instructions.

H. Install thresholds where indicated.

I. Sound tile after setting. Replace hollow sounding units.

J. Keep control and expansion joints free of mortar, grout, and adhesive.

K. Prior to grouting, allow installation to completely cure; minimum of 48 hours.

L. Grout tile joints unless otherwise indicated. Use standard grout unless otherwise indicated.

M. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

3.04 INSTALLATION - WALL THIN-BRICK

A. Over cementitious backer units on studs, install in accordance with TCNA (HB) Method W244, using membrane at toilet rooms.

B. Over coated glass mat backer board on studs, install in accordance with TCNA (HB) Method W245.

C. Over gypsum wallboard on wood or metal studs install in accordance with TCNA (HB) Method W243, thin-set with dry-set or latex-Portland cement bond coat, unless otherwise indicated.
   1. Where waterproofing membrane is indicated other than at showers and bathtub walls, install in accordance with TCNA (HB) Method W222, one coat method.

D. Over interior concrete and masonry install in accordance with TCNA (HB) Method W202, thin-set with dry-set or latex-Portland cement bond coat.

3.05 CLEANING

A. Clean tile and grout surfaces.

B. Ensure that all grout haze is removed.

3.06 PROTECTION

A. Do not permit traffic over finished floor surface for 4 days after installation.

END OF SECTION

SECTION 095100
ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES UPDATED OCTOBER 2022 AND FEB 2024

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.

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:** **Updated Oct 2022**
   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.**

C. **Acoustical Panels Type ACT-2:**
   1. **Size: 24 by 24 inches,**
   2. **Panel Edge: Tegular.**
   3. **Surface Pattern: Perforated.**
   4. **Surface Color: White.**
   5. **Suspension System: Exposed grid.**
   6. **Products:**
      a. **USG Frost 490.** **Updated Feb 2024**
      b. **Armstrong Ultima High NRC 1941A.**

D. **Acoustical Panels Type ACT-3:**
   1. **Size: 24 by 24 inches.**
   2. **Panel Edge: Tegular.**
   3. **Surface Pattern: Perforated.**
   4. **Surface Color: White.**
   5. **Suspension System: Exposed grid.**
   6. **Products:**
      a. **USG Sandrift 808.**

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.
   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.

Updated Oct 2022.

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. **Updated Oct 2022**

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..

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

SECTION 096429

WOOD STRIP AND PLANK FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wood strip flooring, nailed.

B. Secondary subflooring.

C. Sleepers on cushion blocks.

D. Moisture Suppression Underlayment

F. Surface finishing.

This section updated Dec 2020

See Bolded Areas for Updates

1.02 RELATED REQUIREMENTS

A. Section 099123 - Interior Painting: Surface finish to flooring.

1.03 REFERENCE STANDARDS

A. MFMA (SPEC) - Guide Specifications for Maple Flooring Systems; current edition.

B. NWFA (IG) - Installation Guidelines; current edition located at www.nwfa.org.

1.04 SUBMITTALS

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

B. Product Data: Provide data for flooring, floor finish materials, cushion blocks, and game insert or socket devices.

C. Shop Drawings: Indicate floor joint pattern and termination details.
   1. Indicate provisions for expansion and contraction, base, base corner details, and game insert or socket devices.

D. Samples: Submit two samples 24" by 24" inch in size illustrating floor finish, color, and sheen.

E. Installation Instructions: Indicate standard and special installation procedures.

F. Maintenance Data: Include maintenance procedures and recommended maintenance materials.

1.05 QUALITY ASSURANCE

A. Perform work of this section in accordance with MFMA (SPEC) and NWFA (IG).

B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

C. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years of documented experience. Harlequin Activity sprung floor system shall be installed by a qualified Harlequin contractor.

D. Should flooring deficiencies due to improper installation arise prior to expiration of the Contractor's one-year warranty and require remediation, the following conditions shall apply:
   1. In the case of remediation by way of floor sanding, the Owner and Contractor shall negotiate a pro-rated reimbursement to compensate the Owner for the resulting reduction in the life expectancy of the flooring.
   2. In the case of remediation by way of flooring replacement, the Contractor's warranty coverage shall apply and remediation will be at the Contractor's expense.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials and store off the floor in a well-ventilated, weather-tight space.

B. Storage And Handling Requirements:
   1. Wood Flooring:

a. Store wood materials on premises in area with environmental conditions as specified in Field Conditions to allow acclimation to moisture content that will prevail under environmental conditions under which the building will be operated.
b. Open bundled wood materials and stack loosely in crisscross fashion to allow uniform acclimation.

1.07 FIELD CONDITIONS

A. Do not install wood flooring until wet construction work is complete and ambient air at installation space has moisture content stabilized at maximum moisture content of 20 percent.

B. Provide heat, light, and ventilation prior to installation.

C. **Store materials in area of installation as required to achieve a maximum of 7% moisture content. Moisture content shall be verified by BYU Construction PM in consultation with BYU Wood Floor Supervisor prior to installation. BYU Wood Floor Supervisor to field verify the moisture content of all delivered and stored wood floor prior to installation.**

D. Maintain minimum room temperature of 65 degrees F for a period of two days prior to delivery of materials to installation space, during installation, and after installation.

E. **Moisture testing of Concrete Slab shall be conducted before installation of wood flooring. Follow NWFA Installation guidelines for maximum acceptable moisture levels. Do not install any flooring within 60 days of a concrete pour.**

F. **Wood flooring including Performance Space flooring shall be planned to be installed after the following is completed first: All overhead work such as rigging, fire sprinklers, electrical, HVAC, etc. All interior ceiling and wall finishes shall be completed prior to installation of wood flooring. Protect wood flooring from foot traffic with a durable non-damaging covering until Substantial Completion and turn over to owner.**

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Hardwood Strip and Plank Flooring:
1. Connor Sports Court International, www.connorsports.com.
2. Aacer Flooring, www.aacerflooring.com
3. Robbins Flooring, www.robbinsfloor.com
4. **Muscanell Mills, www.nationalwood.com (performance venue flooring only).**

B. Spung Floor System: Harlequin, Activity; www.harlequinfloors.com

C. Floor Finish Manufacturer: Basic Coatings.

D. Moisture Suppression Underlayment: Versashield MBX, www.versashield4floors.com

E. Cleats: Powernail www.powernail.com

F. Substitutions: Section 016000 - Product Requirements.

2.02 MATERIALS

A. Wood Strip Flooring - Type Sports Floor:
1. Species: Northern hard maple & Brazilian cherry where occurs
2. Grade: First.
3. Cut: Flat grain.
4. Moisture Content: 7 percent maximum.
5. Actual Thickness: 25/32 inch.
6. Actual Width: 2-1/4 inches.
7. Edge: Tongue and Groove.
8. End: End matched.
9. Length: Random, minimum of 9 inches.

B. Flooring Nails: **Cleats Only. 16 gauge, 1 3/4" – 2" length.**

C. **Sleepers and Shims:**
   1. **Softwood lumber 2 by 4 inch size.**
      a. **Douglas Fir No. 1 or KD Southern Yellow Pine.**
   2. **Neoprene Resilient Pads.**
      a. **Mason Industries Super W. Waffle Pad**
      b. **Maxiflex by VMC.**
   3. **Stop Blocks: 5/8 inch plywood strips to limit deflection to 1/8 inch maximum.**

D. Secondary Subflooring: 23/32 inch thick plywood, APA Rated Sheathing, span rating of 48/24 with square edges; Exposure 1, sanded.

F. **Moisture Suppression Underlayment System:** VersaShield MBX.

2.03 ACCESSORIES

A. Ventilating Base: **(except at Performance Floor locations).** Extruded aluminum, 4 inch high with a 4 inch toe, ventilating type, with attachment accessories, fabricated corner intersections, mill finish.

B. Cushion Blocks: Resilient pads, rubber material, sealed air channels for resiliency; compressible to 1/16 inch under a 40 psi load with full and immediate recovery.

C. Transition Strip: Same species and finish as flooring material; profiles indicated.

D. Game Socket Devices: Cast aluminum type, with anchors.

E. Floor Finish: Basic Coatings Water borne urethane, to achieve high gloss sheen on sports floors and satin sheen on non-sports floors surface; type recommended by flooring manufacturer.
   1. **VersaSeal Floor Sealer, 2 coats**
   2. **Street Shoe NXT Finishes, 3 coats**

F. Marking Paint: NONE

2.04 SOURCE QUALITY CONTROL

A. Inspect and stamp species and grade on underside of each piece of wood flooring at factory.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting this work.

B. Verify that concrete subfloor surface is smooth and flat to plus or minus 1/4 inch in 10 feet.

C. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

A. Cushioned Sleepers:
   1. Place vapor retarder over subfloor surface, lapping edges and ends minimum 6 inches and tape seal; secure in place.
   2. Secure cushion blocks to underside of sleepers at 6 inches on center and **at 6 inches at** each end. Shim between blocks and sleepers for equal bearing on floor surface and to achieve level line of plus or minus 1/4 inch in 10 feet.
   3. Place sleepers over vapor retarder; space sleepers at 12 inches on center; do not secure to subfloor.

B. Secondary Subflooring: Place two layers of plywood subflooring over sleepers.
   1. Lay the first layer perpendicular to the sleepers, with end joints over sleepers, and nail at 12 inches on center.
   2. **Lay the second layer at a 45 degree angle to the first layer.**

C. Prepare substrate to receive wood flooring in accordance with manufacturer's, MFMA, and NWFA instructions.

D. Broom clean **and vacuum** substrate.

3.03 INSTALLATION

A. Moisture Suppression Underlayment:

1. Place over wood subfloor; lap edges and ends 2 inches; tape all edges.

B. Wood Flooring:

1. Install in accordance with manufacturer's, MFMA, and NWFA instructions; blind nail to sleepers. Fasten at 6 inches on center maximum at perimeter and in field.
2. Lay flooring parallel to length of room areas. Verify alignment as work progresses. Install flooring from Stage Left to Stage Right for Performance Flooring.
3. Arrange flooring with end matched grain set flush and tight.
4. Terminate flooring at centerline of door openings where adjacent floor finish is dissimilar; provide divider strips and transition strips in accordance with flooring manufacturer's recommendations and as indicated.
5. Install edge strips at unprotected or exposed edges, and where flooring terminates.
6. Secure edge strips after installation of flooring with stainless steel screws.
7. Install flooring tight to floor access covers.
8. Provide 2 inch maximum expansion space at fixed walls and other interruptions or as per contract documents.
9. **Install slip sheets between layers of plywood or between plywood and hardwood. Overlap seams 4 inches minimum.**
10. **Provide solid fire blocking at flooring to comply with IBC Section 717.2.1.**

C. Install base at floor perimeter to cover expansion space in accordance with manufacturer's instructions. Miter inside and outside corners.

D. Install floor sockets and inserts to a depth sufficient to ensure flush top surface with floor surface.

E. Finishing:

1. Mask off adjacent surfaces before beginning sanding.
2. Sand flooring to smooth even finish with no evidence of sander marks. Take precautions to contain dust by utilizing industry standard dustless sanding methods. Remove any residual dust by vacuum.
3. Apply finish in accordance with floor finish manufacturer's and MFMA **and NWFA** instructions.
4. Apply filler and two seal coats.
5. Apply first coat, allow to dry, then sand lightly to remove irregularities. Vacuum clean and wipe with damp cloth before applying succeeding coat.
6. Lightly sand between coats and vacuum clean before applying succeeding coat.
7. Apply game lines as indicated on drawings (if applicable)
8. Apply last three coats of finish.
9. **Finish Performance Flooring 1 week minimum and 3 weeks maximum after installation is complete.**

3.04 CLEANING

A. Clean floor surfaces in accordance with floor finish manufacturer's instructions.

3.05 PROTECTION

A. Prohibit traffic on floor finish for 72 hours after installation.

END OF SECTION

Harlequin **Activity®**

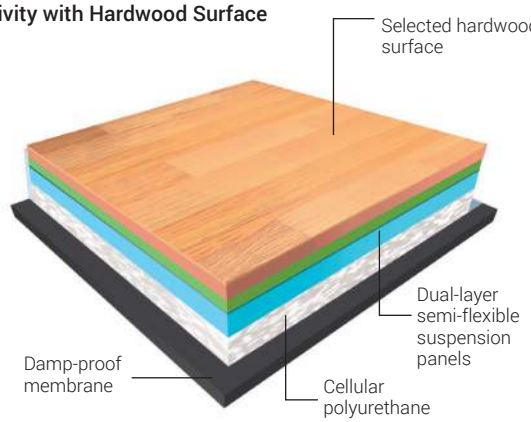
Harlequin Activity is a permanently installed sprung floor system, based on the well-established 'triple-sandwich' construction originated by Harlequin over 30 years ago. It's a fully floating system with no fixings to the sub-floor and can be laid on any reasonably smooth and flat surface without prior preparation.

Harlequin Activity is shock-damped to avoid a 'trampoline' effect and provides area and point elasticity to offer identical characteristics across the whole floor. An 'industry standard' choice, when correctly reinforced, it can withstand heavy loading including retractable seating.

Harlequin Activity is only available for installation by our Contracts Division. Activity can be installed with a Harlequin vinyl performance surface for all types of dance. A hardwood surface is available for specifiers who need a surface for multi-purpose use, including traffic by the general public, full stage entertainment, ballroom dance or when required to match existing décor.

Activity with Vinyl Surface

Activity with Hardwood Surface



Specification Guide

Permanent or Portable	Permanent
Finish	Harlequin Vinyl Performance or Approved Hardwood Surface
Weight	37-40 lbs/yd^2 (vinyl surface) 47-50 lbs/yd^2 (hardwood surface)
Overall Thickness	2⅛" (2.125) nominal (vinyl surface) 2¼" (2.25) nominal (hardwood surface)
Testing Standards	DIN 18032-2
Average Shock Absorption (Min. 53%)	59.4%
Vertical Deformation (Min. 2.3mm)	3.8mm
Area Deflection (Max 15%)	7.2%
Rolling Load (Min. 1500N)	>1500 N

Harlequin Sprung Floor Application Guide

Along with Harlequin Activity, we offer additional sprung flooring options, which are listed below along with the recommended surface. These recommendations are based on experience and customer preference only. Please contact a Flooring Specialist to determine which option best suits your requirements.

✓ = We recommend.

	Allegro	Cascade	Fiesta	FreeStyle	Hardwood	Hi-Shine	Marine	Reversible	Reversible Pro	Standfast	Studio	Studio B
Activity		✓	✓	✓	✓		✓			✓	✓	✓
AeroDeck		✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
Liberty		✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
Liberty (portable)		✓		✓		✓		✓	✓		✓	✓
Liberty LatchLoc		✓		✓		✓		✓	✓	✓	✓	
WoodSpring		✓	✓	✓	✓		✓			✓	✓	✓

American Harlequin Corporation
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Moorestown, NJ 08057

(800) 642 6440
contact@harlequinfloors.com
harlequinfloors.com

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CALL 800-642-6440 or VISIT www.harlequinfloors.com
For samples or information on Harlequin Floors complete range of vinyl and sprung floors.

SECTION 099123

INTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints, stains, and varnishes.

C. Materials for back-priming woodwork.

D. 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. Elevator pit ladders.
   3. Surfaces inside cabinets.
   4. Prime surfaces to receive wall coverings.
   5. 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.

E. 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.

B. Section 055000 - Metal Fabrications: Shop-primed items.

C. Section 055100 - Metal Stairs: Shop-primed items.

D. Section 099113 - Exterior Painting.

E. Section 099600 - High-Performance Coatings.

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.

B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2016.

C. ASTM D4258 - Standard Practice for Surface Cleaning Concrete for Coating; 2005 (Reapproved 2012).

D. ASTM D4259 - Standard Practice for Abrading Concrete; 1988 (Reapproved 2012).

E. ASTM D4260 - Standard Practice for Liquid and Gelled Acid Etching of Concrete; 2005 (Reapproved 2012).

F. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2015.

G. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board; 2007.

H. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition, www.paintinfo.com.

I. SCAQMD 1113 - South Coast Air Quality Management District Rule No.1113; current edition.

J. SSPC V1 (PM1) - Good Painting Practice: Painting Manual, Volume 1; Fourth Edition.

K. SSPC V2 (PM2) - Systems and Specifications: Steel Structures Painting Manual, Volume 2; Fourth Edition.

L. SSPC-SP 1 - Solvent Cleaning; 2015.

M. SSPC-SP 2 - Hand Tool Cleaning; 1982 (Ed. 2004).

N. SSPC-SP 3 - Power Tool Cleaning; 1982 (Ed. 2004).

O. SSPC-SP 6 - Commercial Blast Cleaning; 2007.

P. SSPC-SP 13 - Surface Preparation of Concrete; (Reaffirmed 2015); 2003.

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.

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/#sle.
   2. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
   3. Benjamin Moore: www.benjaminmoore.com.
   4. Manufacturers as listed below for the paint systems and substrates.

C. Transparent Finishes:
   1. PPG Paints Deft Interior Clears/Polyurethanes: www.ppgpaints.com/#sle.
   2. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
   3. [Benjamin Moore: www.benjaminmoore.com].

D. Stains:
   1. PPG Paints Deft Interior Stains: www.ppgpaints.com/#sle.
   2. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
   3. [Benjamin Moore: www.benjaminmoore.com].

E. Primer Sealers: Same manufacturer as top coats.

F. 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, Nonflat: 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.

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.

C. Special use area - Animal or Chemical Laboratory Rooms surfaces to be painted, Unless Otherwise Indicated.
1. Special use areas include all painted surfaces such as gypsum board, ceilings, doors, door frames, railings, handrails, guardrails, and balustrades in Animal or Chemical Laboratory Rooms.
2. Two top coats and one coat primer.
3. Top Coat(s): Interior Epoxy-Modified Latex.
a. Products:
1) PPG PSX 700 Gloss two coats with PPG Amerlock 400 primer coat.
2) PPG Aquapon WB 98-1 Series with PPG primer per manufacturer recommendations.

D. Ferrous metals except hanrdrails, guardrails and metal stairways.
1. Products: Metal Doors and Frames:
a. Option 1: Primer: one coat BM HP04 ultraspec acrylic metal primer Finish Coats: BM P29 Ultraspec HP Acrylic DTM Semi-gloss.
b. Option 2: Rustoleum Primer Metalmax Finish Coats: Two coats Rustoleum Beyond S-38 Satin
c. Option 3: Primer SW Pro Industrial Procryl Universal Primer. Two Finish Coats: SW 6509-62822 Multi surface acrylic emamel.

E. Dry Fall: Metals; exposed structure and overhead-mounted services in utilitarian spaces, including shop primed steel deck, structural steel, metal fabrications, galvanized ducts, galvanized conduit, and galvanized piping.

