PROJECT MANUAL

Replace 13 Elevators and 6 Escalators

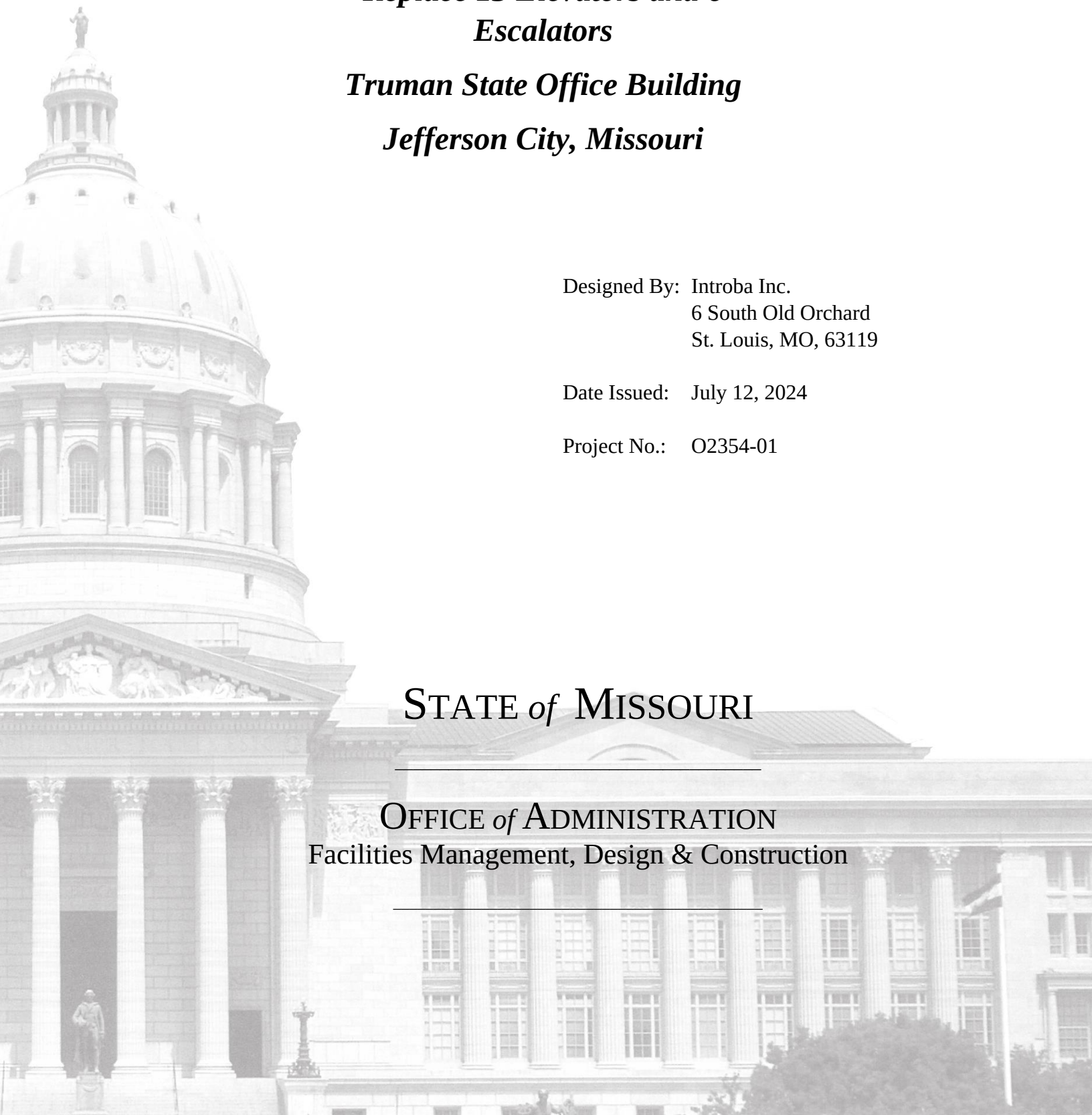
Truman State Office Building

Jefferson City, Missouri

Designed By: Introba Inc.
6 South Old Orchard
St. Louis, MO, 63119

Date Issued: July 12, 2024

Project No.: O2354-01



STATE *of* MISSOURI

OFFICE *of* ADMINISTRATION
Facilities Management, Design & Construction

SECTION 000107 - PROFESSIONAL SEALS AND CERTIFICATIONS

PROJECT NUMBER: (O2354-01)

THE FOLLOWING DESIGN PROFESSIONALS HAVE SIGNED AND SEALED THE ORIGINAL PLANS AND SPECIFICATIONS FOR THIS PROJECT, WHICH ARE ON FILE WITH THE DIVISION OF FACILITIES MANAGEMENT, DESIGN AND CONSTRUCTION:

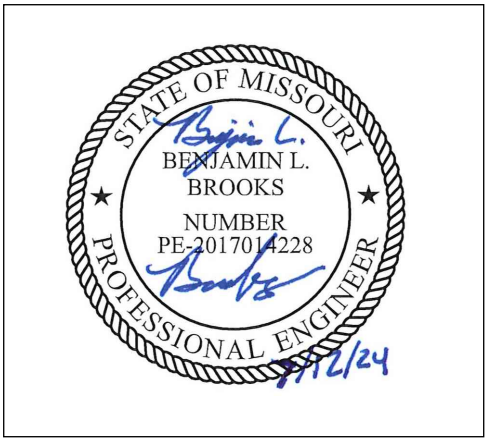
A. Architect of Record

1. Bradford A. Pierce
2. Missouri AR005805
3. Responsible for Divisions 02, 05, 07, 08 & 14.

07/12/2024

B. Fire Protection Engineer

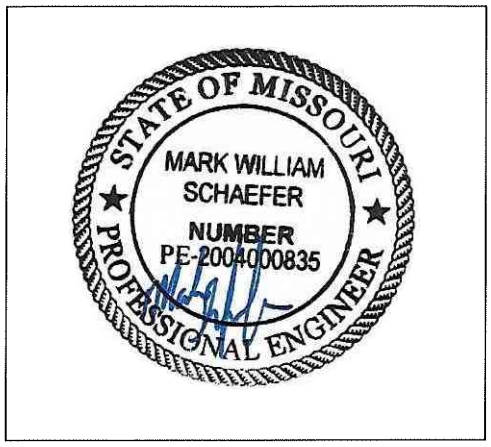
1. Benjamin Brooks
2. Missouri PE-2017014228
3. Responsible for Division 21.



07/12/2024

C. Plumbing/HVAC Engineer

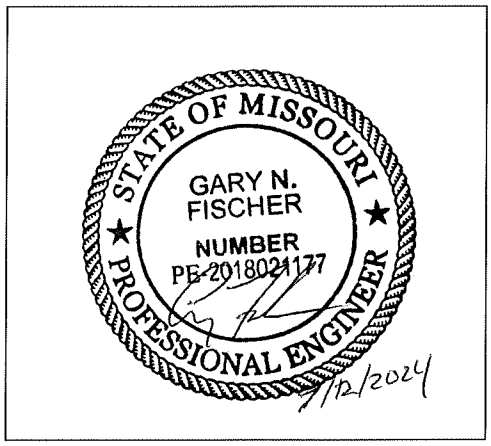
1. Mark Schaefer
2. Missouri PE-2004000835
3. Responsible for Divisions 22 & 23.



07/12/2024

D. Electrical Engineer

1. Gary Fischer
2. Missouri PE-2018021177
3. Responsible for Divisions 26 & 28.



07/12/2024

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SECTION 000115 – LIST OF DRAWINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section provides a comprehensive list of the drawings that comprise the Bid Documents for this project.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 LIST OF DRAWINGS

A. The following list of drawings is a part of the Bid Documents:

00-GENERAL

G-000 COVER SHEET

05-ARCHITECTURE

A-000 LEGEND, SYMBOLS AND ABBREVIATIONS
AD-101 NORTH PASSENGER ELEVATORS DEMO 1, 2, 3, 4 & 13
AD-102 NORTH PASSENGER ELEVATORS DEMO 1, 2, 3, 4 & 13
AD-103 NORTH PASSENGER ELEVATORS DEMO 1, 2, 3, 4 & 13
AD-104 SOUTH PASSENGER ELEVATORS DEMO 5, 6, 7, 8 & 14
AD-105 SOUTH PASSENGER ELEVATORS DEMO 5, 6, 7, 8 & 14
AD-106 SOUTH PASSENGER ELEVATORS DEMO 5, 6, 7, 8 & 14
AD-107 ELEVATORS 9 & 10 DEMO
AD-108 ELEVATOR 11 DEMO
AD-109 ESCALATOR DEMO PLANS
A-101 NORTH PASSENGER ELEVATORS 1, 2, 3, 4 & 13
A-102 NORTH PASSENGER ELEVATORS 1, 2, 3, 4 & 13
A-103 NORTH PASSENGER ELEVATORS 1, 2, 3, 4 & 13
A-104 SOUTH PASSENGER ELEVATORS 5, 6, 7, 8 & 14
A-105 SOUTH PASSENGER ELEVATORS 5, 6, 7, 8 & 14
A-106 SOUTH PASSENGER ELEVATORS 5, 6, 7, 8 & 14
A-107 ELEVATORS 9 & 10

A-108 ELEVATOR 11

A-109 ESCALATOR PLANS

A-402 ELEVATIONS - INTERIOR

A-406 FINISH SCHEDULE & MATERIAL FINISH LEGEND

08-FIRE PROTECTION

F-001 FIRE PROTECTION SYMBOLS AND ABBREVIATIONS

F-002 FIRE ALARM SYMBOLS AND ABBREVIATIONS

F-101 FIRE PROTECTION ELEVATOR PIT - DEMOLITION

F-102 FIRE PROTECTION TOP OF SHAFT - DEMOLITION

F-103 FIRE PROTECTION PENTHOUSE DEMOLITION

F-104 FIRE PROTECTION ELEVATOR PIT - NEW WORK

F-105 FIRE PROTECTION TOP OF SHAFT - NEW WORK

F-106 FIRE PROTECTION PENTHOUSE NEW WORK

F-501 FIRE PROTECTION DETAILS

09-PLUMBING

P-001 PLUMBING SYMBOLS & ABBREVIATIONS

P-101 PLUMBING ELEVATOR #9, #10, & #11 NEW WORK

P-102 PLUMBING NORTH & SOUTH PASSENGER - DEMO & NEW WORK

P-501 PLUMBING DETAILS & SCHEDULES

10-MECHANICAL

M-001 MECHANICAL SYMBOLS & ABBREVIATIONS

M-002 MECHANICAL SYMBOLS & ABBREVIATIONS

MD-100 MECHANICAL PENTHOUSE DEMO

M-101 MECHANICAL PENTHOUSES NEW WORK

M-108 MECHANICAL SCHEDULES

M-501 MECHANICAL DETAILS

11-ELECTRICAL

E-000 ELECTRICAL SYMBOLS AND ABBREVIATIONS

ED-101 ELECTRICAL ELEV 1,2,3,4,5,6,7,8,13,14 - DEMOLITION

ED-102 ELECTRICAL ELEVATORS 9 & 10 - DEMOLITON

ED-103 ELECTRICAL ELEVATOR 11 - DEMOLITION

ED-104 ELECTRICAL ESCALATORS - DEMOLITION

ED-105 ELECTRICAL ESCALATORS - DEMOLITION

ED-106	ELECTRICAL 8TH FLOOR - DEMOLITION
ED-107	ELECTRICAL PENTHOUSE - DEMOLITION
E-101	ELECTRICAL ELEV 1,2,3,4,5,6,7,8,13,14 - NEW WORK
E-102	ELECTRICAL ELEVATORS 9 & 10 - NEW WORK
E-103	ELECTRICAL ELEVATOR 11 - NEW WORK
E-104	ELECTRICAL ESCALATORS - NEW WORK
E-105	ELECTRICAL ESCALATORS - NEW WORK
E-106	ELECTRICAL 8TH FLOOR - NEW WORK
E-107	ELECTRICAL PENTHOUSE - NEW WORK

END OF SECTION 000115

SECTION 001116 - INVITATION FOR BID

1.0 OWNER:

A. The State of Missouri
Office of Administration,
Division of Facilities Management, Design and Construction
Jefferson City, Missouri

2.0 PROJECT TITLE AND NUMBER:

A. Replace 13 Elevators and 6 Escalators
Truman State Office Building
Jefferson City, Missouri
Project No.: O2354-01

3.0 BIDS WILL BE RECEIVED:

A. Until: 1:30 PM, November 14, 2022

B. **Only electronic bids on MissouriBUYS shall be accepted: https://missouribuys.mo.gov. Bidder must be registered to bid.**

4.0 DESCRIPTION:

A. Scope: The project includes the replacement of 13 elevators and 6 escalators and related work.

B. MBE/WBE/SDVE Goals: MBE 10%, WBE 10%, and SDVE 3%**. NOTE: Only MBE/WBE firms certified by the State of Missouri Office of Equal Opportunity as of the date of bid opening, or SDVE(s) meeting the requirements of Section 34.074, RSMo and 1 CSR 30-5.010, can be used to satisfy the MBE/WBE/SDVE participation goals for this project.**

C. **NOTE: Bidders are provided new Good Faith Effort (GFE) forms on MissouriBUYS.

5.0 PRE-BID MEETING:

A. Place/Time**:** 10 AM, October, 15, 2024, at Harry S Truman Building, Room 750 ; 301 West High Street, Jefferson City, MO 65109.