1. Shop primer by others.
2. One top coat _____.
3. Top Coat: Latex Dry Fall.
    a. Products:
        1) PPG Paints Speedhide Super Tech Water Based Interior Dry-Fog, 6-723XI, Flat.
        2) Sherwin-Williams Waterborne Acrylic Dryfall, Flat.
4. Primer: As recommended by top coat manufacturer for specific substrate.

F. Concrete Floors to be Painted.
1. Two top coats and one coat primer.
2. Top Coat(s): Latex Floor Paint, Gloss.
    a. Products:
        1) PPG Paints Break-Through Interior/Exterior Gloss Water-Borne Acrylic, V71-610 Series.
3. Primer: As recommended by top coat manufacturer for specific substrate.

G. Transparent Finish on Wood.
1. 1 top coat over sanding sealer over stain.
2. Stain: Semi-Transparent Stain for Wood; MPI #90.
    a. Products:
3. Top Coat(s): Clear Water Based Varnish.
    a. Products:
        1) PPG Paints Deft Interior Polyurethane WB Acrylic Satin, DFT 159.
        2) PPG Paints Deft Interior Polyurethane WB Acrylic Semi-Gloss, DFT 158
        3) Sherwin-Williams Wood Classics Waterborne Polyurethane Varnish, Satin.

H. Transparent Finish on Concrete Floors.
1. Sealer: Water Based for Concrete Floors.
    a. Products:
        1) Spartan Straight Seal.

I. Wood, Opaque, Latex, 3 Coat:
1. One coat of latex primer sealer as recommended by top coat paint manufacturer.
2. Semi-gloss: Two coats of latex enamel; PPG Regency, BM Regal Select, PPG Diamond 350.

J. Concrete/Masonry, Opaque, Latex, 3 Coat:
1. One coat of block filler. Follow top coat manufacturers recommendation.
2. Two coats of latex enamel; ____.
    a. Option 1: BM Ultraspec 571 Low Lustre
    b. Option 2: PPG Regency Semi-Gloss
    c. Option 3: Sherwin-Williams ProMar 200 Waterbased Acrylic, Semi-Gloss

K. Guardrails, Handrails and metal stairways, Galvanized Metals, Unprimed, 3 Coat:
1. One coat of PPG Amerlock 400 Epoxy primer.
2. Two coats; PPG Pitthane Ultra Semi Gloss.

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. Plaster and Stucco: 12 percent.
   3. Masonry, Concrete, and Concrete Masonry Units : 12 percent.
   4. Interior Wood: 15 percent, measured in accordance with ASTM D4442.
   5. Concrete Floors and Traffic Surfaces: 8 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.

G. Concrete:
   1. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
   2. Clean surfaces with pressurized water. Use pressure range of 1500 to 4000 psi at 6 to 12 inches. Allow to dry.
   3. Clean concrete according to ASTM D4258. Allow to dry.
   4. Prepare surface as recommended by top coat manufacturer and according to SSPC-SP 13.

H. 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.

I. Concrete Floors and Traffic Surfaces: Remove contamination, acid etch, and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.

J. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.

K. Plaster: Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.

L. Insulated Coverings: Remove dirt, grease, and oil from canvas and cotton.

M. Aluminum: Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.

N. Copper: Remove contamination by steam, high pressure water, or solvent washing.

O. Galvanized Surfaces:
   1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
   2. Prepare surface according to SSPC-SP 2.

P. Ferrous Metal:
   1. Solvent clean according to SSPC-SP 1.
   2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
   3. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning". Protect from corrosion until coated.

Q. Wood Surfaces to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.

R. Wood Surfaces to Receive Transparent Finish: Wipe off dust and grit prior to sealing, seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after sealer has dried; sand lightly between coats. Prime concealed surfaces with gloss varnish reduced 25 percent with thinner.

S. Glue-Laminated Beams: Prior to finishing, wash surfaces with solvent, remove grease and dirt.

T. Wood Doors to be Field-Finished: Seal wood door top and bottom edge surfaces with tinted primer.

U. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

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. Wood to Receive Transparent Finishes: Tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.

J. 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

FIRE SUPPRESSION, PLUMBING & MECHANICAL - TABLE OF CONTENTS

SECTION 210500

COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 GENERAL THIS SECTION UPDATED COMPLETE OCTOBER 2020

1.01 SECTION INCLUDES

A. Above ground piping.
B. Escutcheons.
C. Pipe, fittings, sleeves, escutcheons, seals, and connections for sprinkler systems.
D. Expansion joints.
E. Expansion loops.
F. Pipe hangers and supports.
G. Pipe sleeves.

1.02 RELATED REQUIREMENTS

A. Section 078400 - Firestopping.
B. Section 099113 - Exterior Painting: Preparation and painting of exterior fire protection piping systems.
C. Section 099123 - Interior Painting: Preparation and painting of interior fire protection piping systems.
D. Section 210523 - General-Duty Valves for Water-Based Fire-Suppression Piping.
E. Section 210553 - Identification for Fire Suppression Piping and Equipment: Piping identification.
F. Section 211200 - Fire-Suppression Standpipes: Standpipe design.
G. Section 211300 - Fire-Suppression Sprinkler Systems: Sprinkler systems design.
H. Section 220553 - Identification for Plumbing Piping and Equipment: Piping identification.

1.03 REFERENCE STANDARDS

A. ASME A112.18.1 - Plumbing Supply Fittings; 2012.
B. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Welding, Brazing, and Fusing Procedures; Welders; Braziers; and Welding, Brazing and Fusing Operators; 2017.
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 B16.5 - Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard; 2017.
G. ASME B16.9 - Factory-Made Wrought Buttwelding Fittings; 2012.
H. ASME B16.11 - Forged Fittings, Socket-welding and Threaded; 2016 (Errata 2017).
I. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2012.
J. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2013.
K. ASME B16.25 - Buttwelding Ends; 2012.
L. ASME B36.10M - Welded and Seamless Wrought Steel Pipe; 2015.
M. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999 (Reapproved 2014).

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N. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.

O. ASTM A135/A135M - Standard Specification for Electric-Resistance-Welded Steel Pipe; 2009 (Reapproved 2014).

P. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2017.

Q. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2015a.

R. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984 (Reapproved 2014).

S. ASTM A795/A795M - Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use; 2013.

T. ASTM B32 - Standard Specification for Solder Metal; 2008 (Reapproved 2014).

U. ASTM B75/B75M - Standard Specification for Seamless Copper Tube; 2011.

V. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2016.

W. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2016.

X. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2016.

Y. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.

Z. ASTM D2239 - Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter; 2012a.

AA. ASTM D2609 - Standard Specification for Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe; 2015.

AB. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a.

AC. ASTM F438 - Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40; 2015.

AD. ASTM F439 - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80; 2013.

AE. ASTM F442/F442M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR); 2013.

AF. ASTM F493 - Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings; 2014.

AG. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2011-AMD 1.

AH. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015 (with March 2016 Errata).

AI. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; 2010.

AJ. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings; 2012.

AK. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; 2017.

AL. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast; 2009.

AM. AWWA C606 - Grooved and Shouldered Joints; 2015.

AN. ITS (DIR) - Directory of Listed Products; current edition.

AO. NFPA 13 - Standard for the Installation of Sprinkler Systems; 2016.

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AP. NFPA 14 - Standard for the Installation of Standpipe and Hose Systems; 2016.

AQ. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

AR. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 SUMMARY TABLE

Item	Spec Section	Summary
Design	211300 1.06.B	Design with a margin of safety of 10%.
Submittal	211300 1.05.C	Submit shop drawings, product data, and hydraulic calculations to AHJ and BYU Fire Marshal for approval.
Pipe Thickness	210500 2.02.A	Minimum Pipe Thickness Schedule Mains: Sch 10 Grooved Branch: Sch 10 Threaded Branch: Sch 30
Design	Division 210000	Design does not need to be FM approved.
Drain Discharge	210500 3.03.I	All drain valves shall be discharged to the exterior of the building.
Flex Hose Drops	211300 2.02.F	Minimum capability of 5 bends is required.
Control Valves	210500 3.03.H	To be installed 7'-0" maximum above finish floor.
Flow Switches	211300 2.03.E	To be key operated/activated for testing purposes.
Dry/Pre-action Valves	211300 2.03.A	Victaulic is the only approved manufacturer.
Exposed Pipe Fittings	210500 3.03.F	Shall have a minimum 1" outlet with a bushing to accommodate future remodels.
Exposed Areas	210500 3.03.E	Piping shall be installed as high as possible.
Dry Systems	210500 2.02.A	Black pipe shall be used. Galvanized is not acceptable.

1.05 SUBMITTALS

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

B. Product Data: Provide manufacturers catalogue information. Indicate valve data and ratings.

C. Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections. Include flow calculations.

D. Manufacturer's Qualification Statement.

E. Installer's Qualification Statement.

F. Project Record Documents: Record actual locations of components and tag numbering.

G. Operation and Maintenance Data: Include installation instructions and spare parts lists.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.
   2. Extra Valve Stem Packings: One for each type and size of valve.

I. Warranty Materials: Include all warranty certificates and schedule list of start and end dates for manufacturer equipment.

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1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified in this section.
   1. Minimum three years' experience for lead installers.
   2. Approved by manufacturer.

C. Conform to UL (DIR) requirements.

D. U.S. made domestic equipment, pipes, valves, and fittings.

E. Valves: Bear UL (DIR) and ITS (DIR) or Warnock Hersey product listing label or marking. Provide manufacturer's name and pressure rating marked on valve body.

F. Products Requiring Electrical Connection: Listed and classified as suitable for the purpose specified and indicated.

G. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store valves in shipping containers, with labeling in place.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in protected place until installation.

1.08 WARRANTY

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

B. Correct defective Work within a one year period after Date of Substantial Completion.

C. 11 months after substantial completion, contractor shall meet with BYU personnel to ensure integrity of system and to address any warranty issues identified during meeting.

PART 2 PRODUCTS

2.01 FIRE PROTECTION SYSTEMS

A. Sprinkler Systems: Conform to NFPA 13 (or NFPA 13R as applicable).

B. Standpipe and Hose Systems: Conform to NFPA 14.

C. Welding Materials and Procedures: Conform to ASME BPVC-IX.

2.02 ABOVE GROUND PIPING

A. Steel Pipe: ASTM A795 Schedule 10, ASTM A53 Schedule 40, ASTM A135/A135M Schedule 10, or ASTM A795 Schedule 40 _____.
   1. Minimum Pipe Thickness Schedule
      a. Mains: Sch 10
      b. Grooved Branch: Sch 10
      c. Threaded Branch: Sch 30
   2. Use Schedule
      a. Conditioned Space: black pipe
      b. Unconditioned Space: galvanized pipe
      c. Dry System: black pipe

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3. Steel Fittings: ASME B16.9, wrought steel, buttwelded, ASME B16.25, buttweld ends, ASTM A234/A234M, wrought carbon steel or alloy steel, ASME B16.5, steel flanges and fittings, or ASME B16.11, forged steel socket welded and threaded.
4. Cast Iron Fittings: ASME B16.1, flanges and flanged fittings and ASME B16.4, threaded fittings.
5. Malleable Iron Fittings: ASME B16.3, threaded fittings and ASTM A47/A47M.
6. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.
7. Mechanical Formed Fittings: Carbon steel housing with integral pipe stop and O-ring pocked and O-ring, uniformly compressed into permanent mechanical engagement onto pipe.
8. Mechanical Saddle Tee: Victaulic 920, 920N, or 920 CROSS

B. Copper Tube: ASTM B75/B75M or ASTM B88 (ASTM B88M), H58 drawn temper.
1. Type: Type L (B).
2. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze solder joint, pressure type.
3. Joints: AWS A5.8M/A5.8 Classification BCuP-3 or BCuP-4 copper/silver braze or ASTM B32, alloy Sn95 solder.

C. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), H58 drawn.
1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze, grooved.
2. Mechanical Grooved Couplings: Ductile iron housing with alkyd enamel paint coating clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts, and washers.

2.03 PIPE SLEEVES

A. Vertical Piping:
1. Sleeve Length: 1 inch above finished floor.
2. Provide sealant for watertight joint.
3. Blocked Out Floor Openings: Provide 1-1/2 inch angle set in silicon adhesive around opening.
4. Drilled Penetrations: Provide 1-1/2 inch angle ring or square set in silicone adhesive around penetration.

B. Plastic, Sheet Metal, or Moisture-Resistant Fiber: Pipe passing through interior walls, partitions, and floors, unless steel or brass sleeves are specified below.

C. Pipe Passing Through Below Grade Exterior Walls:
1. Provide watertight space with link rubber or modular seal between sleeve and pipe on both pipe ends.

D. Pipe Passing Through Quarry Tile, Terrazzo, or Ceramic Tile Floors:
1. Connect sleeve with floor plate.

E. Pipe Passing Through Concrete Beam Flanges, except where Brass Pipe Sleeves are Specified:
1. Galvanized steel pipe or black iron pipe with asphalt coating.
2. Connect sleeve with floor plate except in mechanical rooms.

F. Pipe Passing Through Mechanical, Laundry, and Animal Room Floors above Basement:
1. Galvanized steel pipe or black iron pipe with asphalt coating.
2. Connect sleeve with floor plate except in mechanical rooms.

G. Not required for wall hydrants for fire department connections or in drywall construction.

H. Penetrations in concrete beam flanges are permitted but are prohibited through ribs or beams without prior approval from the Architect.

I. Clearances:

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1. Wall, Floor, Floor, Partitions, and Beam Flanges: 2 inch greater than external; pipe diameter.
2. All Rated Openings: Caulked tight with fire stopping material conforming to ASTM E814 in accordance with Section 078400 to prevent the spread of fire, smoke, and gases.

2.04 MANUFACTURED SLEEVE-SEAL SYSTEMS

A. Manufacturers:
   1. Advance Products & Systems, Inc; _____: www.apsonline.com
   2. The Metraflex Company; _____: www.metraflex.com
   3. Trumbull Industries.
   4. Garlock
   5. Substitutions: See Section 016000 - Product Requirements.

B. 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.

2.05 ESCUTCHEONS

A. Manufacturers:
   1. Victaulic.
   2. Globe
   3. Reliable
   4. Substitutions: See Section 016000 - Product Requirements.

B. Material:
   1. Fabricate from nonferrous metal.
   2. Chrome-plated.
   3. Grade TP304, seamless tube, ASTM A269/A269M stainless steel.
   4. Metals and Finish: Comply with ASME A112.18.1.

C. Construction:
   1. One-piece for mounting on chrome-plated tubing or pipe and one-piece or split-pattern type elsewhere.
   2. Internal spring tension devices or setscrews to maintain a fixed position against a surface.

2.06 PIPE HANGERS AND SUPPORTS

A. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron, adjustable swivel, split ring.

B. Hangers for Pipe Sizes 2 inches and Over: Carbon steel, adjustable, clevis.

C. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

D. Wall Support for Pipe Sizes to 3 inches: Unistrut with clamp

E. Wall Support for Pipe Sizes 4 inches and Over: Welded steel bracket and wrought steel clamp.

F. Vertical Support: Steel riser clamp.

G. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

H. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

I. Seismic Hangers and Couplings:

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1. Provide coupling with a factory set disengagement rating of 140 percent to 160 percent of the static weight.
2. Provide resettable and reusable, break away couplings.
3. Provide tether cables to avoid excessive seismic joint movement.
4. Coupling to be manufactured from non-corrosive materials.
5. Manufacturers:
    a. The Metraflex Company; Seismic Breakaway Hanger: www.metrafire.com
    b. Substitutions: See Section 016000 - Product Requirements.

2.07 EXPANSION LOOPS - HOSE AND BRAID

A. Manufacturers:
    1. The Metraflex Company; FireLoop: www.metrafire.com
    2. Substitutions: See Section 016000 - Product Requirements.

B. Provide flexible loops with two flexible sections of hose and braid, two 90 degree elbows, and 180 degree return with support bracket and air release or drain plug.

C. Provide flexible loops capable of movement in the x, y, and z planes. Flexible loops to impart no thrust loads to the building structure.

D. Flexible Connectors: Flanged, braided type with wetted components of stainless steel, sized to match piping.
    1. Maximum Allowable Working Pressure: 150 psig at 120 degrees F.
    2. End Connections: Same as specified for pipe jointing.
    3. End Connections: Flanged ductile iron; complying with ASME B16.5 Class 125.
    4. End Connections: Threaded; complying with ASME B16.11.
    5. Provide necessary accessories including, but not limited to, swivel joints.

2.08 MECHANICAL COUPLINGS

A. Manufacturers:
    1. Victaulic Company; FireLock Style 009H: www.victaulic.com
    2. Grinnell.
    3. Gruvlok.
    4. Substitutions: See Section 016000 - Product Requirements.

B. Rigid Mechanical Couplings for Grooved Joints:
    1. Dimensions and Testing: Comply with AWWA C606.
    2. Minimum Working Pressure: 300 psig.
    3. Housing Material: Fabricate of ductile iron conforming to ASTM A536.
    4. Housing Coating: Factory applied orange enamel.
    5. Gasket Material: EPDM suitable for operating temperature range from minus 30 degrees F to 230 degrees F.
    6. Bolts and Nuts: Hot dipped galvanized or zinc electroplated steel.
    7. Provide stops for direct stab installation without field assembly.

PART 3 EXECUTION

3.01 INSTALLERS

A. Western Automatic Sprinkler.

B. Frontier Fire

C. Delta Fire

D. Kimco

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E. The Safety Team / Triple A Fire

F. Preferred Fire

G. Substitutions: See Section 016000 - Product Requirements.

3.02 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and foreign material, from inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.03 INSTALLATION

A. Install sprinkler system and service main piping, hangers, and supports in accordance with NFPA 13.

B. Install standpipe piping, hangers, and supports in accordance with NFPA 14.

C. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.

D. Install piping to conserve building space, to not interfere with use of space and other work.

E. In areas with no ceiling, piping shall be installed as high as possible.

F. In exposed piping situations, head fittings shall have a 1" minimum outlet with a bushing to accommodate future remodel work.

G. Group piping, whenever practical, at common elevations.

H. Floor control valves shall be installed 7'-0" maximum above finish floor, unless prior approval is received from BYU.

I. All drain valves shall be discharged to the exterior of the building. In a below grade application, drain lines shall tie to an auxiliary drain, not a mop sink. Do not tie into any drain line without BYU approval.

J. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

K. 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.
   5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

L. Pipe Hangers and Supports:
   1. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
   2. Place hangers within 12 inches of each horizontal elbow.
   3. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
   4. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
   5. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
   6. Provide copper hangers and supports for copper piping.
   7. 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 fire suppression systems is specified in Section 099123.

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b. Painting of exterior fire suppression systems is specified in Section 099113.

M. Slope piping for dry systems and arrange all systems to drain at low points. Use eccentric reducers to maintain top of pipe level.

N. Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
1. Painting of interior fire suppression systems is specified in Section 099123.
2. Painting of exterior fire suppression systems is specified in Section 099113.

O. Structural Considerations:
1. Do not penetrate building structural members unless indicated.
2. Locate flexible expansion loops at or near the building seismic joint.

P. Provide sleeves when penetrating footings, floors, walls, and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
1. Aboveground Piping:
a. Pack solid using mineral fiber conforming to ASTM C592.
b. Fill space with an elastomer caulk to a depth of 0.50 inch where penetrations occur between conditioned and unconditioned spaces.
2. All Rated Openings: Caulk tight with fire stopping material conforming to ASTM E814 in accordance with Section 078400 to prevent the spread of fire, smoke, and gases.
3. Caulk exterior wall sleeves watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed components.

Q. 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.

R. Escutcheons:
1. Install and firmly attach escutcheons at piping penetrations into finished spaces.
2. Provide escutcheons on both sides of partitions separating finished areas through which piping passes.
3. Attach plates at the underside only of suspended ceilings.
4. Use chrome plated escutcheons in occupied spaces and to conceal openings in construction.

S. 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.

T. Die cut threaded joints with full cut standard taper pipe threads with Teflon tape and non-toxic joint compound applied to male threads only.

3.04 CLEANING

A. Upon completion of work, clean all parts of the installation.

B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

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C. See Section 017419 - Construction Waste Management and Disposal, for additional requirements.

END OF SECTION

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SECTION 210548

VIBRATION AND SEISMIC CONTROLS FOR FIRE SUPPRESSION PIPING AND EQUIPMENT

PART 1 GENERAL **THIS SECTION UPDATED COMPLETE OCTOBER 2020**

1.01 SECTION INCLUDES

A. Seismic control requirements.

B. Seismic restraints for suspended components and equipment.

1.02 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete.

B. Section 055000 - Metal Fabrications: Materials and requirements for fabricated metal supports.

C. Section 220548 - Vibration and Seismic Controls for Plumbing Piping and Equipment

D. Section 230548 - Vibration and Seismic Controls for HVAC Piping and Equipment

1.03 DEFINITIONS

A. Fire Suppression Component: Where referenced in this section in regards to seismic controls, applies to any portion of the fire suppression 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. FEMA E-74 - Reducing the Risks of Nonstructural Earthquake Damage; 2011.

C. ICC (IBC) - International Building Code; 2015.

D. NFPA 13 - Standard for the Installation of Sprinkler Systems; 2016.

E. UL 203A - Standard for Sway Brace Devices for Sprinkler System Piping; Current Edition, Including All Revisions.

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 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.

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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 - Seismic Controls:
   1. Include dimensioned plan views and sections indicating proposed fire suppression component locations and distributed system routing, with locations and details of gravity supports and seismic restraints and associated attachments.

E. Field quality control test reports.

1.07 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.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five 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 SEISMIC CONTROL REQUIREMENTS

A. Design and provide fire suppression 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 fire suppression components.

B. Seismic Design Criteria: ICC (IBC)/ASCE 7/NFPA 13.

C. Component Importance Factor (Ip): Fire suppression components to be assigned a component importance factor (Ip) of 1.5 unless otherwise indicated.

D. Seismic Restraints:
   1. Provide seismic restraints for fire suppression components except where exempt according to applicable codes and specified seismic design criteria, as approved by authorities having jurisdiction.
   2. Seismic restraint capacities to be verified by a Nationally Recognized Testing Laboratory (NRTL) or certified by an independent third-party registered professional engineer acceptable to authorities having jurisdiction.

E. Seismic Attachments:

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1. Comply with support and attachment requirements of NFPA 13.

F. Seismic Interactions:
   1. Include provisions to prevent seismic impact between fire suppression 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.
   3. Comply with minimum clearance requirements between other equipment, distribution systems, and associated supports and fire protection sprinkler system drops and sprigs.

G. Seismic Relative Displacement Provisions:
   1. Use suitable fittings or flexible connections, in accordance with NFPA 13.
   2. Provide clearance around fire suppression system piping extending through walls, floors, platforms, and foundations in accordance with NFPA 13.

2.02 MANUFACTURERS

A. Substitutions: See Section 016000 - Product Requirements.

2.03 PERFORMANCE REQUIREMENTS

A. General:
   1. All vibration isolators, base frames and inertia bases to conform to all uniform deflection and stability requirements under all operating loads.
   2. Steel springs to function without undue stress or overloading.
   3. Steel springs to operate in the linear portion of the load versus deflection curve over deflection range of not less than 50 percent above specified deflection.
   4. Lateral to vertical stiffness ratio to not exceed 0.08 with spring deflection at minimum 75 percent of specified deflection.
   5. All equipment mounted on vibration isolated bases to have minimum operating clearance of 2 inches between the base and floor or support beneath unless noted otherwise.

2.04 SEISMIC RESTRAINTS FOR SUSPENDED COMPONENTS AND EQUIPMENT

A. Products to be listed in accordance with the requirements of NFPA 13.

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. Comply with the requirements of NFPA 13.

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 piping connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.

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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.

D. Submit detailed reports indicating inspection and testing results and corrective actions taken.

E. Inspect isolated equipment after installation and submit report. Include static deflections.

F. Seismic inspection in the presence of Authority Having Jurisdiction, at time of hydrostatic test.

END OF SECTION

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SECTION 211300

FIRE-SUPPRESSION SPRINKLER SYSTEMS

PART 1 GENERAL UPDATED MAY 2023

1.01 SECTION INCLUDES

A. Wet-pipe sprinkler system.

B. Dry-pipe sprinkler system.

C. Pre-action sprinkler system.

D. System design, installation, and certification.

E. Fire department connections.

1.02 RELATED REQUIREMENTS

A. Section 078400 - Firestopping.

B. Section 083477 - Smoke and Fire Protective Curtain Assemblies: Smoke and fire curtains to be released by activation of sprinkler system.

C. Section 210500 - Common Work Results for Fire Suppression: Pipe and fittings.

D. Section 210523 - General-Duty Valves for Water-Based Fire-Suppression Piping.

E. Section 210548 - Vibration and Seismic Controls for Fire Suppression Piping and Equipment.

F. Section 210553 - Identification for Fire Suppression Piping and Equipment.

G. Section 211200 - Fire-Suppression Standpipes.

H. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.

I. Section 284600 - Fire Detection and Alarm.

1.03 REFERENCE STANDARDS

A. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2015.

B. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements; 2015.

C. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2015.

D. ITS (DIR) - Directory of Listed Products; current edition.

E. NFPA 13 - Standard for the Installation of Sprinkler Systems; 2016.

F. NFPA 13R - Standard for the Installation of Sprinkler Systems in Low-Rise Residential Occupancies; 2016.

G. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

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. First install scope shall be determined at this meeting.

1.05 SUBMITTALS

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

B. Product Data: Provide data on sprinklers, valves, and specialties, including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.

C. Shop Drawings:

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1. Submit preliminary layout of finished ceiling areas indicating only sprinkler locations coordinated with ceiling installation.
2. Indicate hydraulic calculations, detailed pipe layout, hangers and supports, seismic bracing, sprinklers, components and accessories. Indicate system controls.
3. Submit shop drawings, product data, and hydraulic calculations to AHJ and BYU Fire Marshal for approval. Submit proof of approval to Architect.

D. Manufacturer's Certificate: Certify that system has been tested and meets or exceeds specified requirements and code requirements.

E. Designer's Qualification Statement.

F. Manufacturer's Qualification Statement.

G. Installer's Qualification Statement.

H. Operation and Maintenance Data: Include components of system, servicing requirements, record drawings, inspection data, replacement part numbers and availability, and location and numbers of service depot.

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 Sprinklers: Type and size matching those installed, in quantity required by referenced NFPA design and installation standard.
3. Sprinkler Wrenches: For each sprinkler type.

J. Project Record Documents: Record actual locations of sprinklers and deviations of piping from drawings. Indicate drain and test locations.

1.06 QUALITY ASSURANCE

A. Designer Qualifications: Professional Fire Protection Engineer Utah or NICET Level III Technician.

B. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.

C. Water Velocity: the maximum water velocity shall not exceed 32 fps.

D. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.

E. Installer Qualifications: Company specializing in performing the work of this section with minimum three years' experience and approved by manufacturer.

F. Equipment and Components: Provide products that bear UL (DIR) label or marking. All products shall be domestic only.

G. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified and indicated.

1.07 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.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Store products in shipping containers and maintain in place until installation. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

B. Schedule inspection of material with Owner prior to first install.

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PART 2 PRODUCTS

2.01 SPRINKLER SYSTEM

A. Sprinkler System: Provide coverage for entire building.

B. Occupancy: comply with NFPA 13.

C. Water Supply: Determine volume and pressure from water flow test data.
   1. Contractor shall perform flow test.

D. Interface system with building control system.

E. Provide fire department connections where indicated.

F. Storage Cabinet for Spare Sprinklers and Tools: Steel, in location designated.

G. Pipe 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.

2.02 SPRINKLERS

A. Suspended Ceiling Type: Concealed pendant type with matching screw on escutcheon plate.
   1. Response Type: Quick. **Updated May 2023: Concealed noted above**
   2. Coverage Type: Standard.
   3. Finish: Brass.
   4. Escutcheon Plate Finish: Enamel, color as selected.
   5. Fusible Link: Glass bulb type temperature rated for specific area hazard.
   6. Manufacturers:
      a. Victaulic _____.
      b. Globe _____.
      c. Reliable _____.

B. Exposed Area Type: Pendant or Upright type with guard in minimum 1" fitting with bushing.
   1. Response Type: Quick.
   2. Coverage Type: Standard.
   3. Finish: Brass.
   4. Fusible Link: Glass bulb type temperature rated for specific area hazard.
   5. Manufacturers:
      a. Victaulic _____.
      b. Globe _____.
      c. Reliable _____.

C. Sidewall Type: Semi-recessed horizontal sidewall type with matching push on escutcheon plate.
   1. Response Type: Quick.
   2. Coverage Type: Standard.
   3. Finish: Brass.
   4. Escutcheon Plate Finish: Enamel, color as selected.
   5. Fusible Link: Glass bulb type temperature rated for specific area hazard.
   6. Manufacturers:
      a. Victaulic _____.
      b. Globe _____.
      c. Reliable _____.

D. Dry Sprinklers: Semi-Recessed Pendant type with matching escutcheon plate.

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1. Response Type: Quick.
2. Coverage Type: Standard.
3. Finish: Brass.
4. Escutcheon Plate Finish: Enamel, color as selected.
5. Fusible Link: Glass bulb type temperature rated for specific area hazard.
6. Manufacturers:
    a. Victaulic _____.
    b. Globe _____.
    c. Reliable _____.

E. Residential Sprinklers: Type as designed by engineer. _____ _____ _____.
1. Response Type: Quick.
2. Fusible Link: Glass bulb type temperature rated for specific area hazard.

F. Flexible Drop System: Stainless steel, minimum of 5 bends.
1. Application: Use to properly locate sprinkler heads.
2. Include all supports and bracing.
3. Provide braided type tube as required for the application.
4. Manufacturers:
    a. Victaulic Company; AH2 or AH2CC: www.victaulic.com.
    b. Viking; Superflex _____.
    c. Substitutions: See Section 016000 - Product Requirements.

2.03 PIPING SPECIALTIES

A. Dry Pipe Sprinkler Alarm Valve: Check type valve with divided seat ring, rubber faced clapper to automatically actuate water motor alarm, accelerator, and with the following additional capabilities and features:
1. Activate electric alarm.
2. Test and drain valve.
3. Externally resettable.
4. Replaceable internal components without removing valve from installed position.
5. Manufacturers:
    a. Victaulic Company; Series 768 - NXT: www.victaulic.com.

B. Pre-action Valve:
1. Operated by detection system listed for releasing service and independent of building fire alarm system with provisions for local, manual, and indicated remote releases.
2. Provide test detection device for each actuation circuit adjacent to each controlled valve in accordance with NFPA 13.
3. Manufacturers:
    a. Victaulic Company; Model 769N _____.

C. Backflow Preventer: Double check valve assembly backflow preventer with drain and butterfly valve with tamper switch on each end.
1. Manufacturers:
    a. Ames; Colt 200_____.
    b. Wilkins; Model 957 _____.
    c. Apollo; Model DCLF4A _____.

D. Test Connections:
1. Inspector's Test Connection:
    a. Provide test connections approximately 6 ft above floor for each or portion of each sprinkler system equipped with an alarm device, located at the most remote part of each system.

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b. Route test connection to an open-site drain location on exterior of the building.
   1) In basement locations, route to auxiliary drain.
   2) Drain location shall accept full flow without negative consequences.
   3) Draining to mop sinks is not allowed.
c. Supply discharge orifice with same size as corresponding sprinkler orifice.
d. Limit vertical height of exterior wall penetration to 2 ft above finished grade.

E. Water Flow Switch: Key activated. Vane type switch for mounting horizontal or vertical _____.
   1. Manufacturers:
      a. Potter; Model VSR-AT_____.

F. Fire Department Connections:
   1. 5" Storz Connection as per AHJ
      a. Signage: Raised or engraved lettering 1 inch minimum indicating system type.
   2. **Requires 24V power. Coordinate with electrician. Updated Oct 2022.**

2.04 AIR COMPRESSOR

A. Compressor: Single-unit, electric motor driven, motor, motor starter, safety valves, check valves, air maintenance device incorporating electric pressure switch and unloader valve.

2.05 NITROGEN GENERATOR

A. Provide piping and accessories to connect to dry and pre-action fire suppression systems.

B. Accessories:
   1. Provide air maintenance device.
   2. Provide nitrogen storage tank sized to comply with NFPA 13.
   3. Provide purge valves to remove oxygen from the system.
   4. Provide nitrogen analyzer to determine the nitrogen purity.
   5. Provide system with replaceable filters.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with referenced NFPA design and installation standard.

B. Install equipment in accordance with manufacturer's instructions.

C. Provide complete set of 11"x17" laminated fire protection plans at the main control valve of sprinkler system.

D. Install testable double check backflow preventer at potable water supply connection to fire protection system.
   1. Test backflow preventer within ten days of system being in service and provide test documentation to BYU project manager.

E. Locate 5" Storz fire department connection with sufficient clearance from walls and obstructions to allow full swing of fire department wrench handle.

F. Locate outside alarm horn and strobe at FDC on building wall as indicated.
   1. Blue lens as per AHJ.

G. Place pipe runs to minimize obstruction to other work.

H. Place piping in concealed spaces above finished ceilings.

I. Place piping in exposed spaces as high as possible.

J. Center sprinklers in two directions in ceiling tile and provide piping offsets as required.
   1. Exceptions as approved by Owner.

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K. Install air compressor on vibration isolators. Refer to Section 220548.

L. Install guards on sprinklers where indicated.

M. Hydrostatically test entire system.

N. All tests will be the responsibility of this contractor. If tests are not run or do not have the proper witness, then they will be run later and all damage caused by the system, or caused in uncovering the system for such test, will be borne by this contractor.

O. Require test be witnessed by BYU Fire Marshal and Authority Having Jurisdiction.

P. Whether the underground serving the sprinkler system is done by this contractor or another, this contractor shall be responsible to verify with the AHJ and BYU Fire Marshal that the underground has been flushed and tested by the contractor who installed it in accordance with NFPA-24 prior to connection of the underground piping to the overhead sprinkler system.

3.02 INTERFACE WITH OTHER PRODUCTS

A. Ensure required devices are installed and connected as required to fire alarm system.

END OF SECTION

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SECTION 220517

SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pipe sleeves.

B. Manufactured sleeve-seal systems.

1.02 RELATED REQUIREMENTS

A. Section 078400 - Firestopping.

B. Section 099113 - Exterior Painting: Preparation and painting of exterior piping systems.

C. Section 099123 - Interior Painting: Preparation and painting of interior piping systems.

D. Section 220523 - General-Duty Valves for Plumbing Piping.

E. Section 220553 - Identification for Plumbing Piping and Equipment: Piping identification.

F. Section 220716 - Plumbing Equipment Insulation.

G. Section 220719 - Plumbing Piping Insulation.

1.03 REFERENCE STANDARDS

A. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2016.

B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a.

1.04 SUBMITTALS

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

B. Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.

C. 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 minimum three years documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified this section.
   1. Minimum three years' experience.
   2. Approved by manufacturer.

C. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store sleeve and sleeve seals in shipping containers, with labeling in place.

B. Provide temporary protective coating on cast iron and steel sleeves if shipped loose.

PART 2 PRODUCTS

2.01 PIPE SLEEVES

A. Manufacturers:
   1. Flexicraft Industries; Pipe Wall Sleeve: www.flexicraft.com
   2. Link Seal;.

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3. Substitutions: See Section 016000 - Product Requirements.

B. Vertical Piping:
   1. Sleeve Length: 1 inch above finished floor.
   2. Provide sealant for watertight joint.
   3. Blocked Out Floor Openings: Provide 1-1/2 inch angle set in silicon adhesive around opening.
   4. Drilled Penetrations: Provide 1-1/2 inch angle ring or square set in silicone adhesive around penetration.

C. Plastic or Sheet Metal: Pipe passing through interior walls, partitions, and floors, unless steel or brass sleeves are specified below.

D. Pipe Passing Through Below Grade Exterior Walls:
   1. Zinc coated or cast iron pipe.
   2. Provide watertight space with link rubber or modular seal between sleeve and pipe on both pipe ends.

E. Pipe Passing Through Concrete Beam Flanges, except where Pipe Sleeves are Specified:
   1. Galvanized steel pipe or black iron pipe with asphalt coating.
   2. Connect sleeve with floor plate except in mechanical rooms.

F. Pipe Passing Through Mechanical, Laundry, and Animal Room Floors above Basement:
   1. Galvanized steel pipe or black iron pipe with asphalt coating.
   2. Connect sleeve with floor plate except in mechanical rooms.

G. Penetrations in concrete beam flanges are permitted but are prohibited through ribs or beams without prior approval from the Architect and/or Owner's Structural Engineer.

H. Clearances:
   1. Provide allowance for insulated piping.
   2. Wall, Floor, Partitions, and Beam Flanges: 1/2 inch greater than external pipe diameter including insulation.
   3. All Rated Openings: Caulked tight with fire stopping material conforming to ASTM E814 in accordance with Section 078400 to prevent the spread of fire, smoke, and gases.

2.02 MANUFACTURED SLEEVE-SEAL SYSTEMS

A. Manufacturers:
   1. Flexicraft Industries; PipeSeal: www.flexicraft.com
   2. Link Seal.
   3. Metra Seal.
   4. Substitutions: See Section 016000 - Product Requirements.

B. 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.

PART 3 EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and foreign material, from inside and outside, before assembly.