B. Access to State of Missouri property requires presentation of a photo ID by all persons

6.0 HOW TO GET PLANS & SPECIFICATIONS:

A. View Only Electronic bid sets are available at no cost or paper bid sets for a deposit of $200.00 from American Document Solutions (ADS). MAKE CHECKS PAYABLE TO: American Document Solutions. Mail to: American Document Solutions, 1400 Forum Blvd., Suite 7A, Columbia, Missouri 65203. Phone 573-446-7768, Fax 573-355-5433, https://www.adsplanroom.net. NOTE: Prime contractors will be allowed a maximum of two bid sets at the deposit rate shown above. Other requesters will be allowed only one bid set at this rate. Additional bid sets or parts thereof may be obtained by any bidder at the cost of printing and shipping by request to American Document Solutions at the address shown above. **Bidder must secure at least one bid set to become a planholder.**

B. **Refunds: Return plans and specifications in unmarked condition within 15 working days of bid opening to American Document Solutions, 1400 Forum Blvd., Suite 7A, Columbia, Missouri 65203. Phone 573-446-7768, Fax 573-355-5433. Deposits for plans not returned within 15 working days shall be forfeited.**

C. Information for upcoming bids, including downloadable plans, specifications, Invitation for Bid, bid tabulation, award, addenda, and access to the ADS planholders list, is available on the Division of Facilities Management, Design and Construction's web site: https://oa.mo.gov/facilities/bid-opportunities/bid-listing-electronic-plans.

7.0 POINT OF CONTACT:

A. Designer: Introba Inc., Brad Pierce, (314) 391-2188, email: Brad.Pierce@introba.com

B. Project Manager: Ryan Abbott, (573) 298-1967, email: Ryan.Abbott@oa.mo.gov

8.0 GENERAL INFORMATION:

A. The State reserves the right to reject any and all bids and to waive all informalities in bids. No bid may be withdrawn for a period of 20 working days subsequent to the specified bid opening time. The contractor shall pay not less than the prevailing hourly rate of wages for work of a similar character in the locality in which the work is performed, as determined by the Missouri Department of Labor and Industrial Relations and as set out in the detailed plans and specifications.

B. Bid results will be available at https://oa.mo.gov/facilities/bid-opportunities/bid-listing-electronic-plans after it is verified that at least one bid is awardable and affordable.

Very Important MissouriBUYS Instructions to Help Submit a Bid Correctly

A. The bidder shall submit his or her bid and all supporting documentation on MissouriBUYS eProcurement System. No hard copy bids shall be accepted. Go to https://missouribuys.mo.gov and register. The bidder must register and complete a profile fully with all required documents submitted prior to submitting a bid.

B. Once registered, log in.
1. Under "Solicitation" select "View Current Solicitations."
2. Under "Filter by Agency" select "OA-FMDC-Contracts Chapter 8", then click "Filter Solicitation" button.
3. Select "Active Solicitations" tab.
4. To see the Solicitation Summary, click on the Project Number and the summary will open. Click each heading to open detailed information.

C. Here are simplified instructions for uploading the bid to MissouriBUYS:
1. Find the solicitation by completing Steps 1 through 4 above.
2. Select the three dots under "Actions." Select "Add New Response."
3. When the Quote box opens, give the response a title and select "OK."
4. The detailed solicitation will open. Select "Check All" for the Original Solicitation Documents, open each document, and select "Accept." If this step is not completed, a bid cannot be uploaded. Scroll to the bottom of the page and select "Add Attachments." If you do not see this command, not all documents have been opened and accepted.
5. The Supplier Attachments box will open. Select "Add Attachment" again.
6. The Upload Documents box will open. Read the instructions for uploading. Disregard the "Confidential" check box.
7. Browse and attach up to 5 files at a time. Scroll to bottom of box and select "Upload." The Supplier Attachments box will open. Repeat Steps 5 through 7 if more than 5 files are to be uploaded.
8. When the Supplier Attachments box opens again and uploading is complete, select "Done." A message should appear that the upload is successful. If it does not, go to the Bidder Response tab and select "Submit."
9. The detailed solicitation will open. At the bottom select "Close."

D. Any time a bidder wants to modify the bid, he or she will have to submit a new one. FMDC will open the last response the bidder submits. The bidder may revise and submit the bid up to the close of the solicitation (bid date and time). Be sure to allow for uploading time so that the bid is successfully uploaded prior to the 1:30 PM deadline; we can only accept the bid if it is uploaded before the deadline.

E. If you want to verify that you are uploading documents correctly, please contact Paul Girouard: 573-751-4797, paul.girouard@oa.mo.gov ; April Howser: 573-751-0053, April.Howser@oa.mo.gov ; or Mandy Roberson: 573-522-0074, Mandy.Roberson@oa.mo.gov.

F. If you are experiencing login issues, please contact Web Procure Support (Proactis) at 866-889-8533 anytime from 7:00 AM to 7:00 PM Central Time, Monday through Friday. If you try using a userid or password several times that is incorrect, the system will lock you out. Web Procure Support is the only option to unlock you! If you forget your userid or password, Web Procure Support will provide a temporary userid or password. Also, if it has been a while since your last successful login and you receive an "inactive" message, contact Web Procure (Proactis). If you are having a registration issue, you may contact Cathy Holliday at 573-751-3491 or by email: cathy.holliday@oa.mo.gov.

SECTION 002113 – INSTRUCTIONS TO BIDDERS

1.0 - SPECIAL NOTICE TO BIDDERS

A. If awarded a contract, the Bidder's employees, and the employees of all subcontractors, who perform the work on the project must adhere to requirements in Section 013513 – Site Security and Health Requirements as applicable per Agency.

B. The Bidder's prices shall include all city, state, and federal sales, excise, and similar taxes that may lawfully be assessed in connection with the performance of work, and the purchased of materials to be incorporated in the work. THIS PROJECT IS NOT TAX EXEMPT.

2.0 - BID DOCUMENTS

A. The number of sets obtainable by any one (1) party may be limited in accordance with available supply.

B. For the convenience of contractors, sub-contractors and suppliers, copies of construction documents are on file at the office of the Director, Division of Facilities Management, Design and Construction and on the Division's web site - https://oa.mo.gov/facilities/bid-opportunities/bid-listing-electronic-plans.

3.0 - BIDDERS' OBLIGATIONS

A. Bidders must carefully examine the entire site of the work and shall make all reasonable and necessary investigations to inform themselves thoroughly as to the facilities available as well as to all the difficulties involved in the completion of all work in accordance with the specifications and the plans. Bidders are also required to examine all maps, plans and data mentioned in the specifications. No plea of ignorance concerning observable existing conditions or difficulties that may be encountered in the execution of the work under this contract will be accepted as an excuse for any failure or omission on the part of the contractor to fulfill in every detail all of the requirements of the contract, nor accepted as a basis for any claims for extra compensation.

B. Under no circumstances will contractors give their plans and specifications to another contractor. Any bid received from a contractor whose name does not appear on the list of plan holders may be subject to rejection.

4.0 - INTERPRETATIONS

A. No bidder shall be entitled to rely on oral interpretations as to the meaning of the plans and specifications or the acceptability of alternate products, materials, form or type of construction. Every request for interpretation shall be made in writing and submitted with all supporting documents not less than five (5) working days before opening of bids. Every interpretation made to a bidder will be in the form of an addendum and will be sent as promptly as is practicable to all persons to whom plans and specifications have been issued. All such addenda shall become part of the contract documents.

B. Approval for an "acceptable substitution" issued in the form of an addendum as per Paragraph 4A above, and as per Article 3.1 of the General Conditions; ACCEPTABLE SUBSTITUTIONS shall constitute approval for use in the project of the product.

C. An "acceptable substitution" requested after the award of bid shall be approved if proven to the satisfaction of the Owner and the Designer as per Article 3.1, that the product is acceptable in design, strength, durability, usefulness, and convenience for the purpose intended. Approval of the substitution after award is at the sole discretion of the Owner.

D. A request for "Acceptable Substitutions" shall be made on the Section 006325 Substitution Request Form. The request shall be sent directly to the project Designer. A copy of said request should also be mailed to the Owner, Division of Facilities Management, Design and Construction, Post Office Box 809, Jefferson City, Missouri 65102.

5.0 - BIDS AND BIDDING PROCEDURE

A. Bidders shall submit all submission forms and accompanying documents listed in SECTION 004113 – BID FORM, Article 5.0, ATTACHMENTS TO BID by the stated time or their bid will be rejected for being non-responsive.

Depending on the specific project requirements, **the following is a GENERIC list** of all possible bid forms that may be due with bid submittals and times when they may be due. Please check for specific project requirements on the proposal form (Section 004113). ***Not all of the following bid forms may be required to be submitted.***

Bid Submittal – due before stated date and time of bid opening (see IFB):

004113	Bid Form (all pages are always required)
004322	Unit Prices Form
004336	Proposed Subcontractors Form
004337	MBE/WBE/SDVE Compliance Evaluation Form
004338	MBE/WBE/SDVE Eligibility Determination for Joint Ventures
004339	MBE/WBE/SDVE GFE Determination
004340	SDVE Business Form
004541	Affidavit of Work Authorization
004545	Anti-Discrimination Against Israel Act Certification form

B. All bids shall be submitted without additional terms and conditions, modification or reservation on the bid forms with each space properly filled. Bids not on these forms will be rejected.

C. All bids shall be accompanied by a bid bond executed by the bidder and a duly authorized surety company, certified check, cashier's check or bank draft made payable to the Division of Facilities Management, Design and Construction, State of Missouri, in the amount indicated on the bid form, Section 004113. Failure of the contractor to submit the full amount required shall be sufficient cause to reject his bid. The bidder agrees that the proceeds of the check, draft or bond shall become the property of the State of Missouri, if for any reason the bidder withdraws his bid after closing, or if on notification of award refuses or is unable to execute tendered contract, provide an acceptable performance and payment bond, provide evidence of required insurance coverage and/or provide required copies of affirmative action plans within ten (10) working days after such tender.

D. The check or draft submitted by the successful bidder will be returned after the receipt of an acceptable performance and payment bond and execution of the formal contract. Checks or drafts of all other bidders will be returned within a reasonable time after it is determined that the bid represented by same will receive no further consideration by the State of Missouri. Bid bonds will only be returned upon request.

6.0 - SIGNING OF BIDS

A. A bid from an individual shall be signed as noted on the Bid Form.

B. A bid from a partnership or joint venture shall require only one signature of a partner, an officer of the joint venture authorized to bind the venture or an attorney-in-fact. If the bid is signed by an officer of a joint venture or an attorney-in-fact, a document evidencing the individual's authority to execute contracts should be included with the bid form.

C. A bid from a limited liability company (LLC) shall be signed by a manager or a managing member of the LLC.

D. A bid from a corporation shall have the correct corporate name thereon and the signature of an authorized officer of the corporation manually written. Title of office held by the person signing for the corporation shall appear, along with typed name of said individual. Corporate license number shall be provided and, if a corporation organized in a state other than Missouri, a Certificate of Authority to do business in the State of Missouri shall be attached. In addition, for corporate proposals, the President or Vice-President should sign as the bidder. If the signatory is other than the corporate president or vice president, the bidder must provide satisfactory evidence that the signatory has the legal authority to bind the corporation.

E. A bid should contain the full and correct legal name of the Bidder. If the Bidder is an entity registered with the Missouri Secretary of State, the Bidder's name on the bid form should appear as shown in the Secretary of State's records.

F. The Bidder should include its corporate license number on the Bid Form and, if the corporation is organized in a state other than Missouri, a Certificate of Authority to do business in the State of Missouri shall be attached to the bid form.

7.0 - RECEIVING BID SUBMITTALS

A. It is the bidder's sole responsibility to assure receipt by Owner of bid submittals by the date and time specified in the Invitation for Bid. Bids received after the date and time specified shall not be considered by the Owner.

B. Bids must be submitted through the MissouriBUYS statewide eProcurement system (https://www.missouribuys.mo.gov/) in accordance with the instructions for that system. The Owner shall only accept bids submitted through MissouriBUYS. Bids received by the Owner through any other means, including hard copies, shall not be considered and will be discarded by the Owner unopened.

C. To respond to an Invitation for Bid, the Bidder must first register with MissouriBUYS by going through the MissouriBUYS Home Page (https://www.missouribuys.mo.gov/), clicking the "Register" button at the top of the page, and completing the Vendor Registration. Once registered, the Bidder accesses its account by clicking the "Login" button at the top of the MissouriBUYS Home Page. Enter your USERID and PASSWORD, which the Bidder will select. Under Solicitations, select "View Current Solicitations." A new screen will open. Under "Filter by Agency" select "OA-FMDC-Contracts Chapter 8." Under "Filter by Opp. No." type in the State Project Number. Select "Submit." Above the dark blue bar, select "Other Active Opportunities." To see the Solicitation Summary, single click the Opp. No. (Project Number) and the summary will open. Single quick click each blue bar to open detailed information. The Bidder must read and accept the Original Solicitation Documents and complete all identified requirements. The Bidder should download and save all of the Original Solicitation Documents on its computer so that the Bidder can prepare its response to these documents. The Bidder should upload its completed response to the downloaded documents as an attachment to the electronic solicitation response.

D. Step-by-step instructions for how a registered vendor responds to a solicitation electronically are provided in Section 001116 – Invitation For Bid.

E. The Bidder shall submit its bid on the forms provided by the Owner on MissouriBUYS with each space fully and properly completed, including all amounts required for alternate bids, unit prices, cost accounting data, etc. The Owner may reject bids that are not on the Owner's forms or that do not contain all requested information.

F. No Contractor shall stipulate in his bid any conditions not contained in the specifications or standard bid form contained in the contract documents. To do so may subject the Contractor's bid to rejection.

G. The completed forms shall be without interlineations, alterations or erasures.

8.0 - MODIFICATION AND WITHDRAWAL OF BIDS

A. Bidder may withdraw his bid at any time prior to scheduled closing time for receipt of bids, but no bidder may withdraw his bid for a period of twenty (20) working days after the scheduled closing time for receipt of bids.

B. The Bidder shall modify his or her original bid by submitting a revised bid on MissouriBUYS.

9.0 - AWARD OF CONTRACT

A. The Owner reserves the right to reject any and/or all bids and further to waive all informalities in bidding when deemed in the best interest of the State of Missouri.

B. The Owner reserves the right to let other contracts in connection with the work, including but not by way of limitation, contracts for the furnishing and installation of furniture, equipment, machines, appliances and other apparatus.

C. The Owner shall award a contract to the lowest, responsive, responsible Bidder in accordance with Section 8.250, RSMo. No contract will be awarded to any Bidder who has had a contract with the Owner terminated within the preceding twelve months for material breach of contract or who has been suspended or debarred by the Owner.

D. Award of alternates, if any, will be made in numerical order unless all bids received are such that the order of acceptance of alternates does not affect the determination of the lowest, responsive, responsible bidder.

E. No bid shall be considered binding upon the Owner until the written contract has been properly executed, a satisfactory bond has been furnished, evidence of required insurance coverage, submittal of executed Section 004541, Affidavit of Work Authorization form, documentation evidencing enrollment and participation in a federal work authorization program has been received and an affirmative action plan submitted. Failure to execute and return the contract and associated documents within the prescribed period of time shall be treated, at the option of the Owner, as a breach of bidder's obligation and the Owner shall be under no further obligation to bidder.

F. If the successful bidder is doing business in the State of Missouri under a fictitious name, he shall furnish to Owner, attached to the Bid Form, a properly certified copy of the certificate of Registration of Fictitious Name from the State of Missouri, and such certificate shall remain on file with the Owner.

G. Any successful bidder which is a corporation organized in a state other than Missouri shall furnish to the Owner, attached to the Bid Form, a properly certified copy of its current Certificate of Authority to do business in the State of Missouri, such certificate to remain on file with the Owner. No contract will be awarded by the Owner unless such certificate is furnished by the bidder.

H. Any successful bidder which is a corporation organized in the State of Missouri shall furnish at its own cost to the Owner, if requested, a Certificate of Good Standing issued by the Secretary of State, such certificate to remain on file with the Owner.

I. Transient employers subject to Sections 285.230 and 285.234, RSMo, (out-of-state employers who temporarily transact any business in the State of Missouri) may be required to file a bond with the Missouri Department of Revenue. No contract will be awarded by the Owner unless the successful bidder certifies that he has complied with all applicable provisions of Section 285.230-234.

J. Sections 285.525 and 285.530, RSMo, require business entities to enroll and participate in a federal work authorization program in order to be eligible to receive award of any state contract in excess of $5,000. Bidders should submit with their bid an Affidavit of Work Authorization (Section 004541) along with appropriate documentation evidencing such enrollment and participation. Section-004541, Affidavit of Work Authorization is located on the MissouriBUYS solicitation for this project. Bidders must also submit an E-Verify Memorandum before the Owner may award a contract to the Bidder. Information regarding a E-Verify is located at https://www.uscis.gov/e-verify/. The contractor shall be responsible for ensuring that all subcontractors and suppliers associated with this contract enroll in E-Verify.

10.0 - CONTRACT SECURITY

A. The successful bidder shall furnish a performance/payment bond as set forth in General Conditions Article 6.1 on a condition prior to the State executing the contract and issuing a notice to proceed.

11.0 - LIST OF SUBCONTRACTORS

A. If required by "Section 004113 – Bid Form," each bidder must submit as part of their bid a list of subcontractors to be used in performing the work (Section 004336). The list must specify the name of the single designated subcontractor, for each category of work listed in "Section 004336 - Proposed Subcontractors Form." If work within a category will be performed by more than one subcontractor, the bidder must provide the name of each subcontractor and specify the exact portion of the work to be done by each. Failure to list the Bidder's firm, or a subcontractor for each category of work identified on the Bid Form or the listing of more than one subcontractor for any category without designating the portion of work to be performed by each shall be cause for rejection of the bid. If the bidder intends to perform any of the designated subcontract work with the use of his own employees, the bidder shall make that fact clear, by listing his own firm for the subject category. **If any category of work is left vacant, the bid shall be rejected.**

12.0 - WORKING DAYS

A. Contract duration time is stated in working days and will use the following definition in determining the actual calendar date for contract completion:

1. Working days are defined as all calendar days except Saturdays, Sundays and the following State of Missouri observed holidays: New Year's Day, Martin Luther King, Jr. Day, Lincoln Day, Washington's Birthday, Truman Day, Memorial Day, Juneteenth, Independence Day, Labor Day, Columbus Day, Veterans Day, Thanksgiving Day and Christmas Day.

13.0 - AMERICAN AND MISSOURI - MADE PRODUCTS AND FIRMS

A. By signing the bid form and submitting a bid on this project, the Bidder certifies that it will use American and Missouri products as set forth in Article 1.7 of the General Conditions. Bidders are advised to review those requirements carefully prior to bidding.

B. A preference shall be given to Missouri firms, corporations or individuals, or firms, corporations or individuals that maintain Missouri offices or places of business, when the quality of performance promised is equal or better and the price quoted is the same or less.

C. Pursuant to Section 34.076, RSMo, a contractor or Bidder domiciled outside the boundaries of the State of Missouri shall be required, in order to be successful, to submit a bid the same percent less than the lowest bid submitted by a responsible contractor or Bidder domiciled in Missouri as would be required for such a Missouri domiciled contractor or Bidder to succeed over the bidding contractor or Bidder domiciled outside Missouri on a like contract or bid being let in the person's domiciliary state and, further, the contractor or Bidder domiciled outside the boundaries of Missouri shall be required to submit an audited financial statement as would be required of a Missouri domiciled contractor or Bidder on a like contract or bid being let in the domiciliary state of that contractor or Bidder.

14.0 – ANTI-DISCRIMINATION AGAINST ISRAEL ACT CERTIFICATION:

A. Pursuant to section 34.600, RSMo, if the Bidder meets the section 34.600, RSMo, definition of a "company" and the Bidder has ten or more employees, the Bidder must certify in writing that the Bidder is not currently engaged in a boycott of goods or services from the State of Israel as defined in section 34.600, RSMo, and shall not engage in a boycott of goods or services from the State of Israel, if awarded a contract, for the duration of the contract. The Bidder is requested to complete and submit the applicable portion of Section 004545 - Anti-Discrimination Against Israel Act Certification with their Bid Form. The applicable portion of the exhibit must be submitted prior to execution of a contract by the Owner and issuance of Notice to Proceed. If the exhibit is not submitted, the Owner shall rescind its Intent to Award and move to the next lowest, responsive, responsible bidder.

15.0 - MBE/WBE/SDVE INSTRUCTIONS

A. Definitions:

1. **"MBE"** means a Minority Business Enterprise.

2. **"MINORITY"** has the same meaning as set forth in 1 C.S.R. 10-17.010.

3. **"MINORITY BUSINESS ENTERPRISE"** has the same meaning as set forth in section 37.020, RSMo.

4. **"WBE"** means a Women's Business Enterprise.

5. **"WOMEN'S BUSINESS ENTERPRISE"** has the same meaning as set forth in section 37.020, RSMo.

6. **"SDVE"** means a Service-Disabled Veterans Enterprise.

7. **"SERVICE-DISABLED VETERAN"** has the same meaning as set forth in section 34.074, RSMo.

8. **"SERVICE-DISABLED VETERAN ENTERPRISE"** has the same meaning as "Service-Disabled Veteran Business" set forth in section 34.074, RSMo.

B. MBE/WBE/SDVE General Requirements:

1. For all bids greater than $100,000, the Bidder shall obtain MBE, WBE and SDVE participation in an amount equal to or greater than the percentage goals set forth in the Invitation for Bid and the Bid Form, unless the Bidder is granted a Good Faith Effort waiver by the Director of the Division, as set forth below. If the Bidder does not meet the MBE, WBE and SDVE goals, or make a good faith effort to do so, the Bidder shall be non-responsive, and its bid shall be rejected.

2. The Bidder should submit with its bid all of the information requested in the MBE/WBE/SDVE Compliance Evaluation Form for every MBE, WBE, or SDVE subcontractor or material supplier the Bidder intends to use for the contract work. The Bidder is required to submit all appropriate MBE/WBE/SDVE documentation before the stated time and date set forth in the Invitation for Bid. If the Bidder fails to provide such information by the specified date and time, the Owner shall reject the bid.

3. The Director reserves the right to request additional information from a Bidder to clarify the Bidder's proposed MBE, WBE, and/or SDVE participation. The Bidder shall submit the clarifying information requested by the Owner within two (2) Working Days of receiving the request for clarification.

4. Pursuant to section 34.074, RSMo, a Bidder that is a SDVE doing business as Missouri firm, corporation, or individual, or that maintains a Missouri office or place of business, shall receive a three-point bonus preference in the contract award evaluation process. The bonus preference will be calculated and applied by reducing the bid amount of the eligible SDVE by three percent of the apparent low responsive bidder's bid. Based on this calculation, if the eligible SDVE's evaluation is less than the apparent low responsive bidder's bid, the eligible SDVE's bid becomes the apparent low responsive bid. This reduction is for evaluation purposes only, and will have no impact on the actual amount(s) of the bid or the amount(s) of any contract awarded. In order to be eligible for the SDVE preference, the Bidder must complete and submit with its bid the Missouri Service Disabled Veteran Business Form, and any information required by the form. The form is available on the MissouriBUYS solicitation for this project.

C. Computation of MBE/WBE/SDVE Goal Participation:

1. A Bidder who is a MBE, WBE, or SDVE may count 100% of the contract towards the MBE, WBE or SDVE goal, less any amounts awarded to another MBE, WBE or SDVE. (NOTE: A MBE firm that bids as general contractor must obtain WBE and SDVE participation; a WBE firm that bids as a general contractor must obtain MBE and SDVE participation; and a SDVE firm that bids as general contractor must obtain MBE and WBE participation.) In order for the remaining contract amount to be counted towards the MBE, WBE or SDVE goal, the Bidder must complete the MBE/WBE/SDVE Compliance Evaluation Form (Section 004337) identifying itself as an MBE, WBE or SDVE.

2. The total dollar value of the work granted to a certified MBE, WBE or SDVE by the Bidder shall be counted towards the applicable goal.