3.02 INSTALLATION

A. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.

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B. Install piping to conserve building space, to not interfere with use of space and other work.

C. Install piping and pipe sleeves to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

D. 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.

E. Structural Considerations:
   1. Do not penetrate building structural members unless indicated.

F. Provide sleeves when forming penetrations for footings, floors, walls, and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
   1. Underground Piping: Caulk pipe sleeve watertight with specified building waterproofing membrane, and provide mechanically expandable chloroprene inserts with bitumen sealed metal components.
   2. Aboveground Piping:
      a. Pack solid using mineral fiber conforming to ASTM C592.
      b. Fill space with an elastomer caulk to a depth of 0.50 inch where penetrations occur between conditioned and unconditioned spaces.
   3. All Rated Openings: Caulk tight with fire stopping material conforming to ASTM E814 in accordance with Section 078400 to prevent the spread of fire, smoke, and gases.
   4. Caulk exterior wall sleeves watertight with specified building waterproofing membrane, and provide mechanically expandable chloroprene inserts with mastic-sealed components.
   5. Specified building waterproofing membrane shall be completed by manufacturer-certified waterproofing/air barrier installer.

G. 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.

H. 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. No more than one pipe is permitted per sleeve.

3.03 CLEANING

A. Upon completion of work, clean all parts of the installation.

B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

C. See Section 017419 - Construction Waste Management and Disposal, for additional requirements.

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.

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.

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.
f.

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 $\frac{btu \cdot in}{h \cdot ft^{2} \cdot {}^{\circ}F}$

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. Storm water.
   5. Natural Gas.
   6. Flanges, unions, and couplings.
   7. Pipe hangers and supports.
   8. Manufactured sleeve-seal systems.
   9. Valves.
   10. Flow controls.
   11. Water pressure reducing valves.
   12. Relief valves.
   13. 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.

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J. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV; 2012.

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).

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AJ. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings; 2014.

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.

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BG. ASTM F493 - Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings; 2014.

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.

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CJ. MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves; 2013.

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.

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2.02 SANITARY SEWER PIPING, BURIED BEYOND 5 FEET OF BUILDING

A. Refer to Division 33, section 333113, Site Sanitary Sewerage Gravity Piping.

2.03 SANITARY SEWER PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Cast Iron Pipe: CISPI 301, hubless.
   1. Fittings: Cast iron.
   2. Joints: CISPI 310, neoprene gasket and extra heavy stainless steel clamp and shield assemblies.

B. PVC Pipe: ASTM D2665 or ASTM D3034.
   1. Fittings: PVC.
   2. Joints: Solvent welded, with ASTM D2564 solvent cement.
   3. Pipe: Solid core.

2.04 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.

2.05 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.

2.06 DOMESTIC WATER PIPING, BURIED BEYOND 5 FEET OF BUILDING

A. Refer to Division 33, section 331416, Site Water Utility Distribution Piping

2.07 DOMESTIC WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Copper Pipe: ASTM B42, annealed.
   1. Fittings: ASME B16.26, cast bronze.
   2. Joints: None.

B. Ductile Iron Pipe: AWWA C151/A21.51.
   1. Fittings: Ductile or gray iron, standard thickness.
   2. Joints: AWWA C111/A21.11, styrene butadiene rubber (SBR) or vulcanized SBR gasket with 3/4 inch diameter rods.

C. PE Pipe: ASTM D2239.
   1. Fittings: ASTM D2609, PE.
   2. Joints: Mechanical with clamp.

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3. Fusion weld.

D. Cross-Linked Polyethylene (PEX) Pipe: ASTM F876 or ASTM F877.
   1. Manufacturers:
      a. Uponor, Inc; _____: www.uponorengineering.com
      b. Viega LLC; PureFlow PEX with Corrugated Sleeve: www.viega.us
      c. Substitutions: See Section 016000 - Product Requirements.
   2. 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.
   3. Fittings: Brass and copper.
   4. Fittings: Brass and engineered polymer (EP) ASTM F1960.
   5. Joints: Mechanical compression fittings.

E. 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.

2.08 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.

C. Stainless Steel Pipe: ASTM A269/A269M, Grade TP304 alloy.

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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.

2.09 STORM WATER PIPING, BURIED BEYOND 5 FEET OF BUILDING

A. Refer to Division 33, section 334100, Subrdrainage.

2.10 STORM WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Cast Iron Pipe: CISPI 301, hubless, service weight.
1. Fittings: Cast iron.
2. Joints: Neoprene gaskets and extra heavy stainless steel clamp-and-shield assemblies.

B. PVC Pipe: ASTM D2665 or ASTM D3034.
1. Fittings: PVC.
2. Joints: Solvent welded, with ASTM D2564 solvent cement.
3. Pipe: Solid core.

2.11 STORM WATER PIPING, ABOVE GRADE

A. Cast Iron Pipe: CISPI 301, hubless, service weight.
1. Fittings: Cast iron.
2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies.

2.12 NATURAL GAS PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Polyethylene Pipe: ASTM D2513, SDR 11.
1. Anode-less risers, per AHJ.
2. Fittings: ASTM D2683 or ASTM D2513 socket type.
3. Joints: Fusion welded.

2.13 NATURAL GAS PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, wrought steel welding type.
2. Joints: Threaded or welded to ASME B31.1.
3. Paint exposed piping with 3 part epoxy, colors to be approved by owner.

2.14 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.

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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.

2.15 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.

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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.
   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.

2.16 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.

2.17 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.

2.18 BUTTERFLY VALVES

A. Manufacturers:
   1. Nibco

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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.

2.19 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.

2.20

2.21 WATER PRESSURE REDUCING VALVES

A. Manufacturers:
1. Amtrol Inc; _____: www.amtrol.com
2. Cla-Val Company; _____: www.cla-val.com
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.

2.22 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.

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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.

2.23 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.

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.

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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.
   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.

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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).

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 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 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
    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/#sle.
   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/#sle.
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/#sle.
   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 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.

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/#sle.
      b. Johnson Controls International, PLC; _____: www.johnsoncontrols.com/#sle.
      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/#sle.
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/#sle.
   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/#sle.
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/#sle.
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/#sle.
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/#sle.
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/#sle.
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/#sle.
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 microprocessor 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:

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 233100

HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal ductwork.

B. Nonmetal ductwork.

C. Casing and plenums.

D. Buried ductwork.

E. Kitchen hood ductwork.

F. Laboratory exhaust 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.

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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.

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.

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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.

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.

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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.

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).

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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.
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

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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.
   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).

K. Factory Fabricated Kitchen Cooking Hood and Grease Exhaust Duct Systems: Nominal 3 inches thick ceramic fiber insulation between 20 gage, 0.0375 inch, Type 304 stainless steel liner and 24 gage, 0.0239 inch aluminized steel sheet outer jacket.
   1. Tested and UL listed for use with commercial cooking equipment in accordance with NFPA 96.
   2. Certified for zero clearance to combustible material in accordance with:
      a. UL 2221 with a 2 hour rating.
   3. Materials and construction of the modular sections and accessories to be in accordance with the terms of the following listings:
      a. UL 1978.
      b. UL 2221.
   4. Manufacturers:
      a. AMPCO by Hart & Cooley, Inc.; Z-Clear
      b. DuraVent; DuraZDuct (DIS3Z)
      c. Security Chimneys International; Secure Duct (CIX3Z)
      d. Selkirk Corporation; ZeroClear (IPS-Z3)
      e. Substitutions: See Section 016000 - Product Requirements.

L. Shop Fabricated Kitchen Cooking Hood and Grease Exhaust Ductwork: 16 gauge, 0.0598 inch sheet steel or 18 gauge, 0.0500 inch stainless steel constructed with a continuous, liquid-tight weld or braze on the external surface of all joints and seams.
   1. Fabricate in accordance with SMACNA (DCS), SMACNA (KVS), and NFPA 96.
   2. Grease duct shall be wrapped with International Mechanical Code (IMC) compliant duct insulation system to form a 2 hour rated firestop system.
   3. Duct wrap system certified for zero clearance to combustible material in accordance with:
      a. ASTM E2336 Internal Grease Duct Test
   4. Manufacturers:
      a. FyreWrap; Elite 1.5 Duct Insulation
      b. 3M; Fire Barrier Duct Wrap 615+
      c. Morgan ThermalCeramics; Pyroscat DuctWrap XL
      d. Morgan ThermalCeramics; Duct Wrap 2x2+
      e. Substitutions: See Section 016000 - Product Requirements.

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M. Dishwasher Exhaust: Minimum 21 gage, 0.0344 inch thick, single wall, Type 304 stainless steel.
   1. Single wall, shop fabricated or factory built general use vent system.
   2. Designed, fabricated, and installed to be liquid tight preventing exhaust leakage into the building.
   3. Factory built system joints to be sealed during installation with factory supplied overlapping V-bands and sealant.
   4. Shop fabricated system joints shall be welded.

N. Fume Hood Exhaust: Minimum 21 gage, 0.0344 inch thick, single wall, Type 304 stainless steel.
   1. Fabricate in accordance with ductwork manufacturer's instructions, test duct system to sustain positive and negative pressures in compliance with ASHRAE Std 126.
   2. Single wall, shop fabricated or factory built general use vent system.
   3. Designed, fabricated, and installed to be liquid tight preventing exhaust leakage into the building.
   4. Operating Range: -6 inch wg.
   5. Factory built system joints to be sealed during installation with factory supplied overlapping V-bands and sealant.
   6. Provide with factory fabricated and pressure tested access doors.
   7. Shop fabricated system joints shall be welded.

2.05 CASINGS

A. Manufacturers:
   1. Semco;
   2. Commercial Acoustics;
   3. Substitutions: See Section 016000 - Product Requirements.

B. General: Provide built up factory system as indicated on drawings for size, wall thickness, and as specified herein.
   1. Fabricate casings in accordance with SMACNA (DCS) and construct for operating pressures indicated.
   2. Where required by drawings, the plenum walls shall be installed on top of contractor provided concrete curbing to ensure a level surface for the walls to be installed on. The curbing shall be no less than 4” thick and 2” wider than the thickness of the walls that are to be installed on them. The curbing shall be installed with #4 rebar doweled into the floor with #4 rebar for pads 4” thick and #5 for pads that are 6” thick with a maximum of 16” center to center in a cross grid pattern. All curbs shall either be installed with chamfered edges or troweled edges to prevent chipping and cracking at the edges.
   3. Access doors shall be provided to service all internal components, where the plenum will allow. All access doors shall be large enough for a person to pass through the opening.
   4. The responsibility to provide a complete and operable plenum system lies with the installing sheet metal, or mechanical contractor. This contractor shall coordinate the efforts of the equipment suppliers, and subcontractors to insure that the final systems are complete and fully functional.

C. Factory Fabricated Plenum Systems Construction:
   1. Plenum walls and ceilings shall be constructed with nominal thickness of 4” or 2” as required by drawings. Walls and ceilings shall be constructed with 18 gauge G90 galvanized exterior solid panels and 22 gauge 3/32” diameter holes on 3/16” staggered center spacing for the interior solid perforated panels. Internal panel reinforcements shall be role formed 16 gauge G90 galvanized steel and spaced with a maximum spacing of 24 inches. Perimeter and internal reinforcements shall be welded with the panels sheets to form a double wall insulated casing. Prior to the welding of the perforated panel the panel shall be filled with sound retarding and absorbing fill that shall be incombustible, inert, mildew-resistant, and vermin proof. The fill shall be slightly large and thicker that the inside void that its fills, no void shall be allowed. The face

panel shall be attached to plenum panel such that the inner liner is compressed and will hold it in position even in the presence of severe vibration from shipment, installation, or operation.

2. Door panels shall be of similar construction to standard panels. Doors shall be the same thickness as the plenum panels overlapping air/acoustical seals around the sill, jambs, and head. All doors shall be a minimum of 24” wide x 60” high unless otherwise specified on the drawings. Door frames shall be constructed of extruded aluminum or similar with gasketing around the frame. Face panel sheets shall be 20 gauge G90 galvanized steel on both sides of the door. All doors shall be installed such that the pressure created by the fan, or fans, shall close the door. All doors shall be provided with a minimum of 2 heavy duty hinges and two quick open latches. See drawings for doors that are to be provided with view windows. View windows shall be provided with two layer glass, one clear and one with wire reinforcement, view glass shall be 12”x12” unless the door isn’t large enough, then an 8”x8” view glass shall be provided.
3. Floor channels and panel connectors shall be 16 gauge G90 galvanized steel and roll formed. All panel accessories and trim shall be made of 18 gauge G90 galvanized steel furnished in standard lengths to be cut in the field as required. All openings for fans, coils, filters, duct connections, etc. shall be provided by the plenum wall manufacturer, all pipe and conduit penetrations shall be located and cut in the field and sealed air tight as per manufacturer’s requirements. All fasteners shall be provided with the plenum wall system and shall be sized to withstand the air pressure force that the system shall be subjected to, #12x1” self-tapping hex head sheet metal screws located at 12” on centers shall be used as a minimum requirement.

D. Factory Fabricated Plenum Systems Performance:
1. Acoustical panel ratings shall be determined by the dual reverberation room method in accordance with ASTM specifications E-90-81, E413-73, C423-81a, E795, or latest version thereof. The test set-up and procedure shall be such that all effects of flanking transmission, standing waves and test chamber sound absorption are eliminated. Data shall be presented on the submittals for tests conducted using current production materials and methods. The minimum allowable transmission loss of panels and components when tested in accordance with ASTM E-90-81 and E413-73, or latest version shall be as follows:

Transmission Loss In Decibels

Octave Band	2	3	4	5	6	7	
Frequency (Hz)	125	250	500	1000	2000	4000	STC
4" panel assembly	22	29	40	48	54	60	41
2" panel assembly	21	24	35	43	52	57	37

Sound Absorption Coefficients

Octave Band	2	3	4	5	6	7	
Frequency (Hz)	125	250	500	1000	2000	4000	STC
4" panel assembly	0.86	1.09	1.22	1.06	1.05	1.05	1.1
2" panel assembly	0.31	0.82	1.19	1.12	1.07	1.06	1.11

2.06 KITCHEN HOOD EXHAUST DUCTWORK

A. Fabricate in accordance with ductwork manufacturer's installation instructions, SMACNA (DCS), SMACNA (KVS), and NFPA 96.

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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. Kitchen Hood Exhaust: Provide residue traps at base of vertical risers with provisions for clean out.

G. Grease Hood Exhaust: Duct shall slope back to hood or approved grease reservoir at a minimum slope of 1/4" per foot.

H. Grease Duct Test: Prior to the use or concealment of any portion of a grease duct system, a leakage test and light test shall be performed by the contractor and witnessed by Owner's project manager, BYU Fire Marshall, and project commissioning agent. Ducts shall be considered to be concealed where installed in shafts or covered by coatings or wraps that prevent the ductwork from being visually inspected on all sides. The permit holder shall be responsible to provide the necessary equipment and perform the grease duct leakage test. A light test shall be performed to determine that all welded and brazed joints are liquid tight.
   1. A light test shall be performed by passing a lamp having a power rating not less than 100 watts equivalent, through the entire section of ductwork to be tested. The lamp shall be open so as to emit light equally in all directions perpendicular to the duct walls.
   2. A light test shall be performed for the entire duct system, including the hood-to-duct connection. The ductwork shall be permitted to be tested in sections, provided that every joint is tested.
   3. For listed factory-built grease ducts, this test shall be limited to duct joints assembled in the field and shall exclude factory welds.

I. Underground Ducts: Slope to plenums or low pump out points at 1:500. Provide access doors for inspection.

J. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.

K. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

L. Use crimp joints with or without bead for joining round duct with crimp in direction of air flow.

M. Use double nuts and lock washers on threaded rod supports.

N. 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.

O. Set plenum doors 6 to 10 inches above floor. Arrange door swings so that fan static pressure holds door in closed position.

P. 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 233700
AIR OUTLETS AND INLETS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Diffusers.

B. Critical Environment Laminar Flow Diffusers.

C. Round ceiling diffusers.

D. Slot ceiling diffusers.

E. Registers/grilles.
   1. Floor-mounted, linear supply register/grilles.

F. Door grilles.

G. Louvers.

H. Goosenecks.

I. Gravity ventilators.

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.

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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.

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

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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.

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

2.05 SQUARE AND RECTANGULAR SUPPLY AIR DIFFUSERS

A. Type: Square or rectangular louvered face ceiling diffuser with square or rectangular neck, field removeable core, and with one-, two-, three-, or four-way horizontal discharge pattern.

B. Connections: Square, rectangular, and transition piece for round.

C. Frame: Provide surface mount type as indicated on drawings.

D. Fabrication: Heavy gauge steel with baked enamel finish.

E. Color: As indicated on drawings.

F. Accessories: Furnish diffuser with moveable vanes, to adjust discharge pattern from horizontal to vertical, for diffusers installed 12 feet above finished floor and higher.

G. Models:
   1. Titus No. TDC
   2. Hart & Cooley No. SRE
   3. Price No. SMD
   4. Krueger No. SHPC

2.06 CRITICAL ENVIRONMENT LAMINAR FLOW DIFFUSERS

A. Type: Low velocity, non-aspirating, laminar flow, radial perforated face, 24" x 24" or 24" x 48" module sizes, border type for lay-in or surface mount, as per drawings.

B. Connections: Round

C. Frame: Steel, aluminum, or stainless steel, as per application, as specified by engineer.

D. Face: Steel, aluminum, or stainless steel, as per application, as specified by engineer. Face shall be completely removable for cleaning, and shall have safety cables to prevent accidental falling or removal.

E. Fabrication: Steel, aluminum, or stainless steel, pan and face as per application, as specified by engineer. Baked enamel finish.

F. Color: As indicated on drawings.

G. Models:
   1. Titus No. TLF
   2. Price No. LFD
   3. Krueger No. 5000

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2.07 PERFORATED FACE RETURN AIR GRILLES - T-BAR

A. Type: Perforated face, border type for lay-in installation.

B. Frame: Inverted T-bar type, module sizes 12" x 24" or 24" x 24".

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

2.08 PERFORATED FACE RETURN AIR GRILLES - SURFACE 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

2.09 CEILING SLOT DIFFUSERS

A. Type: Continuous, 1/2 in., 3/4 in., 1 in. wide slot, one - eight slots wide, and 1 1/2 in. or 2" in. wide slot, one - four slots wide, as per drawings.

B. Fabrication: Extruded aluminum construction with factory baked enamel finish.

C. Color: As indicated on the drawings.

D. Frame: T-bar ceiling mounting or surface mounting with screw or concealed fastening, as per drawings.

E. Plenum: Integral, galvanized steel, insulated.

F. Accessories: Pattern controllers, concealed mounting brackets, mitered corners assemblies, blank offs, and alignment strips.