3. Expenditures for materials and supplies obtained from a certified MBE, WBE, or SDVE supplier or manufacturer may be counted towards the MBE, WBE and SDVE goals, if the MBE, WBE, or SDVE assumes the actual and contractual responsibility for the provision of the materials and supplies.

4. The total dollar value of the work granted to a second or subsequent tier subcontractor or a supplier may be counted towards a Bidder's MBE, WBE and SDVE goals, if the MBE, WBE, or SDVE properly assumes the actual and contractual responsibility for the work.

5. The total dollar value of work granted to a certified joint venture equal to the percentage of the ownership and control of the MBE, WBE, or SDVE partner in the joint venture may be counted towards the MBE/WBE/SDVE goals.

6. Only expenditures to a MBE, WBE, or SDVE that performs a commercially useful function in the work may be counted towards the MBE, WBE and SDVE goals. A MBE, WBE, or SDVE performs a commercially useful function when it is responsible for executing a distinct element of the work and carrying out its responsibilities by actually performing, managing and supervising the work or providing supplies or manufactured materials.

D. Certification of MBE/WBE/SDVE Subcontractors:

1. In order to be counted towards the goals, an MBE or WBE must be certified by the State of Missouri Office of Equal Opportunity and an SDVE must be certified by the State of Missouri, Office of Administration, Division of Purchasing and Material Management or by the Department of Veterans Affairs.

2. The Bidder may determine the certification status of a proposed MBE or WBE subcontractor or supplier by referring to the Office of Equal Opportunity (OEO)'s online MBE/WBE directory (https://apps1.mo.gov/MWBCertifiedFirms/). The Bidder may determine the eligibility of a SDVE subcontractor or supplier by referring to the Division of Purchasing and Materials Management's online SDVE directory (https://oeo.mo.gov/sdve-certification-program/) or the Department of Veterans Affairs' directory (https://veterans.certify.sba.gov/#search).

3. Additional information, clarifications, etc., regarding the listings in the directories may be obtained by calling the Division at (573)751-3339 and asking to speak to the Contract Specialist of record as shown in the Supplementary Conditions (Section 007300).

E. Waiver of MBE/WBE/SDVE Participation:

1. If a Bidder has made a good faith effort to secure the required MBE, WBE and/or SDVE participation and has failed, the Bidder shall submit with its bid the information requested in MBE/WBE/SDVE Good Faith Effort (GFE) Determination form. The GFE forms are located on the MissouriBUYS solicitation for this project. The Director will determine if the Bidder made a good faith effort to meet the applicable goals. If the Director determines that the Bidder did not make a good faith effort, the bid shall be rejected as being nonresponsive to the bid requirements. Bidders who demonstrate that they have made a good faith effort to include MBE, WBE, and/or SDVE participation will be determined to be responsive to the applicable participation goals, regardless of the percent of actual participation obtained, if the bid is otherwise acceptable.

2. In determining whether a Bidder has made a good faith effort to obtain MBE, WBE and/or SDVE participation, the Director may evaluate the factors set forth in 1 CSR 30-5.010(6)(C) and the following:
   a. The amount of actual participation obtained;
   b. How and when the Bidder contacted potential MBE, WBE, and SDVE subcontractors and suppliers;
   c. The documentation provided by the Bidder to support its contacts, including whether the Bidder provided the names, addresses, phone numbers, and dates of contact for MBE/WBE/SDVE firms contacted for specific categories of work;
   d. If project information, including plans and specifications, were provided to MBE/WBE/SDVE subcontractors;
   e. Whether the Bidder made any attempts to follow-up with MBE, WBE or SDVE firms prior to bid;
   f. Amount of bids received from any of the subcontractors and/or suppliers that the Bidder contacted;
   g. The Bidder's stated reasons for rejecting any bids;

3. If no bidder has obtained any participation in a particular category (MBE/WBE/SDVE) or made a good faith effort to do so, the Director may waive that goal rather than rebid.

F. Contractor MBE/WBE/SDVE Obligations

1. If awarded a contract, the Bidder will be contractually required to subcontract with or obtain materials from the MBE, WBE, and SDVE firms listed in its bid, in amounts equal to or greater than the dollar amount bid, unless the amount is modified in writing by the Owner.

2. If the Contractor fails to meet or maintain the participation requirements contained in the Contractor's bid, the Contractor must satisfactorily explain to the Director why it cannot comply with the requirement and why failing meeting the requirement was beyond the Contractor's control. If the Director finds the Contractor's explanation unsatisfactory, the Director may take any appropriate action including, but not limited to:

    a. Declaring the Contractor ineligible to participate in any contracts with the Division for up to twelve (12) months (suspension); and/or

    b. Declaring the Contractor be non-responsive to the Invitation for Bid, or in breach of contract and rejecting the bid or terminating the contract.

3. If the Contractor replaces an MBE, WBE, or SDVE during the course of this contract, the Contractor shall replace it with another MBE, WBE, or SDVE or make a good faith effort to do so. All MBE, WBE and SDVE substitutions must be approved by the Director.

4. The Contractor shall provide the Owner with regular reports on its progress in meeting its MBE/WBE/SDVE obligations. At a minimum, the Contractor shall report the dollar-value of work completed by each MBE, WBE, or SDVE during the preceding month and the cumulative total of work completed by each MBE, WBE or SDVE to date with each monthly application for payment. The Contractor shall also make a final report, which shall include the total dollar-value of work completed by each MBE, WBE, and SDVE during the entire contract.

STATE OF MISSOURI
DIVISION OF FACILITIES MANAGEMENT, DESIGN AND CONSTRUCTION
MBE/WBE/SDVE DIRECTORIES

The MBE/WBE Directory for goods and services is maintained by the Office of Equal Opportunity (OEO) and is located at the following web address:

https://apps1.mo.gov/MWBCertifiedFirms/

The SERVICE DISABLED VETERAN ENTERPRISE (SDVE) Directories may be accessed at the following web addresses:

https://oeo.mo.gov/sdve-certification-program/

https://veterans.certify.sba.gov/#search

State of Missouri Construction Contract

THIS AGREEMENT is made (DATE) by and between:

Contractor Name and Address

hereinafter called the "Contractor,"

and the **State of Missouri**, hereinafter called the **"Owner**", represented by the Office of Administration, Division of Facilities Management, Design and Construction.

WITNESSETH, that the Contractor and the Owner, for the consideration stated herein agree as follows:

ARTICLE 1. STATEMENT OF WORK

The Contractor shall furnish all labor and materials and perform all work required for furnishing and installing all labor, materials, equipment and transportation and everything necessarily inferred from the general nature and tendency of the plans and specifications for the proper execution of the work for:

Project Name:	**Replace 13 Elevators and 6 Escalators** **Truman State Office Building** **Jefferson City, Missouri**
Project Number:	**O2354-01**

in strict accordance with the Contract Documents as enumerated in Article 7, all of which are made a part hereof.

ARTICLE 2. TIME OF COMPLETION

The contract performance time is **575 working days** from the transmittal date of this agreement. The contract completion date is **MONTH, DAY, YEAR**. This time includes ten (10) working days for the Contractor to receive, sign and return the contract form along with required bonding and insurance certificates. Failure of the Contractor to provide correct bonding and insurance within the ten (10) working days shall not be grounds for a time extension. Receipt of proper bonding and insurance is a condition precedent to the formation of the contract and if not timely received, may result in forfeiture of the Contractor's bid security. Work may not commence until the Owner issues a written Notice to Proceed and must commence within seven (7) working days thereafter.

ARTICLE 3. LIQUIDATED DAMAGES

Whenever time is mentioned in this contract, time shall be and is of the essence of this contract. The Owner would suffer a loss should the Contractor fail to have the work embraced in this contract fully completed on or before the time above specified. THEREFORE, the parties hereto realize in order to adjust satisfactorily the damages on account of such failure that it might be impossible to compute accurately or estimate the amount of such loss or damages which the Owner would sustain by reason of failure to complete fully said work within the time required by this contract. The Contractor hereby covenants and agrees to pay the Owner, as and for **liquidated damages, the sum of $1,000** per day for each and every day, Sunday and legal holidays excepted, during which the work remains incomplete and unfinished. Any sum which may be due the Owner for such damages shall be deducted and retained by the Owner from any balance which may be due the Contractor when said work shall have been finished and accepted. But such provisions shall not release the Bond of the Contractor from liability according to its terms. In case of failure to complete, the Owner will be under no obligation to show or prove any actual or specific loss or damage.

ARTICLE 4. CONTRACT SUM

The Owner shall pay the Contractor for the prompt, faithful and efficient performance of the conditions and undertakings of this contract, subject to additions, and deductions as provided herein, in current funds the sum of:

Base Bid: $

TOTAL CONTRACT AMOUNT: ($CONTRACT AMOUNT)

UNIT PRICES: The Owner accepts the following Unit Prices:

For changing specified quantities of work from those indicated by the contract drawings and specifications, upon written instructions of Owner, the following unit prices shall prevail. The unit prices include all labor, overhead and profit, materials, equipment, appliances, bailing, shoring, shoring removal, etc., to cover the finished work of the several kinds of work called for. Only a single unit price shall be given and it shall apply for either MORE or LESS work than that shown on the drawings and called for in the specifications or included in the Base Bid. In the event of more or less units than so indicated or included, change orders may be issued for the increased or decreased amount.

ARTICLE 5. PREVAILING WAGE RATE

MISSOURI PREVAILING WAGE LAW (Sections 290.210 to 290.340, RSMo): The Contractor shall pay not less than the specified hourly rate of wages, as set out in the wage order attached to and made part of the specifications for work under this contract, to all workers performing work under the contract, in accordance with sections 290.210 to 290.340, RSMo. The Contractor shall forfeit a penalty to the Owner of one hundred dollars per day (or portion of a day) for each worker that is paid less than the specified rates for any work done under the contract by the Contractor or by any subcontractor, in accordance with section 290.250, RSMo.

DAVIS-BACON ACT: If this Project is financed in whole or in part from Federal funds (as indicated in the Instructions to Bidders or other bid or contract documents for this Project), then this contract shall be subject to all applicable federal labor statutes, rules and regulations, including provisions of the Davis-Bacon Act, 40 U.S.C. §3141 et seq., and the "Federal Labor Standards Provisions," as further set forth in Section 007333 – Supplementary General Conditions for Federally Funded/Assisted Construction Projects, which is incorporated into the contract by reference. Where the Missouri Prevailing Wage Law and the Davis-Bacon Act require payment of different wages for work performed under this contract, the Contractor and all Subcontractors shall pay the greater of the wages required under either law, on a classification by classification basis.

ARTICLE 6. MINORITY/WOMEN/SERVICE DISABLED VETERAN BUSINESS ENTERPRISE PARTICIPATION

The Contractor has been granted a waiver of the 10% MBE and 10% WBE and 3% SDVE participation goals. The Contractor agrees to secure the MBE/WBE/SDVE participation amounts for this project as follows: (OR)

The Contractor has met the MBE/WBE/SDVE participation goals and agrees to secure the MBE/WBE/SDVE participation amounts for this project as follows:

MBE/WBE/SDVE Firm: Subcontract Amt:$
MBE/WBE/SDVE Firm: Subcontract Amt:$
MBE/WBE/SDVE Firm: Subcontract Amt:$

Total $

MBE/WBE/SDVE assignments identified above shall not be changed without a contract change signed by the Owner.

The Director of the Division of Facilities Management, Design and Construction or his Designee shall be the final authority to resolve disputes and disagreements between the Contractor and the MBE/WBE/SDVE firms listed above when such disputes impact the subcontract amounts shown above.

ARTICLE 7. CONTRACT DOCUMENTS

The following documents are hereby incorporated into this contract by reference (all division/section numbers and titles are as utilized in the Project Manual published by the Owner for this Project):

1. Division 0 – Procurement and Contracting Information, including, but not limited to:
    a. Invitation for Bid (Section 001116)

b. Instructions to Bidders (Section 002113)
c. Supplementary Instructions to Bidders (if applicable) (Section 002213)
d. The following documents as completed and executed by the Contractor and accepted by the Owner, if applicable:
    i. Bid Form (Section 004113)
    ii. Unit Prices (Section 004322)
    iii. Proposed Contractors Form (Section 004336)
    iv. MBE, WBE, SDVE Compliance Evaluation Form(s) (Section 004337)
    v. MBE, WBE, SDVE Eligibility Determination Form for Joint Ventures (Section 004338)
    vi. MBE, WBE, SDVE Good Faith Effort (GFE) Determination Form (Section 004339)
    vii. Missouri Service Disabled Veteran Business Form (Section 004340)
    viii. Affidavit of Work Authorization (Section 004541)
    ix. Affidavit for Affirmative Action (Section 005414)
e. Performance and Payment Bond, completed and executed by the Contractor and surety (Section 006113)
f. General Conditions (Section 007213)
g. Supplementary Conditions (Section 007300)
h. Supplementary General Conditions for Federally Funded/Assisted Construction Projects (Section 007333)
i. Wage Rate(s) (Section 007346)

2. Division 1 – General Requirements
3. All Drawings identified in the Project Manual
4. All Technical Specifications included in the Project Manual
5. Addenda, if applicable

ARTICLE 8 – CERTIFICATION

By signing this contract, the Contractor hereby re-certifies compliance with all legal requirements set forth in Section 6.0, Bidder's Certifications of the Bid Form.

Further, if the Contractor provides any "personal information" as defined in §105.1500, RSMo concerning an entity exempt from federal income tax under Section 501(c) of the Internal Revenue Code of 1986, as amended, the Contractor understands and agrees that it is voluntarily choosing to enter into a state contract and providing such information for that purpose. The state will treat such personal information in accord with §105.1500, RSMo.

By signature below, the parties hereby execute this contract document.

APPROVED:

_____
Brian Yansen, Director
Division of Facilities Management,
Design and Construction

_____
Contractor's Authorized Signature

I, Corporate Secretary, certify that I am Secretary of the corporation named above and that (CONTRACTOR NAME), who signed said contract on behalf of the corporation, was then (TITLE) of said corporation and that said contract was duly signed for and in behalf of the corporation by authority of its governing body, and is within the scope of its corporate powers.

_____
Corporate Secretary

STATE OF MISSOURI
OFFICE OF ADMINISTRATION
DIVISION OF FACILITIES MANAGEMENT, DESIGN AND CONSTRUCTION

AFFIDAVIT FOR AFFIRMATIVE ACTION

PROJECT NUMBER

NAME

First being duly sworn on oath states: that

he/she is the ☐ sole proprietor ☐ partner ☐ officer or ☐ manager or managing member of

NAME

a ☐ sole proprietorship ☐ partnership ☐ limited liability company (LLC)

or ☐ corporation, and as such, said proprietor, partner, or officer is duly authorized to make this affidavit on behalf of said sole proprietorship, partnership, or corporation; that under the contract known as

PROJECT TITLE

Less than 50 persons in the aggregate will be employed and therefore, the applicable Affirmative Action requirements as set forth in Article 1.4 of the General Conditions of the State of Missouri have been met.

PRINT NAME & SIGNATURE	DATE

NOTARY INFORMATION

NOTARY PUBLIC EMBOSSER SEAL

STATE OF	COUNTY (OR CITY OF ST. LOUIS)	USE RUBBER STAMP IN CLEAR AREA BELOW
SUBSCRIBED AND SWORN BEFORE ME, THIS DAY OF YEAR		
NOTARY PUBLIC SIGNATURE	MY COMMISSION EXPIRES	
NOTARY PUBLIC NAME (TYPED OR PRINTED)		

MO 300-1401 (05/18) FILE/Construction Contract

Bond No._____

SECTION 006113 - PERFORMANCE AND PAYMENT BOND FORM

KNOW ALL MEN BY THESE PRESENTS, THAT we _____

as principal, and _____

_____as Surety, are held and firmly bound unto the

STATE OF MISSOURI. in the sum of _____ Dollars ($)

for payment whereof the Principal and Surety bind themselves, their heirs, executors, administrators and successors, jointly and severally, firmly by these presents.

WHEREAS, the Principal has, by means of a written agreement dated the _____

day of_____, 20_____, enter into a contract with the State of Missouri for

_____

_____

_____

(Insert Project Title and Number)

NOW, THEREFORE, if the Principal shall faithfully perform and fulfill all the undertakings, covenants, terms, conditions and agreements of said contract during the original term of said contract and any extensions thereof that may be granted by the State of Missouri, with or without notice to the Surety and during the life of any guaranty required under the contract; and shall also faithfully perform and fulfill all undertakings, covenants, terms, conditions and agreements of any and all duly authorized modifications of said contract that may hereafter be made with or without notice to the Surety; and shall also promptly make payment for materials incorporated, consumed or used in connection with the work set forth in the contract referred to above, and all insurance premiums, both compensation and all other kinds of insurance, on said work, and for all labor performed on such work, whether by subcontractor or otherwise, at not less than the prevailing hourly rate of wages for work of a similar character (exclusive of maintenance work) in the locality in which the work is performed and not less than the prevailing hourly rate of wages for legal holiday and overtime work (exclusive of maintenance work) in the locality in which the work is performed both as determined by the Department of Labor and Industrial Relations or determined by the Court of Appeal, as provided for in said contract and in any and all duly authorized modifications of said contract that may be hereafter made, with or without notice to the Surety, then, this obligation shall be void and of no effect, but it is expressly understood that if the Principal should make default in or should fail to strictly, faithfully and efficiently do, perform and comply with any or more of the covenants, agreements, stipulations, conditions, requirements or undertakings, as specified in or by the terms of said contract, and with the time therein named, then this obligation shall be valid and binding upon each of the parties hereto and this bond shall remain in full force and effect; and the same may be sued on at the instance of any material man, laborer, mechanic, subcontractor, individual, or otherwise to whom such payment is due, in the name of the State of Missouri, to the use of any such person.

AND, IT IS FURTHER specifically provided that any modifications which may hereinafter be made in the terms of the contract or in the work to be done under it or the giving by the Owner of any extension of the time for the performance of the contract or any other forbearance on the part of either the Owner or the Principal to the other, shall not in any way release the Principal and the Surety, or either or any of them, their heirs, executors, administrators and successors, from their liability hereunder, notice to the Surety of any such extension, modifications or forbearance being hereby waived.

IN WITNESS WHEREOF, the above bounden parties have executed the within instrument this _____ day of _____, 20 ____.

AS APPLICABLE:

AN INDIVIDUAL

Name: _____

Signature: _____

A PARTNERSHIP

Name of Partner: _____

Signature of Partner: _____

Name of Partner: _____

Signature of Partner: _____

CORPORATION

Firm Name: _____

Signature of President: _____

SURETY

Surety Name: _____

Attorney-in-Fact: _____

Address of Attorney-in-Fact: _____

_____

Telephone Number of Attorney-in-Fact: _____

Signature Attorney-in-Fact: _____

NOTE: Surety shall attach Power of Attorney

STATE OF MISSOURI
OFFICE OF ADMINISTRATION
DIVISION OF FACILITIES MANAGEMENT, DESIGN AND CONSTRUCTION

PRODUCT SUBSTITUTION REQUEST

PROJECT NUMBER

PROJECT TITLE AND LOCATION

CHECK APPROPRIATE BOX

☐ SUBSTITUTION PRIOR TO BID OPENING
(Minimum of (5) working days prior to receipt of Bids as per Article 4 – Instructions to Bidders)

☐ SUBSTITUTION FOLLOWING AWARD
(Maximum of (20) working days from Notice to Proceed as per Article 3 – General Conditions)

FROM: BIDDER/CONTRACTOR (PRINT COMPANY NAME)

TO: ARCHITECT/ENGINEER (PRINT COMPANY NAME)

Bidder/Contractor hereby requests acceptance of the following product or systems as a substitution in accordance with provisions of Division One of the Bidding Documents:

SPECIFIED PRODUCT OR SYSTEM

SPECIFICATION SECTION NO.

SUPPORTING DATA

☐ Product data for proposed substitution is attached (include description of product, standards, performance, and test data)

☐ Sample ☐ Sample will be sent, if requested

QUALITY COMPARISON

	SPECIFIED PRODUCT	SUBSTITUTION REQUEST
NAME, BRAND		
CATALOG NO.		
MANUFACTURER		
VENDOR		

PREVIOUS INSTALLATIONS

PROJECT	ARCHITECT/ENGINEER	
LOCATION		DATE INSTALLED

SIGNIFICANT VARIATIONS FROM SPECIFIED PRODUCT

REASON FOR SUBSTITUTION

DOES PROPOSED SUBSTITUTION AFFECT OTHER PARTS OF WORK?

☐ YES ☐ NO

IF YES, EXPLAIN

SUBSTITUTION REQUIRES DIMENSIONAL REVISION OR REDESIGN OF STRUCTURE OR A/E WORK

☐ YES ☐ NO

BIDDER'S/CONTRACTOR'S STATEMENT OF CONFORMANCE OF PROPOSED SUBSTITUTION TO CONTRACT REQUIREMENT:

We have investigated the proposed substitution. We believe that it is equal or superior in all respects to specified product, except as stated above; that it will provide the same Warranty as specified product; that we have included complete implications of the substitution; that we will pay redesign and other costs caused by the substitution which subsequently become apparent; and that we will pay costs to modify other parts of the Work as may be needed, to make all parts of the Work complete and functioning as a result of the substitution.

BIDDER/CONTRACTOR	DATE

REVIEW AND ACTION

☐ Resubmit Substitution Request with the following additional information:

☐ Substitution is accepted.

☐ Substitution is accepted with the following comments:

☐ Substitution is not accepted.

ARCHITECT/ENGINEER	DATE

STATE OF MISSOURI
OFFICE OF ADMINISTRATION
DIVISION OF FACILITIES MANAGEMENT, DESIGN AND CONSTRUCTION

FINAL RECEIPT OF PAYMENT AND RELEASE

PROJECT NUMBER

KNOW ALL MEN BY THESE PRESENT THAT: hereinafter called "Subcontractor" who heretofore entered into an agreement with hereinafter called "Contractor", for the performance of work and/or furnishing of material for the construction of the project entitled

(PROJECT TITLE, PROJECT LOCATION, AND PROJECT NUMBER)

at

(ADDRESS OF PROJECT)

for the State of Missouri (Owner) which said subcontract is by this reference incorporated herein, in consideration of such final payment by Contractor.

DOES HEREBY:

1. ACKNOWLEDGE that they have been **PAID IN FULL** all sums due for work and materials contracted or done by their Subcontractors, Material Vendors, Equipment and Fixture Suppliers, Agents and Employees, or otherwise in the performance of the Work called for by the aforesaid Contract and all modifications or extras or additions thereto, for the construction of said project or otherwise.
2. RELEASE and fully, finally, and forever discharge the Owner from any and all suits, actions, claims, and demands for payment for work performed or materials supplied by Subcontractor in accordance with the requirements of the above referenced Contract.
1. REPRESENT that all of their Employees, Subcontractors, Material Vendors, Equipment and Fixture Suppliers, and everyone else has been **paid in full** all sums due them, or any of them, in connection with performance of said Work, or anything done or omitted by them, or any of them in connection with the construction of said improvements, or otherwise.

DATED this day of , 20 .

NAME OF SUBCONTRACTOR

BY (TYPED OR PRINTED NAME)

SIGNATURE

TITLE

ORIGINAL: FILE/Closeout Documents

STATE OF MISSOURI
OFFICE OF ADMINISTRATION
DIVISION OF FACILITIES MANAGEMENT,
DESIGN AND CONSTRUCTION

PAY APP NO.	PROJECT NUMBER
CHECK IF FINAL ☐**FINAL**	DATE

MBE/WBE/SDVE PROGRESS REPORT

Remit with **ALL** Progress and Final Payments

(Please check appropriate box) ☐CONSULTANT ☐CONSTRUCTION

PROJECT TITLE	
PROJECT LOCATION	
FIRM	
ORIGINAL CONTRACT SUM (Same as Line Item 1. on Form A of Application for Payment) **$**	TOTAL CONTRACT SUM TO DATE (Same as Line Item 3. on Form A of Application for Payment) **$**

THE TOTAL MBE/WBE/SDVE PARTICIPATION DOLLAR AMOUNT OF THIS PROJECT AS INDICATED IN THE ORIGINAL CONTRACT: **$**

SELECT MBE, WBE, SDVE	ORIGINAL CONTRACT PARTICIPATION AMOUNT	PARTICIPATION AMOUNT PAID-TO-DATE (includes approved contract changes)	CONSULTANT/SUBCONSULTANT OR CONTRACTOR/SUBCONTRACTOR/SUPPLIER COMPANY NAME
☐ MBE ☐ WBE ☐ SDVE	$	$	
☐ MBE ☐ WBE ☐ SDVE	$	$	
☐ MBE ☐ WBE ☐ SDVE	$	$	
☐ MBE ☐ WBE ☐ SDVE	$	$	
☐ MBE ☐ WBE ☐ SDVE	$	$	
☐ MBE ☐ WBE ☐ SDVE	$	$	

Revised 05/21

INSTRUCTIONS FOR MBE/WBE/SDVE PROGRESS REPORT

CONTRACTOR OR CONSULTANT TO FILL OUT AND REMIT WITH EACH PAY APPLICATION:

The MBE/WBE/SDVE Progress Report for the project is issued with the contract comprising values reported in the consultant's Proposal or on the successful contractor's Section 004337 Compliance Evaluation Forms.