G. Models:
   1. Titus No. ML
   2. Price No. SDS
   3. Krueger No. 1900

2.10 CEILING EGG CRATE EXHAUST GRILLES

A. Type: Egg crate style face consisting of 1/2 by 1/2 by 1/2 inch grid core.

B. Fabrication: Grid core consists of aluminum with mill aluminum finish.

C. Color: As indicated on the drawings.

D. Frame: The grille shall be suitable for surface or T-bar lay-in mounting, as specified on drawings, and shall have one of the following frame types:
   1. 1 1/4" flat face frame with countersunk screws for surface mounting
   2. 1 1/4" curved face frame with countersunk screws for surface mounting.
   3. Flat T-bar frame for T-bar mounting.

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4. Panel mount frame for T-bar mounting. The maximum grille size shall equal the module size minus four inches. The panel module size options for T-bar ceilings are:
    a. 24 x 12 inches.
    b. 24 x 24 inches.

E. Models:
1. Titus No. 50F
2. Price 80 Series
3. Krueger No. EGC5

2.11 WALL SUPPLY GRILLES

A. Type: Streamlined and individually adjustable blades, 3/4 inch minimum depth, 3/4 inch maximum spacing, horizontal face, double deflection.

B. Frame: 1-1/4 inch margin with countersunk screw mounting and gasket.

C. Fabrication: Steel with 1 - 1 1/2 inch minimum frames and 22 gage, 0.0299 inch minimum blades, with factory baked enamel finish.

D. Color: As indicated on the drawings.

E. Damper: Integral, gang-operated opposed blade type with removable key operator, operable from face. Included only when specified on drawings, by engineer.

F. Models:
1. Titus No. 300FL
2. Price No. 520
3. Krueger No. 880H
4. Hart & Cooley No. 92HVO

2.12 WALL RETURN AND EXHAUST GRILLES

A. Type: Streamlined and parallel fixed blades set at a 30 - 45 degree deflection to provide return or exhaust air with minimum see-through.

B. Frame: 1-1/4 inch margin with countersunk screw mounting and gasket.

C. Fabrication: Steel with 20 gage, 0.0359 inch minimum frames and 22 gage, 0.0299 inch minimum blades, with factory baked enamel finish.

D. Color: As indicated on the drawings.

E. Models:
1. Titus No. 350RL
2. Price No. 530
3. Krueger No. S80
4. Hart & Cooley 94A

2.13 LINEAR FLOOR SUPPLY REGISTERS/GRILLES

A. Type: Streamlined blades with 0 or 15 degree deflection, 1/8 by 3/4 inch on 1/4 inch centers, assembled on expanded tubes mandrel construction.

B. Frame: 1 - 1-1/4 inch heavy margin frame with countersunk screw mounting.

C. Fabrication: Aluminum extrusions with factory baked enamel finish.

D. Color: As indicated on the drawings.

E. Damper: Integral opposed blade volume damper with screwdriver operator, operable from face.

F. Models:
1. Price No. LBPH, LBMH
2. Krueger No. 1800

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3. Shoemaker LF Series
4. Hart & Cooley No. 531

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.

2.15 LOUVERS

A. General: AMCA rated drainable, stationary extruded aluminum weather louvers. Stationary louvers shall be sized to pass 1000 feet per minute velocity with less than 0.2" static pressure drop and shall carry less than 0.03 ounces of water per square foot when tested in accordance with AMCA Standard 500.

B. Type: 4" or 6" deep, with integral gutters incorporated into blades, louver head, and jamb frames to drain water from louver.

C. Fabrication: Louver blade and frame nominal wall thickness shall be 0.081" thick minimum, welded assembly, with factory clear anodized finish. Expanded, flattened aluminum bird screen in removable frame. All louvers shall be one piece.

D. Color: Clear anodized finish, unless otherwise specified on drawings..

E. Mounting: Contractor must coordinate louver size and flange type with structural and architectural openings to assure fit and appearance.

F. Models:
1. Ruskin No. ELF375DX or ELF6375DX
2. Greenheck No. EDJ401 or EDJ601
3. Pottorff No. EFJ-437-HP or EFJ-637-HP
4. American Warming and Ventilating No. LE-23 or LE-33

2.16 GOOSENECKS

A. Fabricate in accordance with SMACNA (DCS) of minimum 18 gage, 0.0598 inch galvanized steel.

B. Mount on minimum 12 inch high curb base where size exceeds 9 by 9 inch.

2.17 GRAVITY VENTILATORS

A. Hood Intake and Relief Gravity Ventilator:
1. Manufacturers:
   a. Twin City Fan & Blower; _____
   b. Greenheck Fan Corporation; _____
   c. Loren Cook Company; _____
   d. Substitutions: See Section 016000 - Product Requirements.
2. General:
   a. Low silhouette for intake and relief applications with natural gravity or negative pressure system(s).
   b. Performance ratings and factory testing to be in accordance with AMCA 511 and AMCA 550.
   c. Suitable for non-ducted applications.
   d. Equipment to bear permanently affixed manufacturer's nameplate listing model and serial number.
3. Hood and Base:
   a. Material: Galvanized steel.
   b. Hood Construction: Precision formed, arched panels with interlocking seams.
   c. Vertical End Panels: Fully locked into hood end panels.

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d. Curb Cap: Pre-punched mounting holes for installation.

4. Bird screen:
   a. Fabricate in accordance with ASTM B221 (ASTM B221M).
   b. Construction: 1/2 inch Galvanized mesh.
   c. Horizontally mounted across hood intake area.
5. Hood Support: Galvanized steel construction and fastened so hood can be removed completely from the base or hinged open.
6. Options/Accessories:
   a. Roof Curbs:
      1) Flat Roofs:
         (a) Welded, straight side, 24 inch high curb with flashing flange and wood nailer.
      2) Pitched Roofs: Welded, straight side, 24" high curb with flashing flange and wood nailer.
   b. Curb Seal: Rubber seal between hood and roof curb.
   c. Factory Finish: Baked enamel matching or complementing building colors.
   d. Insect Screen:
      1) Fabricate in accordance with ASTM B221 (ASTM B221M).
      2) Construct of fine mesh aluminum.
      3) Fitted to top of the throat to prevent entry of insects.
   e. Tie-Down Points: Aluminum brackets located on hood supports to secure fan in heavy wind applications.

B. Spun Aluminum Intake and Relief Gravity Ventilator:
1. Manufacturers:
   a. Twin City Fan & Blower; _____
   b. Greenheck Fan Corporation; _____
   c. Loren Cook Company; _____
   d. Substitutions: See Section 016000 - Product Requirements.
2. General:
   a. Provide low silhouette configuration for intake and relief applications with natural gravity or negative pressure system.
   b. Performance ratings and factory testing to be in accordance with AMCA 511 and AMCA 550.
   c. Suitable for non-ducted applications.
   d. Equipment to bear permanently affixed manufacturer's nameplate listing model and serial number.
3. Hood:
   a. Material: Aluminum.
   b. Internal structure constructed of galvanized steel.
4. Bird screen:
   a. Fabricate in accordance with ASTM B221 (ASTM B221M).
   b. Construction: 1/2 inch galvanized mesh.
   c. Horizontally mounted across hood intake area.
5. Housing:
   a. Curb Cap:
      1) Type: No Hinged.
      2) Construction: Aluminum.
      3) Integral deep spun inlet venturi with pre-punched mounting holes to ensure correct attachment to roof.
   b. Wind band:

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1) One piece spun aluminum construction with uniform, original material thickness throughout the housing.
2) Include integral rolled bead for strength.

6. Options/Accessories:
   a. Roof Curbs:
      1) Flat Roofs:
         (a) Welded, straight side, 24" high curb with flashing flange and wood nailer.
      2) Pitched Roofs: Welded, straight side, 24" high curb with flashing flange and wood nailer.
   b. Curb Seal: Rubber seal between hood and roof curb.
   c. Dampers:
      1) Type: Gravity.
      2) Factory designed to prevent outside air from entering back into building when fan is off.
      3) Balanced for minimal resistance to flow.
      4) Galvanized frames with pre-punched mounting holes.
   d. Factory Finish: Baked enamel matching or complementing building colors.
   e. Insect Screen:
      1) Fabricate in accordance with ASTM B221 (ASTM B221M).
      2) Fine mesh aluminum construction.
      3) Fitted to top of the throat to prevent entry of insects.
   f. Tie-Down Points: Aluminum brackets located on hood supports to secure fan in heavy wind applications.

C. Non-Powered Gravity Upblast Roof Ventilator:
1. Manufacturers:
   a. Twin City Fan & Blower; _____
   b. Greenheck Fan Corporation; _____
   c. Loren Cook Company; _____
   d. Substitutions: See Section 016000 - Product Requirements.
2. General:
   a. Discharge air directly away from the mounting surface.
   b. Roof mounted applications designed for use as a weatherproof outlet on vertical, high velocity exhaust systems.
   c. Performance ratings and factory testing to be in accordance with AMCA 511 and AMCA 550.
3. Butterfly Dampers:
   a. Material: Aluminum.
   b. Designed to provide weather protection and prevent backdraft.
   c. Blades with rubber seal.
   d. Balanced for minimal resistance to flow.
4. Wind band:
   a. Construct from heavy gage, galvanized steel with reinforced and bolted seams.
   b. Removable wind band to gain access through the butterfly dampers.
   c. Directs exhaust air away from mounting surface.
5. Curb Caps:
   a. Aluminum construction.
   b. Includes pre-punched mounting holes to ensure correct attachment to roof.
6. Options/Accessories:
   a. Curb Seal: Rubber seal between hood and roof curb.
   b. Finish: Baked enamel matching or complementing building colors.
   c. Roof Curbs:

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1) Flat Roofs:
(a) Welded, straight side, 24 inch high curb with flashing flange and wood nailer.
2) Pitched Roofs: Welded, straight side, 24 inch high curb with flashing flange and wood nailer.
3) Coating: Baked enamel matching or complementing building colors.

d. Tie-Down Points: Aluminum brackets located on hood supports to secure fan in heavy wind applications.

D. Extruded Aluminum Intake and Relief Ventilator:
1. Manufacturers:
a. Twin City Fan & Blower; _____
b. Greenheck Fan Corporation; _____
c. Loren Cook Company; _____
d. Substitutions: See Section 016000 - Product Requirements.
2. Construction:
a. Extruded aluminum louvers, 0.081 inch thick, mitered at corners and welded for maximum strength.
b. Removable Hood: 0.05 inch, reinforced and braced for extra strength.
c. Base: 0.08 inch aluminum with mitered corners and seams with continuous weld for strength and tightness.
d. Bird Screen Galvanized welded wire fabricated in accordance with ASTM B221 (ASTM B221M).
e. Performance ratings and factory testing to be in accordance with AMCA 511 and AMCA 550.
3. Options/Accessories:
a. Insect screen fabricated in accordance with ASTM B221 (ASTM B221M).
b. Coatings: Protective.

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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ELECTRICAL - TABLE OF CONTENTS

DIVISION 26 - ELECTRICAL

DIVISION 28 - ELECTRONIC SAFETY AND SECURITY

PLUMBING & MECHANICAL - TABLE OF CONTENTS

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.

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.

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

SECTION 260519

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 SECTION INCLUDES

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 262300 – Low-Voltage Switchgear.
D. Section 262413 – Switchboards.
E. Section 262416 – Panelboards.
F. Section 260513 - Medium-Voltage Cables: Cables and terminations for systems 601 V through 35,000 V.
G. Section 260519.13 - Undercarpet Electrical Power Cables: Flat conductor cable and fittings for undercarpet power distribution.
H. Section 260526 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.
I. Section 260536 - Cable Trays for Electrical Systems: Additional installation requirements for cables installed in cable tray systems.
J. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
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.

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.

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.

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.
      c. _____.

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.

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, _____ **Updated 2/21**
   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:
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/#sle.
b. Encore Wire Corporation: www.encorewire.com/#sle.
c. General Cable Technologies Corporation; _____: www.generalcable.com/#sle.
d. Southwire Company: www.southwire.com/#sle.
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/#sle.
b. Southwire Company: www.southwire.com/#sle.
c. Stabiloy, a brand of General Cable Technologies Corporation; _____: www.stabiloy.com/#sle.

d. Windy City Wire; www.smartwire.com, 801-633-0651.
e. Substitutions: See Section 016000 - Product Requirements.

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/#sle.
2. Encore Wire Corporation: www.encorewire.com/#sle.
3. Southwire Company: www.southwire.com/#sle.
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/#sle.
2. Encore Wire Corporation: www.encorewire.com/#sle.
3. Southwire Company: www.southwire.com/#sle.
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.

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/#sle.
   2. General Cable Technologies Corporation; _____: www.generalcable.com/#sle.
   3. Okonite: www.okonite.com/#sle.
   4. Southwire Company: www.southwire.com/#sle.
   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 where indicated or required.
   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 mechanical 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 and Larger: Use mechanical connectors or compression connectors where connectors are required.
   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/#sle.
      b. Ideal Industries, Inc: www.idealindustries.com/#sle.
      c. NSI Industries LLC: www.nsiindustries.com/#sle.

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/#sle.
      b. Ilsco: www.ilsco.com/#sle.
      c. Thomas & Betts Corporation: www.tnb.com/#sle.
      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/#sle.
      b. Ilsco: www.ilsco.com/#sle.
      c. Thomas & Betts Corporation: www.tnb.com/#sle.
      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/#sle.
      b. Ilsco: www.ilsco.com/#sle.
      c. Thomas & Betts Corporation: www.tnb.com/#sle.
      d. Substitutions: See Section 016000 - Product Requirements.

2.09 WIRING ACCESSORIES

A. Electrical Tape:
   1. Manufacturers:
      a. 3M: www.3m.com/#sle.
      b. Plymouth Rubber Europa: www.plymouthrubber.com/#sle.
      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/#sle.
      b. Burndy LLC; _____: www.burndy.com/#sle.
      c. Thomas & Betts Corporation: www.tnb.com/#sle.
      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/#sle.
      b. Ideal Industries, Inc: www.idealindustries.com/#sle.
      c. Ilsco: www.ilsco.com/#sle.

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/#sle.
      b. American Polywater Corporation: www.polywater.com/#sle.
      c. Ideal Industries, Inc: www.idealindustries.com/#sle.
      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/#sle.

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.

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. Do not use direct-bearing set-screw type fittings for cables with aluminum armor.
      d. 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.
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

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 for Structures.
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.

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.

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.

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

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.
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.
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/#sle.
b. Burndy LLC; _____: www.burndy.com/#sle.
c. Harger Lightning & Grounding; _____: www.harger.com/#sle.
d. Ilsco.
e. Thomas & Betts Corporation; _____: www.tnb.com/#sle.
f. Substitutions: See Section 016000 - Product Requirements.
5. Manufacturers - Exothermic Welded Connections:
a. Burndy LLC; _____: www.burndy.com/#sle.
b. Cadweld, a brand of Erico International Corporation; _____: www.erico.com/#sle.
c. ThermOweld, a brand of Continental Industries, Inc; _____: www.thermoweld.com/#sle.
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/#sle.
b. Erico International Corporation; _____: www.erico.com/#sle.
c. Harger Lightning & Grounding; _____: www.harger.com/#sle.
d. ThermOweld, a brand of Continental Industries, Inc; _____: www.thermoweld.com/#sle.
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/#sle.
b. Erico International Corporation; _____: www.erico.com/#sle.
c. Galvan Industries, Inc; _____: www.galvanelectrical.com/#sle.

d. Harger Lightning & Grounding; _____: www.harger.com/#sle.
e. Substitutions: See Section 016000 - Product Requirements.

F. Chemically-Enhanced Ground Electrodes:
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/#sle.
b. Erico International Corporation; _____: www.erico.com/#sle.
c. Harger Lightning & Grounding; _____: www.harger.com/#sle.
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/#sle.
b. Harger Lightning & Grounding; _____: www.harger.com/#sle.
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/#sle.

b. Erico International Corporation; _____: www.erico.com/#sle.
c. Harger Lightning & Grounding; _____: www.harger.com/#sle.
d. ThermOweld, a brand of Continental Industries, Inc; _____: www.thermoweld.com/#sle.
e. Substitutions: See Section 016000 - Product Requirements.

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

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.
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. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of electrical work.
2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
3. 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.
4. Do not use products for applications other than as permitted by NFPA 70 and product listing.
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.

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/#sle.
    b. Thomas & Betts Corporation; _____: www.tnb.com/#sle.
    c. Unistrut, a brand of Atkore International Inc; _____: www.unistrut.com/#sle.
    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.
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/#sle.
    b. Erico International Corporation; _____: www.erico.com/#sle.
    c. Unistrut, a brand of Atkore International Inc: www.unistrut.com/#sle.

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/#sle.
    b. ITW Red Head, a division of Illinois Tool Works, Inc; _____: www.itwredhead.com/#sle.
    c. Powers Fasteners, Inc; _____: www.powers.com/#sle.
    d. Simpson Strong-Tie Company Inc; _____: www.strongtie.com/#sle.
    e. Substitutions: See Section 016000 - Product Requirements.
15. Manufacturers - Powder-Actuated Fastening Systems:
    a. Hilti, Inc; _____: www.us.hilti.com/#sle.
    b. ITW Ramset, a division of Illinois Tool Works, Inc; _____: www.ramset.com/#sle.
    c. Powers Fasteners, Inc; _____: www.powers.com/#sle.
    d. Simpson Strong-Tie Company Inc; _____: www.strongtie.com/#sle.

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. 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.

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

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.

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.

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).

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.

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/#sle.
   2. Republic Conduit: www.republic-conduit.com/#sle.
   3. Wheatland Tube Company: www.wheatland.com/#sle.
   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/#sle.
      b. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com/#sle.
      c. Thomas & Betts Corporation: www.tnb.com/#sle.
      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/#sle.
   2. Republic Conduit: www.republic-conduit.com/#sle.
   3. Wheatland Tube Company: www.wheatland.com/#sle.
   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/#sle.
      b. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com/#sle.
      c. Thomas & Betts Corporation: www.tnb.com/#sle.
      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/#sle.
   2. Robroy Industries; _____: www.robroy.com/#sle.
   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/#sle.
      b. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com/#sle.
      c. Thomas & Betts Corporation: www.tnb.com/#sle.
      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.

2.10 ELECTRICAL NONMETALLIC TUBING (ENT)

A. Manufacturers:
   1. Cantex Inc; _____: www.cantexinc.com/#sle.
   2. Carlon, a brand of Thomas & Betts Corporation; _____: www.carlon.com/#sle.
   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.

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:
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.
   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. 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.

R. 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.

S. Provide grounding and bonding in accordance with Section 260526.

T. 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 pullrope 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

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.

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.