At Initial Pay Application fill in the following:

1. Pay App No. Start with 1.
2. Fill in the Project Number and Date.
3. Enter Project Title, Project Location, and Firm.
4. Fill in the "Original Contract Sum" and "Total Contract Sum To Date" (Reference applicable Line Items on Form A of Application for Payment).
5. Indicate the Total Participation Dollar Amount from the Original Contract.
6. Select MBE, WBE, or SDVE for each Consultant/Subconsultant or Contractor/Subcontractor/Supplier.
7. Enter the "Total Amount of Subcontract", "$ Amount (Paid-To-Date)", and Company Name.

For all subsequent Pay Applications fill in the following:

1. Pay App No.
2. If Final Pay App, check box.
3. Fill in the Project Number and Date.
4. Enter Project Title, Project Location, and Firm
5. At each Pay App fill in the "Original Contract Sum" and "Total Contract Sum To Date" (reference applicable Line Items on Form A of Application for Payment).
6. Indicate the Total Participation Dollar Amount from the Original Contract.
7. Select MBE, WBE, or SDVE for each Consultant/Subconsultant or Contractor/Subcontractor/Supplier
8. Enter the "Total Amount of Subcontract", "$ Amount (Paid-To-Date)", and Company Name.

STATE OF MISSOURI
OFFICE OF ADMINISTRATION
DIVISION OF FACILITIES MANAGEMENT, DESIGN AND CONSTRUCTION
AFFIDAVIT – COMPLIANCE WITH PREVAILING WAGE LAW

PROJECT NUMBER

Before me, the undersigned Notary Public, in and for the County of _____

State of _____ personally came and appeared _____
(NAME)

_____ of the _____
(POSITION) (NAME OF THE COMPANY)

(a corporation) (a partnership) (a proprietorship) and after being duly sworn did depose and say that all provisions and requirements set out in Chapter 290, Sections 290.210 through and including 290.340, Missouri Revised Statutes, pertaining to the payment of wages to workmen employed on public works project have been fully satisfied and there has been no exception to the full and completed compliance with said provisions and requirements and with Wage Determination No: _____ issued by the Department of Labor and Industrial Relations, State of Missouri on the _____ day of _____ 20 __ in carrying out the contract and working in connection with _____
(NAME OF PROJECT)

Located at _____ in _____ County
(NAME OF THE INSTITUTION)

Missouri, and completed on the _____ day of _____ 20 __

SIGNATURE

NOTARY INFORMATION

NOTARY PUBLIC EMBOSSER OR BLACK INK RUBBER STAMP SEAL	STATE		COUNTY (OR CITY OF ST. LOUIS)
	SUBSCRIBED AND SWORN BEFORE ME, THIS DAY OF YEAR		**USE RUBBER STAMP IN CLEAR AREA BELOW**
	NOTARY PUBLIC SIGNATURE	MY COMMISSION EXPIRES	
	NOTARY PUBLIC NAME (TYPED OR PRINTED)		

FILE: Closeout Documents

GENERAL CONDITIONS

INDEX

SECTION 007213 - GENERAL CONDITIONS

A. These General Conditions apply to each section of these specifications. The Contractor is subject to the provisions contained herein.

B. The General Conditions are intended to define the relationship of the Owner, the Designer and the Contractor thereby establishing certain rules and provisions governing the operation and performance of the work so that the work may be performed in a safe, orderly, expeditious and workmanlike manner.

ARTICLE 1 – GENERAL PROVISIONS

ARTICLE 1.1 - DEFINITIONS

As used in these contract documents, the following terms shall have the meanings and refer to the parties designated in these definitions.

1. **"COMMISSIONER":** The Commissioner of the Office of Administration.
2. **"CONSTRUCTION DOCUMENTS":** The "Construction Documents" shall consist of the Project Manual, Drawings and Addenda.
3. **"CONSTRUCTION REPRESENTATIVE:"** Whenever the term "Construction Representative" is used, it shall mean the Owner's Representative at the work site.
4. **"CONTRACTOR"**: Party or parties who have entered into a contract with the Owner to furnish work under these specifications and drawings.
5. **"DESIGNER"**: When the term "Designer" is used herein, it shall refer to the Architect, Engineer, or Consultant of Record specified and defined in Paragraph 2.0 of the Supplemental Conditions, or his duly authorized representative. The Designer may be either a consultant or state employee.
6. **"DIRECTOR"**: Whenever the term "Director" is used, it shall mean the Director of the Division of Facilities Management, Design and Construction or his Designee, representing the Office of Administration, State of Missouri. The Director is the agent of the Owner.
7. **"DIVISION":** Shall mean the Division of Facilities Management, Design and Construction, State of Missouri.
8. **"INCIDENTAL JOB BURDENS":** Shall mean those expenses relating to the cost of work, incurred either in the home office or on the job-site, which are necessary in the course of doing business but are incidental to the job. Such costs include office supplies and equipment, postage, courier services, telephone expenses including long distance, water and ice and other similar expenses.
9. **"JOINT VENTURE"**: An association of two (2) or more businesses to carry out a single business enterprise for profit for which purpose they combine their property, capital, efforts, skills and knowledge.
10. **"OWNER"**: Whenever the term "Owner" is used, it shall mean the State of Missouri, acting by and through the Office of Administration, Division of Facilities Management, Design and Construction.
11. **"PROJECT"**: Wherever the term "Project" is used, it shall mean the work required to be completed by the construction contract.
12. **"PROJECT MANUAL"**: The "Project Manual" shall consist of Introductory Information, Invitation for Bid, Instructions to Bidders, Bid Documents, Additional Information, Standard Forms, General Conditions, Supplemental General Conditions, General Requirements and Technical Specifications.
13. **"SUBCONTRACTOR"**: Party or parties who contract under, or for the performance of part or this entire Contract between the Owner and Contractor. The subcontract may or may not be direct with the Contractor.
14. **"WORK"**: All supervision, labor, materials, tool, supplies, equipment, and any incidental operations and/or activities required by or reasonably inferable from the Contract Documents necessary to construct the Project and to produce the results intended by the Contract Documents in a safe, expeditious, orderly, and workmanlike manner, and in the best manner known to each respective trade.
15. "**WORKING DAYS**": are all calendar days except Saturdays, Sundays and the following holidays: New Year's Day, Martin Luther King, Jr. Day, Lincoln Day, Washington's Birthday (observed), Truman Day, Memorial Day, Juneteenth, Independence Day, Labor Day, Columbus Day, Veterans Day (observed), Thanksgiving Day, Christmas Day.

ARTICLE 1.2 DRAWINGS AND SPECIFICATIONS

A. In case of discrepancy between drawings and specifications, specifications shall govern. Should discrepancies in architectural drawings, structural drawings and mechanical drawings occur, architectural drawings shall govern and, in case of conflict between structural and mechanical drawings, structural drawings shall govern.

B. Specifications are separated into titled divisions for convenience of reference only and to facilitate letting of contracts and subcontracts. The Contractor is responsible for establishing the scope of work for subcontractors, which may cross titled divisions. Neither the Owner nor Designer will establish limits and jurisdiction of subcontracts.

C. Figured dimensions take precedence over scaled measurements and details over smaller scale general drawings. In the event of conflict between any of the documents contained within the contract, the documents shall take precedence and be controlling in the following sequence: addenda, supplementary general conditions, general conditions, division 1 specifications, technical division specifications, drawings, bid form and instructions to bidders.

D. Anything shown on drawings and not mentioned in these specifications or vice versa, as well as any incidental work which is obviously necessary to complete the project within the limits established by the drawings and specifications, although not shown on or described therein, shall be performed by the Contractor at no additional cost as a part of his contract.

E. Upon encountering conditions differing materially from those indicated in the contract documents, the Contractor shall promptly notify the Designer and Construction Representative in writing before such conditions are disturbed. The Designer shall promptly investigate said conditions and report to the Owner, with a recommended course of action**.** If conditions do materially differ and cause an increase or decrease in contract cost or time required for completion of any portion of the work, a contract change will be initiated as outlined in Article 4 of these General Conditions.

E. Only work included in the contract documents is authorized, and the Contractor shall do no work other than that described therein or in accordance with appropriately authorized and approved contract changes.

ARTICLE 1.3 - COMPLIANCE WITH LAWS, PERMITS, REGULATIONS AND INSPECTIONS

A. Since the Owner is the State of Missouri, municipal or political subdivisions, zoning ordinances, construction codes (other than licensing of trades), and other like ordinances are not applicable to construction on Owner's property, and Contractor will not be required to submit drawings and specifications to any municipal or political subdivision, authority, obtain construction permits or any other licenses (other than licensing of trades) or permits from or submit to inspections by any municipality or political subdivision relating to the construction for this project. All permits or licenses required by municipality or political subdivision for operation on property not belonging to Owner shall be obtained by and paid for by Contractor. Each Contractor shall comply with all applicable laws, ordinances, rules and regulations that pertain to the work of this contract.

B. Contractors, subcontractors and their employees engaged in the businesses of electrical, mechanical, plumbing, carpentry, sprinkler system work, and other construction related trades shall be licensed to perform such work by the municipal or political subdivision where the project is located, if such licensure is required by local code. Local codes shall dictate the level (master, journeyman, and apprentice) and the number, type and ratio of licensed tradesmen required for this project within the jurisdiction of such municipal or political subdivision.

C. Equipment and controls manufacturers and their authorized service and installation technicians that do not maintain an office within the jurisdiction of the municipal or political subdivision but are a listed or specified contractor or subcontractor on this project are exempt from Paragraph 1.3 B above.

D. The Contractor shall post a copy of the wage determination issued for the project and included as a part of the contract documents, in a prominent and easily accessible location at the site of construction for the duration of the project.

E. Any contractor or subcontractor to such contractor at any tier signing a contract to work on this project shall provide a ten-hour Occupational Safety and Health Administration (OSHA) construction safety program for their on-site employees which includes a course in construction safety and health approved by OSHA or a similar program approved by the Department of Labor and Industrial Relations which is at least as stringent as an approved OSHA program. The contractor shall

forfeit as a penalty to the public body on whose behalf the contract is made or awarded, two thousand five hundred dollars plus one hundred dollars for each employee employed by the contractor or subcontractor, for each calendar day, or portion thereof, such employee is employed without the required training.

ARTICLE 1.4 - NONDISCRIMINATION IN EMPLOYMENT

A. The Contractor and his subcontractors will not discriminate against individuals based on race, color, religion, national origin, sex, disability, or age, but may use restrictions which relate to bona fide occupational qualifications. Specifically, the Contractor and his subcontractors shall not discriminate:

1. Against recipients of service on the basis of race, color, religion, national origin, sex, disability or age.

2. Against any employee or applicant, for employment on the basis of race, color, religion, national origin, sex or otherwise qualified disability status.

3. Against any applicant for employment or employee on the basis of age, where such applicant or employee is between ages 40 and 70 and where such Contractor employs at least 20 persons.

4. Against any applicant for employment or employee on the basis of that person's status as a disabled or Vietnam-era veteran.

The Contractor and his Subcontractors will take affirmative action to insure applicants for employment and employees are treated equally without regard to race, color, religion, national origin, sex, disability, or age. Such action shall include, but not be limited to, the following: employment, upgrading, demotion and transfer; recruitment or recruitment advertising; and selection for training, including apprenticeship. The Contractor and his Subcontractors will give written notice of their commitments under this clause to any labor union with which they have bargaining or other agreements.

B. The Contractor and his subcontractors shall develop, implement, maintain and submit in writing to the Owner an affirmative action program if at least fifty (50) persons in the aggregate are employed under this contract. If less than fifty (50) persons in the aggregate are to be employed under this contract, the Contractor shall submit, in lieu of the written affirmative action program, a properly executed Affidavit for Affirmative Action in the form included in the contract specifications. For the purpose of this section, an "affirmative action program" means positive action to influence all employment practices (including, but not limited to, recruiting, hiring, promoting and training) in providing equal employment opportunity regardless of race, color, sex, national origin, religion, age (where the person affected is between age 40 and 70), disabled and Vietnam-era veteran status, and disability. Such "affirmative action program" shall include:

1. A written policy statement committing the total organization to affirmative action and assigning management responsibilities and procedures for evaluation and dissemination;

2. The identification of a person designated to handle affirmative action;

3. The establishment of non-discriminatory selection standards, objective measures to analyze recruitment, an upward mobility system, a wage and salary structure, and standards applicable to lay-off, recall, discharge, demotion and discipline;

4. The exclusion of discrimination from all collective bargaining agreements; and

5. Performance of an internal audit of the reporting system to monitor execution and to provide for future planning.

In the enforcement of this non-discrimination clause, the Owner may use any reasonable procedures available, including, but not limited to: requests, reports, site visits and inspection of relevant documents of contractors and subcontractors.

C. In the event of the Contractor's or his subcontractor's noncompliance with any provisions of this Article of the Contract, the Owner may cancel this contract in whole or in part or require the Contractor to terminate his contract with the subcontractor.

ARTICLE 1.5 - ANTI-KICKBACK

No employee of the division, shall have or acquire any pecuniary interest, whether direct or indirect, in this contract or in any part hereof. No officer, employee, designer, attorney, or administrator of or for the Owner who is authorized in such capacity and on behalf of the Owner to exercise any legislative, executive, supervisory or other similar functions in connection with the construction of the project, shall have or acquire any pecuniary interest, whether direct or indirect, in this contract, any material supply contract, subcontract,

insurance contract, or any other contract pertaining to the project.

ARTICLE 1.6 - PATENTS AND ROYALTIES

A. The Contractor shall hold and save the Owner and its officers, agents, servants and employees harmless from liabilities of any nature or kind, including cost and expenses, for, or on account of, any patented or unpatented invention, process, article or appliance manufactured or used in the performance of this contract, including its use by the Owner, unless otherwise specifically stipulated in the contract documents.

B. If the Contractor uses any design, device or materials covered by letters, patent or copyright, the Contractor shall provide for such use by suitable agreement with the Owner of such patented or copyrighted design, device or material. It is mutually agreed and understood, without exception, that the contract prices shall include all royalties or costs arising from the use of such design, device or materials, in any way involved in the work. The Contractor and/or his sureties shall indemnify and save harmless the Owner of the project from any and all claims for infringement by reason of the use of such patented or copyrighted design, device or materials or any trademark or copyright in connection with work agreed to be performed under this contract and shall indemnify the Owner for any cost, expense or damage it may be obliged to pay by reason of such infringement at any time during the prosecution of the work or after completion of the work.

ARTICLE 1.7 - PREFERENCE FOR AMERICAN AND MISSOURI PRODUCTS AND SERVICES

A. By virtue of statutory authority a preference will be given to Missouri labor and to products of mines, forests and quarries of the state of Missouri when they are found in marketable quantities in the state, and all such materials shall be of the best quality and suitable character that can be obtained at reasonable market prices, all as provided for in Section 8.280, Missouri Revised Statutes and Cumulative Supplements.

B. Furthermore, pursuant to Section 34.076 Missouri Revised Statutes and Cumulative Supplements, a preference shall be given to those persons doing business as Missouri firms, corporations, or individuals, or which maintain Missouri offices or places of business, when the quality of performance promised is equal or better and the price quoted is the same or less. In addition, in order for a non-domiciliary bidder to be successful, his bid must be that same percentage lower than a domiciliary Missouri bidder's bid, as would be required for a Missouri bidder to successfully bid in the non-domiciliary state.

C In accordance with the Missouri Domestic Products Procurement Act Section 34.350 RSMo and Cumulative Supplements any manufactured goods or commodities used or supplied in the performance of this contract or any subcontract thereto shall be manufactured, assembled or produced in the United States, unless the specified products are not manufactured, assembled or produced in the United States in sufficient quantities to meet the agency's requirements or cannot be manufactured, assembled or produced in the United States within the necessary time in sufficient quantities to meet the contract requirements, or if obtaining the specified products manufactured, assembled or produced in the United States would increase the cost of this contract for purchase of the product by more than ten percent.

ARTICLE 1.8 - COMMUNICATIONS

A. All notices, requests, instructions, approvals and claims must be in writing and shall be delivered to the Designer and copied to the Construction Representative for the project except as required by Article 1.12 Disputes and Disagreements, or as otherwise specified by the Owner in writing as stated in Section 012600. Any such notice shall be deemed to have been given as of the time of actual receipt.

B. The Contractor shall attend on-site progress and coordination meetings, as scheduled by the Construction Representative, no less than once a month.

C. The Contractor shall ensure that major subcontractors and suppliers shall attend monthly progress meetings as necessary to coordinate the work, and as specifically requested by the Construction Representative.

ARTICLE 1.9 - SEPARATE CONTRACTS AND COOPERATION

A. The Owner reserves the right to let other contracts in connection with this work. The Contractor shall afford other contractors reasonable opportunity for the introduction and storage of their materials and the execution of their work and shall properly connect and coordinate his work with theirs.

B. The Contractor shall consult the drawings for all other contractors in connection with this work. Any work conflicting with the above shall be brought to the attention of the Owner’s Representative before the work is performed. If the Contractor fails to do this, and constructs any

work which interferes with the work of another contractor, the Contractor shall remove any part so conflicting and rebuild same, as directed by the Owner's Representative at no additional cost to the Owner.

C. Each contractor shall be required to coordinate his work with other contractors so as to afford others reasonable opportunity for execution of their work. No contractor shall delay any other contractor by neglecting to perform contract work at the proper time. If any contractor causes delay to another, they shall be liable directly to that contractor for such delay in addition to any liquidated damages which might be due the Owner.

D. Should the Contractor or project associated subcontractors refuse to cooperate with the instructions and reasonable requests of other Contractors or other subcontractors in the overall coordinating of the work, the Owner may take such appropriate action and issue directions, as required, to avoid unnecessary and unwarranted delays.

E. Each Contractor shall be responsible for damage done to Owner's or other Contractor's property by him/her or workers in his employ through their fault or negligence.

F. Should a Contractor sustain any damage through any act or omission of any other Contractor having a contract with the Owner, the Contractor so damaged shall have no claim or cause of action against the Owner for such damage, but shall have a claim or cause of action against the other Contractor to recover any and all damages sustained by reason of the acts or omissions of such Contractor. The phrase "acts or omissions" as used in this section shall be defined to include, but not be limited to, any unreasonable delay on the part of any such contractors.

ARTICLE 1.10 - ASSIGNMENT OF CONTRACT

A. No assignment by Contractor of any amount or any part of this contract or of the funds to be received there under will be recognized unless such assignment has had the written approval of the Director and the surety has been given due notice of such assignment and has furnished written consent thereto. In addition to the usual recitals in assignment contracts, the following language must be set forth: "It is agreed that the funds to be paid to the assignee under this assignment are subject to performance by the Contractor of this contract and to claims or liens for services rendered or materials supplied for the performance of the work called for in said contract in favor of all persons, firms or corporations rendering such services or supplying such materials."

ARTICLE 1.11 - INDEMNIFICATION

A. Contractor agrees to indemnify and save harmless Owner and its respective commissioners, officers, officials, agents, consultants and employees and Designer, their agents, servants and employees, from and against any and all liability for damage arising from injuries to persons or damage to property occasioned by any acts or omissions of Contractor, any subcontractors, agents, servants or employees, including any and all expense, legal or otherwise, which may be incurred by Owner or Designer, its agents, servants or employees, in defense of any claim, action or suit.

B. The obligations of the Contractor under this paragraph shall not extend to the liability of the Designer, his agents or employees, arising out of (1) the preparation or approval of maps, drawings, opinions, reports, surveys, contract changes, design or specifications, or (2) giving of or the failure to give directions or instructions by the Designer, his agents or employees as required by this contract documents provided such giving or failure to give is the primary cause of the injury or damage.

ARTICLE 1.12 - DISPUTES AND DISAGREEMENTS

It is hereby expressly agreed and understood that in case any controversy or difference of opinion arises during construction, best efforts will be given to resolution at the field level. Should those efforts be unsuccessful, the Contractor has the right to appeal in writing, the decision of the Director's Designee to the Director at Room 730 Truman Building, P.O. Box 809, Jefferson City, Missouri 65102. The decision of the Director shall be final and binding on all parties.

ARTICLE 2 -- OWNER/DESIGNER RESPONSIBILITIES

A. The Owner shall give all orders and directions contemplated under this contract relative to the execution of the work. During progress of work the Owner will be represented at the project site by the Construction Representative and/or Designer, whose responsibilities are to see that this contract is properly fulfilled.

B. The Owner shall at all times have access to the work whenever it is in preparation or progress. The Contractors shall provide proper facilities for such access and for inspection and supervision.

C. All materials and workmanship used in the work shall be subject to the inspection of the Designer and Construction Representative, and any work which is deemed defective shall be removed, rebuilt or made good immediately upon notice.

The cost of such correction shall be borne by the Contractor. Contractor shall not be entitled to an extension of the contract completion date in order to remedy defective work. All rejected materials shall be immediately removed from the site of the work.

D. If the Contractor fails to proceed at once with the correction of rejected defective materials or workmanship, the Owner may, by separate contract or otherwise, have the defects remedied or rejected. Materials removed from the site and charge the cost of the same against any monies which may be due the Contractor, without prejudice to any other rights or remedies of the Owner.

E. Failure or neglect on the part of Owner to observe faulty work, or work done which is not in accordance with the drawings and specifications shall not relieve the Contractor from responsibility for correcting such work without additional compensation.

F. The Owner shall have the right to direct the Contractor to uncover any completed work.

1. If the Contractor fails to adequately notify the Construction Representative and/or Designer of an inspection as required by the Contract Documents, the Contractor shall, upon written request, uncover the work. The Contractor shall bear all costs associated with uncovering and again covering the work exposed.

2. If the Contractor is directed to uncover work, which was not otherwise required by the Contract Documents to be inspected, and the work is found to be defective in any respect, no compensation shall be allowed for this work. If, however, such work is found to meet the requirements of this contract, the actual cost of labor and material necessarily involved in the examination and replacement plus 10% shall be allowed the Contractor.

G. The Designer shall give all orders and directions contemplated under this contract relative to the scope of the work and shall give the initial interpretation of the contract documents.

H. The Owner may file a written notice to the Contractor to dismiss immediately any subcontractors, project managers, superintendents, foremen, workers, watchmen or other employees whom the Owner may deem incompetent, careless or a hindrance to proper or timely execution of the work. The Contractor shall comply with such notice as promptly as practicable without detriment to the work or its progress.

I. If in the Owner's judgment it becomes necessary at any time to accelerate work, when ordered by the Owner in writing, the Contractor shall redirect resources to such work items and execute such portions of the work as may be required to complete the work within the current approved contract schedule.

ARTICLE 3 -- CONTRACTOR RESPONSIBILITIES

The Contractor shall register and utilize the Owner's eBuilder digital project management system for submission of documents described in the following sections. This includes but is not limited to submittals as required by designer, payment applications, Request for Information (RFI), construction change orders, Request for Proposals (RFP), Designer Supplemental Instructions (DSI), etc.

ARTICLE 3.1 -- ACCEPTABLE SUBSTITUTIONS

A. The Contractor may request use of any article, device, product, material, fixture, form or type of construction which in the judgment of the Owner and Designer is equal in all respects to that named. Standard products of manufacturers other than those specified will be accepted when, prior to the ordering or use thereof, it is proven to the satisfaction of the Owner and Designer that they are equal in design, strength, durability, usefulness and convenience for the purpose intended.

B. Any changes required in the details and dimensions indicated on the drawings for the substitution of products other than those specified shall be properly made at the expense of the Contractor requesting the substitution or change.

C. The Contractor shall submit a request for such substitutions in writing to the Owner and Designer within twenty (20) working days after the date of the "Notice to Proceed." Thereafter no consideration will be given to alternate forms of accomplishing the work. This Article does not preclude the Owner from exercising the provisions of Article 4 hereof.

D. Any request for substitution by the Contractor shall be submitted in accordance with SECTION 002113 - INSTRUCTIONS TO BIDDERS.

E. When a material has been approved, no change in brand or make will be permitted unless:

1. Written verification is received from the manufacturer stating they cannot make delivery on the date previously agreed, or

2. Material delivered fails to comply with contract requirements.

ARTICLE 3.2 -- SUBMITTALS

A. The Contractor's submittals must be submitted with such promptness as to allow for review and approval so as not to cause delay in the work. The Contractor shall coordinate preparation and processing of submittals with performance of construction activities.

   Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.

   Submit four (4) copies to the Designer and additional copies as required for the subcontractors and material suppliers. Also provide copies to meet the requirements for maintenance manuals.