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 multigang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.
14. Minimum Box Size, Unless Otherwise Indicated:
    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/#sle.
    b. Hubbell Incorporated; Bell Products; _____: www.hubbell-rtb.com/#sle.
    c. Hubbell Incorporated; RACO Products; _____: www.hubbell-rtb.com/#sle.
    d. O-Z/Gedney, a brand of Emerson Industrial Automation; _____: www.emersonindustrial.com/#sle.
    e. Thomas & Betts Corporation; _____: www.tnb.com/#sle.
    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/#sle.
    b. Hoffman, a brand of Pentair Technical Products; _____: www.hoffmanonline.com/#sle.
    c. Hubbell Incorporated; Wiegmann Products; _____: www.hubbell-wiegmann.com/#sle.

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/#sle.
      b. Cooper Crouse-Hinds, a division of Eaton Corporation; _____: www.cooperindustries.com/#sle.
      c. Hubbell Incorporated; Killark Products; _____: www.hubbell-killark.com/#sle.
      d. Substitutions: See Section 016000 - Product Requirements.

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.
    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.

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

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.

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.

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. Manufacturer's 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:
   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/#sle.
      b. Mason Industries; _____: www.mason-ind.com/#sle.
      c. Vibration Eliminator Company, Inc; _____: www.veco-nyc.com/#sle.
   2. Substitutions: See Section 016000 - Product Requirements.

2.04 VIBRATION ISOLATORS

A. Manufacturers:
   1. Vibration Isolators:
      a. Kinetics Noise Control, Inc; _____: www.kineticsnoise.com/#sle.
      b. Mason Industries; _____: www.mason-ind.com/#sle.

c. Vibration Eliminator Company, Inc; _____: www.veco-nyc.com/#sle.
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/#sle.
b. Kinetics Noise Control, Inc; _____: www.kineticsnoise.com/#sle.
c. Mason Industries; _____: www.mason-ind.com/#sle.
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.
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.

D. Submit detailed reports indicating inspection and testing results and corrective actions taken.

END OF SECTION

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.

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.
    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.
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.
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. Uninterruptable 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.
    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.
   (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.

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.
(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 Wallplate Finishes: Comply with Section 262725.
4. Use identification label or engraved wallplate to identify serving branch circuit for all receptacles.
5. Use identification label or engraved wallplate 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. ie., vaults, tunnels building, etc.

2.02 IDENTIFICATION NAMEPLATES AND LABELS

A. Identification Nameplates:
1. Manufacturers:
a. Brimar Industries, Inc: www.brimar.com/#sle.
b. Kolbi Pipe Marker Co; _____: www.kolbipipemarkers.com/#sle.
c. Seton Identification Products; _____: www.seton.com/#sle.
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.
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/#sle.
   b. Brother International Corporation: www.brother-usa.com/#sle.
   c. Panduit Corp: www.panduit.com/#sle.
   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.

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/#sle.
   2. HellermannTyton; _____: www.hellermanntyton.com/#sle.
   3. Panduit Corp: www.panduit.com/#sle.
   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/#sle.
   2. Brimar Industries, Inc: www.brimar.com/#sle.
   3. Seton Identification Products; _____: www.seton.com/#sle.

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.
   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/#sle.
   2. Brimar Industries, Inc: www.brimar.com/#sle.
   3. L.H. Dottie.
   4. Seton Identification Products; _____: www.seton.com/#sle.
   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/#sle.
   2. Brimar Industries, Inc: www.brimar.com/#sle.
   3. Seton Identification Products; _____: www.seton.com/#sle.
   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.

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/#sle.
2. Clarion Safety Systems, LLC; _____: www.clarionsafety.com/#sle.
3. Seton Identification Products; _____: www.seton.com/#sle.
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:
   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

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.

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

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.

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 Control gear - Part 1: General Rules; Current Edition, Including All Revisions.

R. UL 60947-4-1 - Low-Voltage Switchgear and Control gear - 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.

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/#sle.
   2. Sensor Switch Inc: www.sensorswitch.com/#sle.
   3. WattStopper: www.wattstopper.com/#sle.
   4. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

B. All Occupancy Sensors:
   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.
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.

2.03 TIME SWITCHES

A. Manufacturers:
1. Tork, a division of NSI Industries LLC; _____: www.tork.com/#sle.
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/#sle.
2. Tork, a division of NSI Industries LLC; _____: www.tork.com/#sle.

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/#sle.
   2. Schneider Electric; Square D Products; _____: www.schneider-electric.us/#sle.
   3. Siemens Industry, Inc; _____: www.usa.siemens.com/#sle.
   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/#sle.
      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.

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.

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

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.

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.

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/#sle.
   2. Leviton Manufacturing Company, Inc; _____: www.leviton.com/#sle.
   3. Pass & Seymour, a brand of Legrand North America, Inc; _____: www.legrand.us/#sle.

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,
    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/#sle.
    2. Leviton Manufacturing Company, Inc; _____: www.leviton.com/#sle.
    3. Pass & Seymour, a brand of Legrand North America, Inc; _____: www.legrand.us/#sle.
    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. 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,
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:
      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/#sle.
   2. Leviton Manufacturing Company, Inc; _____: www.leviton.com/#sle.
   3. Pass & Seymour, a brand of Legrand North America, Inc; _____: www.legrand.us/#sle.
   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/#sle.
2. Thomas & Betts Corporation; _____: www.tnb.com/#sle.
3. Wiremold, a brand of Legrand North America, Inc; _____: www.legrand.us/#sle.

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/#sle.
2. Thomas & Betts Corporation; _____: www.tnb.com/#sle.
3. Wiremold, a brand of Legrand North America, Inc; _____: www.legrand.us/#sle.
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.
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.

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.

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

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.

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.
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.

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.

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/#sle.
   2. Philips Emergency Lighting/Bodine; _____: www.bodine.com/#sle.

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/#sle.
   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, lamp holders, 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.

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.
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.

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

SECTION 265561
THEATRICAL LIGHTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Stage lighting units.

B. Dimmers and control units.

1.02 REFERENCE STANDARDS

A. IESNA LM-63 - ANSI Approved Standard File Format for Electronic Transfer of Photometric Data and Related Information; 2002 (Reaffirmed 2008).

B. 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 layout of rack-mounted equipment and details and diagrams of interconnecting wiring.

C. Product Data: Provide for each item of equipment, showing sizes and ratings.
   1. Photometric Data: Submit on CD or DVD, in IESNA LM-63 standard format.

D. Manufacturer's Installation Instructions.

E. Project Record Documents: Record actual locations of dimmer outlets and circuiting arrangements.

F. Operation Data:
   1. Instructions for operating lighting control system.
   2. Instructions for operating system under unusual conditions when emergency life safety conditions exist.
   3. Identify limits beyond which operation would result in hazardous or unsafe conditions or in equipment damage.
   4. Document ratings of system and of each major component.

G. Maintenance Data:
   1. Routine preventive maintenance schedule.
   2. Lists of special tools, maintenance materials, and replacement parts.
   3. Repair instructions for procedures to check, repair, and test equipment during typical malfunctions.
   4. Recommended cleaning methods, frequency, 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 50 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.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. ETC/Electronic Theatre Controls; _____: www.etcconnect.com/#sle.

2.02 LIGHTING CONTROL COMPONENTS

A. Lighting Dimming and Control System: For stage area and house lighting.
   1. Dimmers: Integral with control console.
   2. Lighting Circuit Connections: Permanently, to dedicated dimmers.

B. Control Console: Fixed, with integral dimmers.
   1. Controls:
      a. Grand master.
      b. Independent master with bump switch for each scene.
      c. Split scene faders with automatic cross fading.
      d. Independent Master Timed Fade: Adjustable 0 to 100 seconds.
      e. House light faders.
      f. Channel faders.
      g. Blackout switch.

C. Dimmers: Modular dimming unit suitable for mounting in standard electronic rack.
   1. Ratings:
      a. Voltage: 120 V, single phase.
      b. Capacity: 20 A.
      c. Duty Cycle: Continuous.
      d. Efficiency: 98 percent, minimum.
      e. Response: Steady state within 6 cycles.
      f. Control Voltage: 16 V.

2.03 STAGE LIGHTING UNITS AND ACCESSORIES

A. Manufacturers:
   1. ETC/Electronic Theatre Controls; _____: www.etcconnect.com/#sle.

B. Floor Pockets: Two gang.
   1. Receptacles: NEMA L5-20R.
   2. Enclosure: Steel.
   3. Cover Plate: Cast aluminum.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install components in accordance with manufacturer's instructions.

B. Provide the services of a manufacturer representative to prepare and start systems.

C. Aim and adjust luminaires as indicated on Drawings.

D. Clean electrical parts to remove conductive and harmful materials.

E. Remove dirt and debris from enclosure.

F. Clean photometric control surfaces as recommended by manufacturer.

G. Clean finishes and touch up damage.

3.02 CLOSEOUT ACTIVITIES

A. See Section 017800 - Closeout Submittals, for closeout submittals.

B. See Section 017900 - Demonstration and Training, for additional requirements.

C. Demonstrate theatrical lighting system operation to Owner personnel for minimum of two hours.

END OF SECTION

SECTION 284600
FIRE DETECTION AND ALARM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fire alarm system design and installation, including all components, wiring, and conduit.
B. Communication with Owner's dispatch station.
C. Circuits from protected premises to dispatch station, including conduit.
D. Remote annunciator panels.
E. Detection devices.
F. Notification/signaling appliances.
G. Battery standby power.
H. Remote relay units.
I. Manual fire-alarm boxes.
J. System smoke detectors.
K. Heat detectors.
L. Magnetic door holders.
M. Addressable interface device.
N. Horn strobe booster panel power supplies.
O. Fire Watch.
P. Replacement and removal of existing fire alarm system components, wiring, and conduit indicated.
Q. Repairs of fire alarm system under contract for specified warranty period.

1.02 RELATED REQUIREMENTS

A. Section 078400 - Firestopping: Materials and methods for work to be performed by this installer.
B. Section 083477 - Smoke and Fire Protective Curtain Assemblies: Smoke and fire curtains to be released by fire alarm system or smoke detectors.
C. Section 083313 - Coiling Counter Doors: Coiling fire doors to be released by fire alarm system.
D. Section 083323 - Overhead Coiling Doors: Coiling fire doors to be released by fire alarm system.
E. Section 087100 - Door Hardware: Electrically operated locks and door holder devices to be monitored and released by fire alarm system.
F. Section 142100 - Electric Traction Elevators: Elevator systems monitored and controlled by fire alarm system.
G. Section 142400 - Hydraulic Elevators: Elevator systems monitored and controlled by fire alarm system.
H. Section 211300 - Fire-Suppression Sprinkler Systems: Supervisory, alarm, and actuating devices installed in sprinkler system.
I. Section 212200 - Clean-Agent Fire Extinguishing System: Supervisory, alarm, and releasing devices installed in extinguishing system.
J. Section 213000 - Fire Pumps: Supervisory devices.

K. Section 233300 - Air Duct Accessories: Smoke dampers monitored and controlled by fire alarm system.

L. Section 260519 - Low-Voltage Electrical Power Conductors and Cables.

M. Section 260526 - Grounding and Bonding for Electrical Systems.

N. Section 260533.13 - Conduit for Electrical Systems.

O. Section 260533.16 - Boxes for Electrical Systems.

P. Section 260536 - Cable Trays for Electrical Systems.

Q. Section 260533 - Identification for Electrical Systems.

R. Section 275129.13 - Area of Refuge/Rescue Assistance Systems: Two-way emergency communication systems for areas of refuge/rescue assistance.

S. Section 284050 - Conductors and Cables for Fire Alarm Detection and Alarm: Conductor and cable requirements for fire alarm systems.

1.03 REFERENCE STANDARDS

A. International Building Code.

B. International Fire Code.

C. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.

D. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.

E. IEEE C62.41.2 - Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits; 2002 (Cor 1, 2012).

F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. NFPA 72 - National Fire Alarm and Signaling Code; 2016.

H. NFPA 101 - Life Safety Code; 2015.

I. NFPA 601 - Standard for Security Services in Fire Loss Prevention; 2015.

J. UL 268 - Standard for Smoke Detectors for Fire Alarm Systems; Current Edition, Including All Revisions.

1.04 DEFINITIONS

A. LED: Light-emitting diode.

B. NEC: National Electrical Code.

C. NICET: National Institute for Certification in Engineering Technologies.

D. FACP: Fire Alarm Control Panel.

E. FARAP: Fire Alarm Remote Annunciator Panel.

F. NCM: Network Communication Module.

G. FAHSB: Fire Alarm Horn Strobe Booster Panel Power Supply.

H. XPIQ: Fire Alarm Audio Transponder.

I. DVC: Digital Voice Controller (For the Newest Notifier Panel).

J. SLC: Signaling Line Circuit.

K. PDF: Portable Document Format.

L. AutoCAD: Software program used to produce electronically drafted or designed documents.

1.05 SUBMITTALS

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

B. Proposal Documents: Submit the following with proposal:
   1. NFPA 72 "Record of Completion", filled out to the extent known at the time.
   2. Manufacturer's detailed data sheet for each control unit, initiating device, and notification appliance.
   3. Certification by Contractor that the system design will comply with the contract documents.

C. Drawings must be prepared using the current version of Revit. _____.
   1. Owner will provide floor plan drawings for Contractor's use; verify all dimensions on Owner-provided drawings.

D. Evidence of designer qualifications.

E. Design Documents: Submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, riser diagrams, and description of operation:
   1. NFPA 72 "Record of Completion", filled out to the extent known at the time.
   2. Clear and concise description of operation, with input/output matrix similar to that shown in NFPA 72 Appendix A-7-5-2.2(9), and complete listing of software required.
   3. System zone boundaries and interfaces to fire safety systems.
   4. Location of all components, circuits, and raceways; mark components with identifiers used in control unit programming.
   5. Circuit layouts; number, size, and type of raceways and conductors; conduit fill calculations; spare capacity calculations; notification appliance circuit voltage drop calculations.
   6. List of all devices on each signaling line circuit, with spare capacity indicated.
   7. Manufacturer's detailed data sheet for each component, including wiring diagrams, installation instructions, and circuit length limitations.
   8. Air-Sampling Smoke Detection Systems: Include air-sampling pipe network layout with sampling ports identified; include calculations demonstrating compliance with specified requirements.
   9. Description of power supplies; if secondary power is by battery include calculations demonstrating adequate battery power.
   10. Certification by either the manufacturer of the control unit or by the manufacturer of each other component that the components are compatible with the control unit.
   11. Certification by the manufacturer of the control unit that the system design complies with the contract documents.
   12. Certification by Contractor that the system design complies with the contract documents.
   13. Show existing components to be removed.

F. Evidence of installer qualifications.

G. Evidence of instructor qualifications; training lesson plan outline.

H. Evidence of maintenance contractor qualifications, if different from installer.

I. Inspection and Test Reports:
   1. Submit inspection and test plan prior to closeout demonstration.
   2. Submit documentation of satisfactory inspections and tests.
   3. Submit NFPA 72 "Inspection and Test Form," filled out.

J. Operating and Maintenance Data: See Section 017800 for additional requirements; revise and resubmit until acceptable; have one set available during closeout demonstration:
   1. Complete set of specified design documents, as approved by authority having jurisdiction.

2. Additional printed set of project record documents and closeout documents, bound or filed in same manuals.
3. Contact information for firm that will be providing contract maintenance and trouble call-back service.
4. List of recommended spare parts, tools, and instruments for testing.
5. Replacement parts list with current prices, and source of supply.
6. Detailed troubleshooting guide and large scale input/output matrix.
7. Preventive maintenance, inspection, and testing schedule complying with NFPA 72; provide printed copy and computer format acceptable to Owner.
8. Detailed but easy to read explanation of procedures to be taken by non-technical administrative personnel in the event of system trouble, when routine testing is being conducted, for fire drills, and when entering into contracts for remodeling.

K. Project Record Documents: See Section 017800 for additional requirements; have one set available during closeout demonstration:
1. Complete set of floor plans showing actual installed locations of components, conduit, and zones.
2. "As installed" wiring and schematic diagrams, with final terminal identifications.
3. "As programmed" operating sequences, including control events by device, updated input/output chart, and voice messages by event.

L. Closeout Documents:
1. Certification by manufacturer that the system has been installed in compliance with his installation requirements, is complete, and is in satisfactory operating condition.
2. NFPA 72 "Record of Completion", filled out completely and signed by installer and authorized representative of authority having jurisdiction.
3. Certificate of Occupancy.
4. Maintenance contract.
5. Report on training results.
6. Upon Date of Substantial Completion, the contractor shall provide a document stating the date commencing the system warranty.

M. Maintenance Materials, Tools, and Software: Furnish the following for Owner's use in maintenance of project.
1. See Section 016000 - Product Requirements, for additional provisions.
2. Furnish spare parts of same manufacturer and model as those installed; deliver in original packaging, labeled in same manner as in operating and maintenance data and place in spare parts cabinet.
3. In addition to the items in quantities indicated in PART 2, furnish the following:
   a. All tools, software, and documentation necessary to modify the fire alarm system using Owner's personnel; minimum modification capability to include addition and deletion of devices, circuits, and zones, and changes to system description, operation, and evacuation and instructional messages.
   b. One copy, on CD-ROM, of all software not resident in read-only-memory.
   c. Extra Fuses: Two for each installed fuse; store inside applicable control cabinet.
4. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
5. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

N. Provide system drawings documenting location of the FACP and any Fire Alarm Remote Annunciator Panel (FARAP), and the address and location of all notification and detection devices.

1.06 QUALITY ASSURANCE

A. Fire Watch: If the existing fire alarm system has been deactivated, and the replacement system is not in operation, the contractor shall provide a continual fire watch until either the existing fire alarm system is reactivated or the new fire alarm system is in normal operation.

B. Copies of Design Criteria Documents: Maintain at the project site for the duration of the project, bound together, an original copy of NFPA 72, the relevant portions of applicable codes, and instructions and guidelines of authorities having jurisdiction; deliver to Owner upon completion.

C. Designer Qualifications: NICET Level III or IV (3 or 4) certified fire alarm technician or registered fire protection engineer, employed by fire alarm control panel manufacturer, Contractor, or installer, with experience designing fire alarm systems in the jurisdictional area of the authorities having jurisdiction.

D. Installer Qualifications: Firm with minimum 3 years documented experience installing fire alarm systems of the specified type and providing contract maintenance service as a regular part of their business.
   1. Authorized representative of control unit manufacturer; submit manufacturer's certification that installer is authorized; include name and title of manufacturer's representative making certification.
   2. Installer Personnel: At least 2 years of experience installing fire alarm systems.
   3. Supervisor: NICET level III or IV (3 or 4) certified fire alarm technician; furnish name and address.

E. Maintenance Contractor Qualifications: Same entity as installer or different entity with specified qualifications.

F. Instructor Qualifications: Experienced in technical instruction, understanding fire alarm theory, and able to provide the required training; trained by fire alarm control unit manufacturer.

G. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

H. The ability for selective input/output control functions based on ANDing, ORing, NOTing, timing and special coded operations shall also be incorporated in the resident software programming of the system.

I. To accommodate and facilitate job site changes, initiation circuits shall be individually configurable on site to provide either alarm/trouble operation, alarm only, trouble only, current limited alarm, no alarm, normally closed device monitoring, a non-latching circuit or an alarm verification circuit.

J. To accommodate and facilitate job site changes indicating appliance circuits shall be individually configurable on site to provide upon activation a steady alarm until (silenced) or (reset) upon any output circuit.

K. The Electrical Contractor is responsible for the installation of the entire system and working very closely with BYU Electrical Shop, and is to provide a completely tested and functioning fire alarm system to the Owner.

L. During the final period prior to final testing, provide the BYU electrical shop with as built drawings of all installed devices, of all programming, shop drawings and other possibly important information: specifically, provide a list of all points appropriate for by-passing the system. In the event of an emergency prior to the final inspection, this information is valuable for a professional response by BYU personnel.

M. All panels and peripheral devices shall be new, in original packaging products of an authorized manufacturer, and shall display the manufacturer's name on each assembly.

N. Installation of Fire Alarm Control Panel (FACP) and field devices:

1. Prior to installation of FACP boards and field devices, a construction meeting shall be scheduled with the owner's project manager, fire alarm personnel and electrical engineer, general contractor, electrical contractor, project architect and electrical engineer; to coordinate the installation of fire alarm system components. Installation of this equipment, prior to this meeting shall not be accepted by the owner and will need to be replaced prior to the Owner's acceptance of the project fire alarm system.

1.07 INSTRUCTIONS TO THE BIDDER

A. The bid shall include all costs deemed necessary to cover all contingencies essential to the installation of the specified system.

B. Total cost for installation, materials, labor project management, permit fees, and other miscellaneous items must be listed separately.

C. A complete material list, including description, manufacturer, catalog number, quantity, unit price, line item total cost, freight expense, programming and miscellaneous related expenses must also be included.

D. All products and materials shall be new and in original packaging, clean and free of defects.

E. Where any discrepancies are found during the bid process, the most stringent requirements must be taken into account for bid preparation purposes.

F. Any cost encountered, but not itemized in the bid, shall not be passed on to the Owner, unless specifically agreed upon in writing.

G. No additional compensation will be allowed for extra work incurred on the part of the contractor due to bidder's failure to notice any pre-existing condition necessitating the additional labor and/or materials.

H. Owner to be notified immediately upon the discovery of any omissions or errors in the specification so corrective addenda may be issued. Such notification must be received by the Owner prior to the bid opening in accordance with bidding instructions.

1.08 RIGHTS OF THE OWNER

A. Reserves the right to accept or reject any bid at its discretion, or to reject all bids for whatever reasons deemed applicable.

B. Reserves the right to purchase all, or part of the materials and hardware for the project.

C. Receipt of a bid response does not obligate the Owner to pay any expenses incurred by the bidder in preparation of the bid response or obligate the Owner in any other respect.

D. Reserves the right to modify the specifications anytime during the bidding period through addendum, or job instruction/change order during project performance will be binding upon the Owner. No verbal instructions or interpretations of requirements shall be accepted.

E. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:
   1. Notify Owner no fewer than seven days in advance of proposed interruption of fire-alarm service.
   2. Do not proceed with interruption of fire-alarm service without Owner's written permission.

1.09 FIELD CONDITIONS

A. Field conditions shall comply wit the following: Do not install/operate equipment unless the following items are in compliance:
   1. Where detectors are installed for signal initiation during construction, they shall be cleaned and verified to be operating in accordance with the listed sensitivity, or they shall be replaced prior to the final acceptance of the system. NFPA 72, 2016, 17.7.1.11.1.

2. Where detectors are installed but not operational during construction, they shall be protected from construction debris, dust, dirt, and damage in accordance with the manufacturer's recommendations and verified to be operating in accordance with the listed sensitivity , or they shall be replaced prior to the final acceptance test of the system. NFPA 72, 2016, 17.7.1.11.2.
3. Where detection is not required during construction, detectors shall not be installed until after all construction trades have completed cleanup. NFPA 72, 2016, 17.7.1.11.3.
4. In areas where the fire alarm control panel (FACP) and/or the fire alarm remote annunciator is install, the fire alarm equipment shall not be installed until after all construction trades have completed cleanup.

1.10 WARRANTY

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

B. Provide control panel manufacturer's warranty that system components other than wire and conduit are free from defects and will remain so for 1 year after date of Substantial Completion.

C. Provide installer's warranty that the installation is free from defects and will remain so for 1 year after date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fire Alarm Control Units - Other Acceptable Manufacturers: Provided their products meet or exceed the performance of the basis of design product, products of the following are acceptable:
   1. Honeywell Security & Fire Solutions/Notifier; _____: www.notifier.com. Fire Protection services, (FPS) - (801-363-9696.

2.02 FIRE ALARM SYSTEM

A. Fire Alarm System: Provide a new automatic fire detection and alarm system:
   1. Provide all components necessary, regardless of whether shown in the contract documents or not.
   2. Protected Premises: Entire building shown on drawings.
   3. Comply with the following; where requirements conflict, order of precedence of requirements is as listed:
      a. ADA Standards.
      b. The requirements of the local authority having jurisdiction.
      c. Applicable local codes.
      d. The contract documents (drawings and specifications).
      e. NFPA 101.
      f. NFPA 72; where the word "should" is used consider that provision mandatory; where conflicts between requirements require deviation from NFPA 72, identify deviations clearly on design documents.
   4. Continuously operate alarm notification appliances.
   5. Identify alarm at fire-alarm control unit and remote annunciators.
   6. Transmit an alarm signal to the remote alarm receiving station.
   7. Notification Appliance Circuit: Operation shall sound per ANSI S3.41
   8. Evacuation Alarm: Multiple smoke zones; allow for evacuation notification of any individual zone or combination of zones, in addition to general evacuation of entire premises.
   9. Voice Notification: Provide emergency voice/alarm communications with multichannel capability; digital.

10. General Evacuation Zones: Each smoke zone is considered a general evacuation zone unless otherwise indicated, with alarm notification in all zones on the same floor, on the floor above, and the floor below.
11. Program notification zones and voice messages as directed by Owner.
12. Hearing Impaired Occupants: Provide visible notification devices in all public areas and in dwelling units.
13. Fire Command Center: As indicated on the drawings..
14. Master Control Unit (Panel): New, located at fire command center.
15. Two-Way Telephone: Provide two-way telephone service for the use of the fire service and others; provide jacks and two portable handsets.
16. The alarm activation of any initiation device shall not prevent the subsequent alarm operation of any other initiation circuit.
17. Disarrangement conditions of any circuit shall not affect the operation of the other circuits.
18. All auxiliary manual controls shall be supervised so that all switches must be returned to the normal automatic position to clear system trouble.
19. Each independently supervised circuit shall include a discreet LCD readout to indicate disarrangement conditions per circuit.
20. The incoming power to the system shall be supervised so that any power failure must be audibly and visually indicated at the control panel (and the remote annunciator). A green "power on" LED shall be displayed continuously while incoming power is present.
21. The system batteries shall be supervised so that a low battery condition or disconnection of the battery shall be audibly and visually indicated at the control panel.
22. The fire alarm system shall have built-in diagnostics that shall display trouble conditions on the LCD display and shall describe in plain English, the location and type of trouble.
23. The system shall have the capability of pinpointing certain system troubles to card and device.
24. The system shall include the means to disconnect any zone, signal circuit or control circuit from an on-board keypad. When the circuit is in the disconnected mode, a system trouble shall be generated and logged into memory with a time and date notation.
25. Contractor shall furnish and install the necessary raceway, conductors and Network Card (NCM) to interface the fire alarm control panel to the campus control station.
26. System trouble signal initiation shall be by one or more of the following devices and actions:
    a. Open circuits, shorts, and grounds in designated circuits.
    b. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
    c. Loss of primary power at fire-alarm control unit.
    d. Ground or a single break in fire-alarm control unit internal circuits.
    e. Abnormal ac voltage at fire-alarm control unit.
    f. Break in standby battery circuitry.
    g. Failure of battery charging.
    h. Abnormal position of any switch at fire-alarm control unit or annunciator.
27. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke barrier walls shall be connected to fire-alarm system.
28. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups.
29. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

30. Voice/Alarm Signaling Service: Central emergency communication system with redundant microphones, preamplifiers, amplifiers, and tone generators provided as a special module that is part of fire-alarm control unit.

B. Supervising Stations and Fire Department Connections:
   1. On-Premises Supervising Station: Existing proprietary station operated by Owner, located the BYU Talmage Building (TMCB) basement._____.

C. Power Requirements
   1. The FACP and sub-panels shall receive 120 VAC power (as noted on the plans) via dedicated and surge protected circuits.
   2. The system shall be provided with a sufficient battery capacity to operate the entire system upon loss of normal 120 VAC power in a normal supervisory mode for a period of twenty-four (24) hours with 5 minutes of alarm operation using horn/strobe notification devices at the end of this period. For those systems with speaker/strobes, the run time following the 24 hour test period, shall be 15 minutes. The system shall automatically transfer to the standby batteries upon power failure. All battery charging and recharging operations shall be automatic.
   3. All circuits requiring system-operating power shall be 24 VDC and shall be individually fuses at the control panel.
   4. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory signals supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.
      a. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.
   5. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
      a. Batteries: Provide sufficient stand-by, lead-acid maintenance-free battery capacity in the FACP for 24 hours of supervisory operation with AC power off. Provide for 5 minute of 100% alarm current after 24 hours of power outage.
      b. Battery Manufacturer: The following are approved manufacturers. The contractor shall only use batteries from the approved list of manufactures, all other manufacturers are not approved to bid on this project:
         1) Universal Battery Brand.
         2) Interstate “Power Patrol”.
         3) ELK Brand.

D. Circuits:
   1. Initiating Device Circuits (IDC): Class A.
   2. Signaling Line Circuits (SLC) Within Single Building: Class A.
   3. Notification Appliance Circuits (NAC): Class A.

E. Spare Capacity:
   1. Initiating Device Circuits: Minimum 20 percent spare capacity.
   2. Notification Appliance Circuits: Minimum 20 percent spare capacity,
   3. Speaker Amplifiers: Minimum 20 percent spare capacity.
   4. Master Control Unit: Capable of handling all circuits utilized to capacity without requiring additional components other than plug-in control modules.

F. Power Sources:
   1. Primary: Dedicated emergency powered branch circuits of the facility emergency power distribution system.
   2. Secondary: Storage batteries.

3. Capacity: Sufficient to operate entire system for period specified by NFPA 72.
4. Each Computer System: Provide uninterruptible power supply (UPS).

2.03 EXISTING COMPONENTS

A. Existing Fire Alarm System: Remove existing components indicated and incorporate remaining components into new system, under warranty as if they were new; do not take existing portions of system out of service until new portions are fully operational, tested, and connected to existing system. Remove labels from new equipment when put into service and label existing fire-alarm equipment "NOT IN SERVICE" until removed from the building.

B. Clearly label components that are "Not In Service."

C. Remove unused existing components and materials from site and dispose of properly.

2.04 FIRE SAFETY SYSTEMS INTERFACES

A. Supervision: Provide supervisory signals in accordance with NFPA 72 for the following:
1. Sprinkler water control valves.
2. Dry-pipe sprinkler system pressure.
3. Dry-pipe sprinkler valve room low temperature.
4. Sprinkler water storage tank low level.
5. Sprinkler water storage tank low temperature.
6. Fire pump(s).
7. Elevator shut-down control circuits.

B. Alarm: Provide alarm initiation in accordance with NFPA 72 for the following:
1. Sprinkler water flow.
2. Total flooding suppression system activation.
3. Kitchen hood suppression activation; also disconnect fuel source from cooking equipment.
4. Elevator lobby, elevator hoistway, and elevator machine room smoke detectors.
5. Generator room heat detector.
6. Duct smoke detectors.

C. Elevators:
1. Elevator lobby, hoistway, and machine room smoke detectors: Elevator recall for fire fighters' service.
2. Elevator Machine Room Heat Detector: Shut down elevator power prior to hoistway sprinkler activation.
3. Sprinkler pressure or waterflow: Shut down elevator power prior to hoistway sprinkler activation.

D. HVAC:
1. Duct Smoke Detectors: Close dampers indicated; shut down air handlers indicated.

E. Doors:
1. Smoke Barrier Door Magnetic Holders: Release upon activation of smoke detectors in smoke zone on either side of door, upon alarm from manual pull station on same floor, and upon sprinkler activation on same floor. Refer to Section 087100.
2. Electromagnetic Door Locks on Egress Doors: Unlock upon activation of any alarm initiating device or suppression system in smoke zone that doors serve as egress from. Refer to Section 087100.
3. Overhead Coiling Fire Doors: Release upon activation of smoke detectors in smoke zone on either side of door, upon alarm from manual pull station on same floor, and upon sprinkler activation on same floor. Refer to Section 083323.

2.05 COMPONENTS

A. General:
   1. Provide flush mounted units where installed in finish areas; in unfinished areas, surface mounted unit are acceptable.
   2. Provide legible, permanent labels for each control device, using identification used in operation and maintenance data.

B. Fire Alarm Control Units, Initiating Devices, and Notification Appliances: Analog, addressable type; listed, classified, and labeled as suitable for the purpose intended.

C. Master Control Unit: As specified for Basis of Design above, or equivalent.

D. REMOTE ANNUNCIATOR (FARAP)
   1. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.
      a. Mounting: Flush cabinet, NEMA 250, Type 1.
   2. Annunciator Panel Model Number:
      a. Notifier, #NCA-2.
   3. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

E. MANUAL FIRE-ALARM BOXES
   1. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
      a. Single-action mechanism, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
      b. Station Reset: Reset shall require a key common to the control panel.
      c. Device shall be constructed of high impact, red Lexan or die cast aluminum housing with raised white lettering and a smooth high gloss finish. Once pulled down, the lever shall remain at a 900 angle from the front of the station to provide a visual indication of the station in alarm. Pull station shall be by the same manufacturer to insure compatibility.
      d. Indoor Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Provide shield where indicated on drawings.
      e. Weatherproof Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.
      f. Mounting: Wall mounted with flush trim ring, unless otherwise indicated, surface provide skirt to cover surface box in all public areas. Skirt to match device color.
      g. Manufacturer - Notifier

F. SYSTEM SMOKE DETECTORS
   1. General Requirements for System Smoke Detectors:
      a. Comply with UL 268; operating at 24-V dc, nominal and shall be documented compatible with the control equipment to which it is connected.
      b. Detectors shall be two-wire type, intelligent.
      c. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

d. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
e. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
f. Integral Visual-Indicating Light. The sensor base shall contain a red LED, which shall pulse to indicate power on and glow continuously to indicate an alarm or a sensor trouble condition.
g. Furnish and install where indicated on the plans with addressable base.
h. When used with a sounder base, see Notification Appliances section below.
i. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
    1) Provide multiple levels of detection sensitivity for each sensor.

2. Photoelectric Smoke Detectors:
    a. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
    b. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
        1) Primary status.
        2) Device type.
        3) Present average value.
        4) Present sensitivity selected.
        5) Sensor range (normal, dirty, etc.).
    c. Photoelectric type and shall communicate actual smoke chamber values to the system controller.
    d. The sensors shall be sensitivity programmable from the system controller. Sensitivity may be varied on a time-factored input. Sensors shall be programmable for "pre-alarm", "sensor very dirty" indications at the system controller. The sensitivity of the sensors shall remain constant throughout the entire range of acceptable dirty buildup until the "sensor very dirty" indication is processed. All "dirty" indications shall be logged into memory at the system controller for call up by maintenance personnel. Any sensor which is not self compensating for dirt build up is not acceptable.
    e. Incorporate a 30 mesh insect screen. The sensor electronics shall be completely shielded to protect against false alarms from EMI and RFI.
    f. Contain an anti-tamper device to discourage unauthorized removal of the sensor from its base.
    g. Manufacturer - Notifier, #

3. Duct Smoke Detectors:
    a. Photoelectric type complying with UL 268A.
    b. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
    c. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
        1) Primary status.
        2) Device type.
        3) Present average value.
        4) Present sensitivity selected.
        5) Sensor range (normal, dirty, etc.).

d. Weatherproof Duct Housing Enclosure: Type 4; NRTL listed for use with the supplied detector.
e. Each sensor shall have multiple levels of detection sensitivity.
f. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
g. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.
h. Furnish and install addressable duct detector with sampling tube, photo electric, as shown on plans.
i. Manufacturer:
1) Notifier, #DNRW.
2) System Sensor.
j. Provide remote test station for all duct smoke detectors that are not readily accessible.

G. PROJECTED BEAM SMOKE DETECTORS
1. Projected Beam Light Source and Receiver: Designed to accommodate small angular movements and continue to operate and not cause nuisance alarms.
2. Detector Address: Accessible from fire-alarm control unit and able to identify the detector's location within the system and its sensitivity setting.
3. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
a. Primary status.
b. Device type.
c. Present average value.
d. Present sensitivity selected.
e. Sensor range (normal, dirty, etc.).
f. Manufacture - Xtrallis (OSID)

H. HEAT DETECTORS
1. General Requirements for Heat Detectors:
a. Comply with UL 521.
b. Heat detector type:
1) Combination type. Actuated by either a fixed temperature of 135 deg F or a rate of rise that exceeds 15 deg F per minute unless otherwise indicated.
2) Rate-of-rise temperature characteristic shall be selectable at fire-alarm control unit for 15 or 20 deg F (8 or 11 deg C) per minute.
3) Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F (57 or 68 deg C).
c. Mounting: Twist-lock base interchangeable with addressable smoke-detector bases.
d. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
e. When the fixed-temperature portion is activated, the units shall be restorable and give visual evidence of such operation.
f. Manufacturer - Notifier, #FST-951.

I. ROOF HATCH FIREMAN ACCESS
1. Install a pushbutton near automated roof hatch. When fire alarm system is activated, the push button becomes activate and provide an override on the access control system to help the firemen access the roof.

J. NOTIFICATION APPLIANCES

1. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated and with screw terminals for system connections.
    a. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections.
    b. Faceplate: Factory finished; red for wall mounted, white for ceiling mounted.
    c. Mounting: Wall mounted with flush trim ring, unless otherwise indicated, surface provide skirt to cover surface box in all public areas. Skirt to match device color.
2. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet (3 m) from the horn, using the coded signal prescribed in UL 464 test protocol.
3. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white lexan lens mounted on an aluminum faceplate. The word "FIRE" in red lettering engraved in minimum 1-inch- (25-mm-) high letters on the sides and shall be pyramidical in shape to allow for side viewing and shall be suitable for installation in the locations shown on the drawings.
    a. Rated Light Output:
        1) 15/30/75/110 cd, selectable in the field.
    b. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
    c. Flashing shall be in a temporal pattern, synchronized with other units.
    d. Strobe Leads: Factory connected to screw terminals.
    e. T tapping of signal device conductors to signal circuit conductors shall NOT be accepted.
    f. Manufacturer - System Sensor, Cooper Wheelock and Notifier.
4. Voice/Tone Notification Appliances:
    a. Appliances shall comply with UL 1480 and shall be listed and labeled by an NRTL.
    b. High-Range Units: Rated 2 to 15 W.
    c. Low-Range Units: Rated 1 to 2 W.
    d. Matching Transformers: Tap range matched to acoustical environment of speaker location.
    e. Use high-range speakers in noisy environments and low-range speakers in quiet locations.
    f. Select speakers for each location to comply with NFPA 72 and ADA 3 requirements.
    g. The alarm speakers shall have multi-tap capabilities from 1/8 to 2 watts and shall be operated by 24 VDC.
    h. Each speaker assembly shall include separate wire leads for in/out wiring for each leg of the associated signal circuit.
    i. The alarm speakers shall be audio-visual assemblies, which shall be flush trim ring.
    j. Output of speaker at minimum wattage across a frequency range of 400 to 4000 Hz.
    k. Manufacturer - System Sensor, Cooper Wheelock.
5. Smoke Detector Sounder Bases (Residential Units):
    a. Appliances shall comply with UL 268 and 464 and shall be listed and labeled by an NRTL.
    b. Sound pressure: 85 dBA (min) continuous tone at 10 feet
    c. Maximum installation temperature 161 degrees F (68 degrees C).
    d. Manufacturer - System Sensor, Cooper Wheelock.

K. MAGNETIC DOOR HOLDERS
1. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching doorplate.
    a. Wall-Mounted Units: Flush mounted unless otherwise indicated.

b. Rating: 120-v ac and 24-v dc.
c. Manufacturer - ESL, #DH24120XY. X = surface (S) or semi-flush (F) mount. Y = Brushed Chrome (C) or Brushed Brass (B).

2. Material and Finish: Match door hardware. Use either brushed chrome or brushed brass.

L. ADDRESSABLE INTERFACE DEVICE (AM) - Look at difference between Monitoring Module and relay Module
1. Description: Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating devices for wired applications with normally open contacts.
2. Furnish and install one AM for each non-addressable device on normally open dry contacts, i.e., sprinkler flow and tamper switches, manual pull stations and NAC power supply (FCPS 24).
3. Manufacturer - Notifier.

M. NON-ADDRESSABLE INTERFACE DEVICE (PAM)
1. Description: Electronic control module, UL listed for use in providing operation of equipment. Provide with normally open and normally closed contacts. 24VDC (7.0 amps) 120 VAC (10 amps).
2. Furnish and install one for all equipment requiring relay operation, with current requirements higher that AM or addressable devices.
3. Manufacturer - Air Products and Controls, #PAM-1.

N. QUAD INTELLIGENT AUDIO TRANSPONDERS
1. Suitable for distributed, multi-channel voice evacuation systems with capability of playing up to four simultaneous messages.
2. Integrated audio amplification and distribution sub systems shall be controlled by the FACP via the SLC (Signaling Line Circuit).

O. Locks and Keys: Deliver keys to Owner.
1. Provide the same standard lock and key for each key operated switch and lockable panel and cabinet; provide 2 keys of each type

P. Instruction Charts: Printed instruction chart for operators, showing steps to be taken when a signal is received (normal, alarm, supervisory, and trouble); easily readable from normal operator's station.
1. Frame: Stainless steel or aluminum with polycarbonate or glass cover.
2. Provide one for each control unit where operations are to be performed.
3. Obtain approval of Owner prior to mounting; mount in location acceptable to Owner.
4. Provide extra copy with operation and maintenance data submittal.

Q. Extra Materials
1. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
a. Smoke Detectors, Heat Detectors and Pull Stations: Quantity equal to 10 percent of amount of each type installed, but no less than 2 units of each type.
b. Detector Bases: Quantity equal to 2 percent of amount of each type installed, but no less than 2 unit of each type.
c. Keys and Tools: One extra set for access to locked and tamperproofed components.
d. Audible and Visual Notification Appliances: Two of each type installed.
e. Fuses: Four of each type installed in the system.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with applicable codes, NFPA 72, NFPA 70, and the contract documents.

B. Conceal all wiring, conduit, boxes, and supports where installed in finished areas.

C. Obtain Owner's approval of locations of devices, before installation.

D. Install instruction cards and labels.

E. Equipment Mounting:
   1. If equipment is wall mounted, install fire-alarm control unit (FACP and FARAP) on finished wall with top of display at 70 inches above the finished floor. All enclosures without a display shall be mounted with the top of the equipment at 70 inches above the finished floor.
   2. If equipment is installed in high ceilings, the fire alarm devices shall be visible from the floor and readily accessible. In this instance, readily accessible, shall be defined per the NEC. We will allow an exception, when a device is located on the ceiling, that a device may be accessed with a portable ladder. In this instance, the device shall be visible from the floor.
   3. Equipment shall not be located above a hard (sheetrocked, etc.) or grid ceiling systems.

F. Speaker, Strobes and Horns: Shall be uniform throughout building at 90“, from center of device, to above the finished floor.

G. Pull Stations: Shall be uniform throughout building at 48" to top of rough-in box. Intent: 46" +/- 1” to the hand pull handle.

H. Horns, Speaker s and Strobes that are to be surface mounted, require Surface Mount Kit with skirt over the J-box. Surface mount kit shall be the same size as device and back box.

I. Smoke- or Heat-Detector Spacing:
   1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
   2. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.
   3. Smooth ceiling spacing shall not exceed 30 feet.
   4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Appendix A in NFPA 72.
   5. HVAC: Locate detectors not closer than 3 feet from air-supply diffuser or return-air opening.
   6. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture.

J. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.

K. Heat Detectors in Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location.

L. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.

M. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.

N. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches below the ceiling.

O. Device Location-Indicating Lights: Locate in public space near the device they monitor.

P. Installation of all devices shall meet the currently adopted NFPA and International Fire alarm codes.

Q. Install fire alarm and detection systems as indicated, in accordance with equipment manufacturer’s written instructions and comply with applicable portions of the NEC and NECA’s “Standards of Installation”.

R. All panels shall be mounted with 4ft. horizontal clearance in front and the width of the panel for observation and testing. All fire alarm junction boxes must be clearly marked for easy identification.

S. Wiring splices are to be avoided, make connections at terminal strips in the cabinets or equipment terminals. Transposing or changing wire color-coding of the wires shall not be permitted.

T. Initiating circuits shall be Class A (Style 6) with separate runs for outgoing and return portions of the loop, such that a single fault in the initiating loop does not prevent operation of indicating devices. Outgoing and return conduits shall be separated by a minimum of 12” vertical and 48” horizontal, per NFPA Annex A 64222.

U. The system shall incorporate NFPA 72D (Style 6) wiring which provides the necessary circuitry for emergency operation of the signaling line circuit during a single break or ground fault.

V. The Contractor is responsible to coordinate with the fire alarm system supplier and the BYU Electrical Shop to insure that raceway size, wire quantity, size and type is suitable for equipment supplied, NEC standards and U.L. requirements. Label all wires and cables with Scotch brand labels for easy identification.

W. Where it is necessary to penetrate existing concrete walls above the ceiling, appropriate sealants shall be used to seal around the conduit, with the fire alarm system installer providing and installing the sealant. Where duct work is penetrated and smoke detectors installed, ducts shall be resealed and provision made to provide access to smoke detectors for servicing and cleaning.

X. When networking fire alarm control panels, existing tunnels shall be utilized.

Y. The screen of the FACP and the remote annunciators shall report the point of alarm or trouble.

Z. Notify the BYU Electrical Shop prior to making any changes in any part of an existing fire alarm system.

AA. Routing of new fire alarm circuits must be coordinated with the BYU Electrical Shop.

AB. 120 VAC power circuits shall not be permitted in alarm raceways.

AC. Provide and install the system in accordance with the plans and specifications of all applicable codes and the manufacturer's recommendations. All wiring shall be installed in strict compliance with all the provisions of NEC - Article 760 A and C, Power Limited Fire Protective Signaling Circuits or if required may be reclassified as non-power limited and wired in accordance with NEC Article 760 A and B. Upon completion, the Contractor shall so certify in writing to the Owner and General Contractor.

AD. All fire alarm devices including but not limited to smoke detectors; heat detectors; relays; pull stations; strobes; speakers; horn strobes; speaker strobes; etc. shall be clearly labeled with its loop, unique address and circuit number. All devices shall have labels which are easily readable from the floor and minimum of ½” x ½” per character in size. Provide 1"x1" for high ceiling mounted devices.

AE. Installation of all fire equipment shall be closely coordinated with all appropriate sub-contractors.

AF. The Owner will network the new installation with the Campus Notifier, Onyx Works system.

AG. The Contractor shall thoroughly remove debris from within the panels and j-boxes, and from the work site before completion of the installation.

AH. The authorized fire system service representative shall terminate the panels, program the panel and test all devices.

3.02 LABELING OF FIRE ALARM DEVICES

A. Labeling requirements:
   1. Electrical contractor shall coordinate and install labels and heads.
   2. If the equipment is located in a public area, install label in an area not visible to the public.

B. Labeling shall include:
   1. Date the equipment was installed. This requirement shall not supersede the date of substantial completion, in regards to the fire alarm system warranty.

2. All addressable devices shall be labeled with their appropriate loop and address numbers.
3. Provide engraved labels for panel enclosures. Refer to Section 260553 for engraved label requirements.

C. Provide labels for the following equipment/devices:
1. Main fire alarm panel.
2. Notification appliance circuit (NAC) panel.
3. Remote annunciator.
4. Smoke detectors.
5. Heat detectors.
6. Notification horn and/or strobes.
7. Notification voice and/or strobes.
8. Control, relay and monitor modules.
9. Pull stations.
10. Beam detectors.
11. Batteries.

3.03 CONNECTIONS

A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Division 08 Section "Door Hardware." Connect hardware and devices to fire-alarm system.
1. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.

B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
1. Alarm-initiating connection to stairwell and elevator-shaft pressurization systems.
2. Smoke dampers in air ducts of designated air-conditioning duct systems.
3. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
4. Supervisory connections at valve supervisory switches.

3.04 ACTIVATION OF FIRE ALARM SYSTEM

A. The building fire alarm system shall not be activated and the devices uncovered, until all grinding and dust producing operations have ceases.

B. Activation of the fire alarm system and uncovering of devices, prior to final grinding and dust production, may make the fire alarm system unacceptable to the owner. If this occurs, per the owner's direction, the fire alarm system panels and devices may have to be replaced at the contractor's expense.

3.05 INSTALLATION OF RACEWAYS

A. All conduit, mounting boxes, junction boxes, panels, detectors, alarm devices, etc. shall be mounted and fastened with appropriate fittings to insure positive grounding throughout the system.

B. Raceways with horn strobe circuiting. Locate ceiling junction boxes no more than 60 feet apart.

C. Install at the Main FACP, a wire gutter capable of handling all system wiring. The minimum gutter size shall be 8" by 8" by 24" long. Run appropriate conduits between gutter and panel.

D. All fire alarm conduits are to be installed in class "A" style, i.e., leave the fire alarm panel in 3/4" conduit and after completing a trunk line circle, return to the fire alarm panel. Each conduit loop may be run separately, such as 1st Floor "A" loop, 2nd Floor "B" loop, etc. (Exception: Where only one

device, such as a horn/strobe or hand pull is remote from the main trunk line or FACP, a “T” conduit is allowable. Where two related devices, such as a valve tamper and its companion flow switch are together, then one conduit is also permitted. Wiring, however, must be supervised in a normal fashion, with a class “A” loop.

E. EMT conduit is required, except for a 6' maximum length of ½” flexible conduit to smoke detectors and similar devices.

F. 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.

G. All conduit is to be minimum 3/4" conduit and all junction boxes shall be 4" sq x 2-1/8" deep or 4 11/16” x 2 1/8” when needed, using blank covers, plaster rings, etc., as required, unless otherwise approved.

H. Where deemed prudent provide spare wires and/or cables in conduits. Coordinate with BYU Electrical Shop.

I. For those particularly challenging locations where EMT conduit is impossible, and with the BYU Electrical Shop concurrence, utilize the following raceway methods:
   1. Metallic flexible conduit above the ceiling and in the walls;
   2. Wiremold #700 wireway on the exposed walls and ceiling, painted to match existing surfaces.

3.06 DEVICE HARDWARE

A. Provide relay contacts for mechanical system shutdown. All mechanical system supply and return air fans are to be shut down immediately upon any alarm condition.

B. “Fan Shut-Down” shall be controlled by a slave relay driven by addressable relays. Furnish and install relays for fans.

C. If a Fire Suppression System is an element of this project, provide addressable modules and necessary relays to tie as specified in the drawings to the FACP.

3.07 FIRE ALARM SPEAKERS

A. Design speaker system at 80% of speaker capacity. Once speakers are installed, verify that the speakers are set at 80% of speaker output.

3.08 TESTING OF FIRE ALARM SYSTEM

A. Each device shall be tested for compliance to manufacturers listed operation.

B. Provide (2) two hard copies of testing report to owner, including the operational status of each device.

3.09 BUILDING FIRE ALARM DRAWINGS NEAR REMOTE ANNUNCIATOR

A. Provide a laminated set of fire alarm drawings, visibly located adjacent to the fire alarm remote annunciator. The drawings shall be housed in a framed cabinet or permanently attached to the wall. The fire alarm drawings shall include fire alarm plans with all fire alarm equipment/devices, located and identified, with their loop and identification number.

3.10 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3.11 INSPECTION AND TESTING FOR COMPLETION

A. Notify Owner 7 days prior to beginning completion inspections and tests.

B. Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.

C. Provide the services of the installer's supervisor or person with equivalent qualifications to supervise inspection and testing, correction, and adjustments.

D. Prepare for testing by ensuring that all work is complete and correct; perform preliminary tests as required.

E. Provide all tools, software, and supplies required to accomplish inspection and testing.

F. Perform inspection and testing in accordance with NFPA 72 and requirements of local authorities; document each inspection and test.

G. Correct defective work, adjust for proper operation, and retest until entire system complies with contract documents.

H. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

I. Fire-alarm system will be considered defective if it does not pass tests and inspections.

J. At the rough-in phase, the contractor shall schedule a rough-in Inspection with Provo City Fire Marshal's office. This inspection shall occur when the raceway and boxes have been installed and before the ceiling have been installed. The Rough-in inspection will assist in examining the fire alarm installation and avoiding any unnecessary alteration to building construction.

K. Demonstration
   1. Engage a factory-authorized service representative to Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.
   2. The manufacturer of the fire alarm system shall provide the owner with the necessary on-site training to program, service and maintain the fire alarm panel. The training shall include, but not limited to:
      a. Add or remove devices device from service.
      b. Diagnosis of the fire alarm system.

3.12 OWNER PERSONNEL INSTRUCTION

A. Provide the following instruction to designated Owner personnel:
   1. Hands-On Instruction: On-site, using operational system.

B. Basic Operation: One-hour sessions for attendant personnel, security officers, and engineering staff; combination of classroom and hands-on:
   1. Initial Training: 1 session pre-closeout.

C. Furnish the services of instructors and teaching aids; have copies of operation and maintenance data available during instruction.

D. Provide means of evaluation of trainees suitable to type of training given; report results to Owner.

3.13 CLOSEOUT

A. Closeout Demonstration: Demonstrate proper operation of all functions to Owner.
   1. Be prepared to conduct any of the required tests.
   2. Have at least one copy of operation and maintenance data, preliminary copy of project record drawings, input/output matrix, and operator instruction chart(s) available during demonstration.
   3. Have authorized technical representative of control unit manufacturer present during demonstration.
   4. Demonstration may be combined with inspection and testing required by authority having jurisdiction; notify authority having jurisdiction in time to schedule demonstration.
   5. Repeat demonstration until successful.

B. Occupancy of the project will not occur prior to Substantial Completion.

C. Substantial Completion of the project cannot be achieved until inspection and testing is successful and:
   1. Specified diagnostic period without malfunction has been completed.
   2. Approved operating and maintenance data has been delivered.
   3. Spare parts, extra materials, and tools have been delivered.
   4. All aspects of operation have been demonstrated to Owner.
   5. Final acceptance of the fire alarm system has been given by authorities having jurisdiction.
   6. Occupancy permit has been granted.
   7. Specified pre-closeout instruction is complete.

D. As-built Drawings:
   1. Provide “Hard Copy” as-built drawings (3 copies) supplied engineer for review and submission to owner.
   2. Provide an electronic copy of manufacturer‘s fire alarm drawings, with all corrections.
   3. Identify all panel booster power supplies, addressable modules, etc., that are located throughout the project.
   4. The Owner will install building fire alarm maps as required adjacent to the FACP and each remote annunciation panel.

E. Electronic Data Files shall be supplied to the engineer. These files shall include all information required to allow the Owner to maintain and modify the fire alarm program, and shall contain a minimum of the following:
   1. CAD of the building fire alarm map indicating the exact location of all devices along with the addresses of the individual devices.
   2. CAD drawing files of “as-built” fire alarm panel components and point-to-point connections.
   3. General configuration programming.
   4. Job specific configuration programming.
   5. Tutorial file on complete programming of fire alarm system.

F. Operating and Maintenance Manuals (three sets) shall be submitted prior to testing of the system, unless the specific manuals are already on file in the BYU Electrical Shop.

3.14 MAINTENANCE DURING WARRANTY PERIOD

A. See Section 017000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.

B. Provide to Owner, at no extra cost, a written maintenance contract for entire manufacturer's warranty period, to include the work described below.

C. Perform repairs as needed, due to failure of fire alarm system.
   1. Emergency response. The fire alarm equipment supplier shall provide an emergency response within four hours of any reported system failure to resolve the problem during 1-year warranty. Repairs required, unless due to improper use, accidents, or negligence beyond the control of the maintenance contractor.
   2. Record keeping required by NFPA 72 and authorities having jurisdiction, for the duration of the warranty period.

D. Provide trouble call-back service upon notification by Owner:
   1. Provide on-site response within 12 hours of notification.

E. Provide a complete description of work performed, equipment replaced and/or adjusted, with a detailed schedule.

F. Maintain a log at each fire alarm control unit, listing the date and time of each call-back visit, the condition of the system, nature of the trouble, correction performed, and parts replaced. Submit duplicate of each log entry to Owner's representative upon completion of site visit.

G. Comply with Owner's requirements for access to facility and security.

END OF SECTION