B. All subcontractors' shop drawings and schedules shall be submitted by the Contractor and shall bear evidence that Contractor has received, reviewed, and approved them. Any shop drawings and schedules submitted without this evidence will be returned to the Contractor for resubmission.

C. The Contractor shall include with the shop drawing, a letter indicating any and all deviations from the drawings and/or specifications. Failure to notify the Designer of such deviations will be grounds for subsequent rejection of the related work or materials. If, in the opinion of the Designer, the deviations are not acceptable, the Contractor will be required to furnish the item as specified and indicated on the drawings.

D. The Designer shall check shop drawings and schedules with reasonable promptness and approve them only if they conform to the design concept of the project and comply with the information given in the contract documents. The approval shall not relieve the Contractor from the responsibility to comply with the drawings and specifications, unless the Contractor has called the Designer's attention to the deviation, in writing, at the time of submission and the Designer has knowingly approved thereof. An approval of any such modification will be given only under the following conditions:

   1. It is in the best interest of the Owner
   2. It does not increase the contract sum and/or completion time
   3. It does not deviate from the design intent
   4. It is without prejudice to any and all rights under the surety bond.

E. No extension of time will be granted because of the Contractor's failure to submit shop drawings and schedules in ample time to allow for review, possible resubmission, and approval. Fabrication of work shall not commence until the Contractor has received approval. The Contractor shall furnish prints of approved shop drawings and schedules to all subcontractors whose work is in any way related to the work under this contract. Only prints bearing this approval will be allowed on the site of construction

F. The Contractor shall maintain a complete file on-site of approved shop drawings available for use by the Construction Representative.

ARTICLE 3.3 – AS-BUILT DRAWINGS

A. The Contractor shall update a complete set of the construction drawings, shop drawings and schedules of all work monthly by marking changes, and at the completion of their work (prior to submission of request for final payment) note all changes and turn the set over to the Construction Representative. The updates shall show all addenda, all field changes that were made to adapt to field conditions, changes resulting from contract changes or supplemental instructions, and all locations of structures, buried installations of piping, conduit, and utility services. All buried and concealed items both inside and outside shall be accurately located as to depth and referenced to permanent features such as interior or exterior wall faces and dimensions shall be given in a neat and legible manner in a contrasting colored pencil or ink. If approved by the Designer, an electronic file format may be provided.

ARTICLE 3.4 – GUARANTY AND WARRANTIES

A. General Guaranty

   1. Neither the final certificate of payment nor any provision in the contract documents nor partial use or occupancy of the premises by the Owner shall constitute an acceptance of work not done in accordance with contract requirements.
   2. The Contractor or surety shall remedy any defects in the work and pay for any damage to property resulting there from which shall appear within a period of one (1) year from the date of substantial completion unless a longer period is otherwise specified or a differing guaranty period has been established in the substantial completion certificate. The Owner will give notice of observed defects with reasonable promptness.
   3. In case of default on the part of the Contractor in fulfilling this part of this contract, the Owner may correct the work or repair the

damage and the cost and expense incurred in such event shall be paid by or recoverable from the Contractor or surety.

4. The work will be free from defects not inherent in the quality required or permitted, and that the Work will conform to the requirements of the Contract Documents. Work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective. The Contractor's guaranty excludes remedy for damage or defect caused by abuse, modifications not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear under normal usage. If required by the Owner, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment

B. Extended Warranty

Manufacturer's certificates of warranty shall be obtained for all major equipment. Warranty shall be obtained for at least one year. Where a longer period is offered at no additional cost or called for in the specific equipment specifications, the longer period shall govern.

ARTICLE 3.5 -- OPERATION AND MAINTENANCE MANUALS

A. Immediately after equipment submittals are approved and no later than ten (10) working days prior to the substantial completion inspection, the Contractor shall provide to the Designer three (3) copies of operating instructions and service manuals, containing the following:

1. Start-up and Shut-down Procedures: Provide a step-by-step write up of all major equipment. When manufacturer's printed start-up, trouble shooting and shut-down procedures are available; they may be incorporated into the operating manual for reference.

2. Operating Instructions: Written operating instructions shall be included for the efficient and safe operation of all equipment.

3. Equipment List: List of all major equipment as installed shall be prepared to include model number, capacities, flow rate, name place data, shop drawings and air and water balance reports.

4. Service Instructions: Provide the following information for all pieces of equipment.

   a. Recommended spare parts including catalog number and name of local supplier or factory representative.

   b. Belt sizes, types, and lengths.

   c. Wiring diagrams.

5. Manufacturer's Certificate of Warranty as described in Article 3.4.

6. Prior to the final payment, furnish to the Designer three (4) copies of parts catalogs for each piece of equipment furnished by him/her on the project with the components identified by number for replacement ordering.

B. Submission of operating instructions shall be done in the following manner.

1. Manuals shall be in quadruplicate, and all materials shall be bound into volumes of standard 8½" x 11" hard binders. Large drawings too bulky to be folded into 8½" x 11" shall be separately bound or folded and in envelopes, cross referenced and indexed with the manuals.

2. The manuals shall identify project name, project number, and include the name and address of the Contractor, subcontractors and manufacturers who were involved with the activity described in that particular manual.

3. Internally subdivide the binder contents with permanent page dividers, logically organized with tab titles clearly printed under reinforced laminated plastic tabs.

4. Contents: Prepare a Table of Contents for each volume, with each product or system description identified.

ARTICLE 3.6 – OTHER CONTRACTOR RESPONSIBILITIES

A. The Contractor shall keep on site, during progress of the work, a competent superintendent satisfactory to the Construction Representative. The superintendent shall represent the Contractor and all agreements made by the superintendent shall be binding. The superintendent shall carefully study and compare all drawings, specifications and other instructions and shall promptly notify the Construction Representative and Designer, in writing, any error, inconsistency or omission which may be discovered. The superintendent shall coordinate all work on the project. Any change of the superintendent shall be approved by the Construction Representative.

B. Contractor shall, at all times, enforce strict discipline and good order among his employees,

and shall not employ on the work any unfit person or anyone not skilled in the work assigned to him/her.

C. The Contractor shall supply sufficient labor, material, plant and equipment and pay when due any laborer, subcontractor or supplier for supplies furnished and otherwise prosecute the work with diligence to prevent work stoppage and insure completion thereof within the time specified.

D. The Contractor and each of his subcontractors shall submit to the Construction Representative, through the Designer such schedules of quantities and costs, progress schedules, payrolls, reports, estimates, records and other data as the Owner may request concerning work performed or to be performed under this contract.

E. The Contractor, subcontractors, and material suppliers shall upon written request, give the Owner access to all time cards, material invoices, payrolls, estimates, profit and loss statements, and all other direct or indirect costs related to this work.

F. The Contractor shall be responsible for laying out all contract work such as layout of architectural, structural, mechanical and electrical work, which shall be coordinated with layouts of subcontractors for general construction work. The Contractor is also responsible for unloading, uncrating and handling of all materials and equipment to be erected or placed by him/her, whether furnished by Contractor or others. No extra charges or compensation will be allowed as a result of failure to verify dimensions before ordering materials or fabricating items.

G. The Contractor must notify the Construction Representative at least one working day before placing concrete or burying underground utilities, pipelines, etc.

H. Contractors shall prearrange time with the Construction Representative for the interruption of any facility operation. Unless otherwise specified in these documents, all connections, alterations or relocations as well as all other portions of the work will be performed during normal working hours.

I. The Contractor shall coordinate all work so there will not be prolonged interruptions of existing equipment operation. Any existing plumbing, heating, ventilating, air conditioning or electrical disconnections necessary for the project, which affect portions of this construction or building or any other building must be scheduled with the Construction Representative to minimize or avoid any disruption of facility operations. In no case, unless previously approved in writing by the Construction Representative, shall utilities be left disconnected at the end of a work day or over a weekend. Any interruption of utilities either intentionally or accidentally shall not relieve the Contractor responsible for the interruption from the responsibility to repair and restore the utility to normal service. Repairs and restoration shall be made before the workers responsible for the repair and restoration leave the job.

J. Contractors shall limit operations and storage of materials to the area within the project, except as necessary to connect to existing utilities, and shall not encroach on neighboring property. The Contractor shall be responsible for repair of their damage to property on or off the project site occurring during construction of project. All such repairs shall be made to the satisfaction of the property owner.

K. Unless otherwise permitted, all materials shall be new and both workmanship and materials shall be of the best quality.

L. Unless otherwise provided and stipulated within these specifications, the Contractor shall furnish, construct, and/or install and pay for materials, devices, mechanisms, equipment, all necessary personnel, utilities including, but not limited to water, heat, light and electric power, transportation services, applicable taxes of every nature, and all other facilities necessary for the proper execution and completion of the work.

M. Contractor shall carefully examine the plans and drawings and shall be responsible for the proper fitting of his material, equipment and apparatus into the building.

N. The Contractor or subcontractors shall not overload, or permit others to overload, any part of any structure during the performance of this contract.

O. All temporary shoring, bracing, etc., required for the removal of existing work and/or for the installation of new work shall be included in this contract. The Contractor shall make good, at no cost to the Owner, any damage caused by improper support or failure of shoring in any respect. Each Contractor shall be responsible for shoring required to protect his work or adjacent property and improvements of Owner and shall be responsible for shoring or for giving written notice to adjacent property owners. Shoring shall be removed only after completion of permanent supports.

P. The Contractor shall provide at the proper time such material as is required for support of the work. If openings are required, whether shown on drawings or not, the Contractor shall see that they are properly constructed.

Q. During the performance of work the Contractor shall be responsible for providing and maintaining warning signs, lights, signal devices, barricades, guard rails, fences and other devices appropriately located on site which will give proper and understandable warning to all persons of danger of entry onto land, structure or equipment.

R. The Contractor shall be responsible for protection, including weather protection, and proper maintenance of all equipment and materials.

S. The Contractor shall be responsible for care of the finished work and shall protect same from damage or defacement until substantial completion by the Owner. If the work is damaged by any cause, the Contractor shall immediately begin to make repairs in accordance with the drawings and specifications. Contractor shall be liable for all damage or loss unless attributable to the acts or omissions of the Owner or Designer. Any claim for reimbursement shall be submitted in accordance with Article 4. After substantial completion the Contractor will only be responsible for damage resulting from acts or omissions of the Contractor or subcontractors through final warranty.

T. In the event the Contractor encounters an unforeseen hazardous material, the Contractor shall immediately stop work in the area affected and report the condition to the Owner and Designer in writing. The Contractor shall not be required, pursuant to Article 4, to perform, any work relating to hazardous materials.

U. In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury or loss. Additional compensation or extension of time claimed by the Contractor on account of an emergency shall be determined as provided in Article 4.

V. Before commencing work, Contractors shall confer with the Construction Representative and facility representative and review any facility rules and regulations which may affect the conduct of the work.

W. Project signs will only be erected on major projects and only as described in the specifications. If no sign is specified, none shall be erected.

ARTICLE 3.7 -- SUBCONTRACTS

A. Subcontractor assignments as identified in the bid form shall not be changed without written approval of the Owner. The Owner will not approve changes of a listed subcontractor unless the Contractor documents, to the satisfaction of the Owner that the subcontractor cannot or will not perform the work as specified.

B. The Contractor is fully responsible to the Owner for the acts and omissions of all subcontractors and of persons either directly or indirectly employed by them.

C. Every subcontractor shall be bound by the applicable terms and provisions of these contract documents, but no contractual relationship shall exist between any subcontractor and the Owner unless the right of the Contractor to proceed with the work is suspended or this contract is terminated as herein provided, and the Owner in writing elects to assume the subcontract.

D. The Contractor shall upon receipt of "Notice to Proceed" and prior to submission of the first payment request, notify the Designer and Construction Representative in writing of the names of any subcontractors to be used in addition to those identified in the bid form and all major material suppliers proposed for all parts of the work.

ARTICLE 4 -- CHANGES IN THE WORK

4.1 CHANGES IN THE WORK

A. The Construction Representative, without giving notice to the surety and without invalidating this contract, may order extra work or make changes by altering, adding to or deducting from the work, this contract sum being adjusted accordingly. All such work shall be executed under the conditions of the original contract. A claim for extension of time caused by any change must be adjusted at the time of ordering such change. No future request for time will be considered.

B. Each Contract Change shall include all costs required to perform the work including all labor, material, equipment, overheads and profit, delay, disruptions, or other miscellaneous expenses. No subsequent requests for additional compensation including claims for delay, disruption, or reduced efficiency as a result of each change will be considered. Values from the Schedule of Values will not be binding as a basis for additions to or deductions from the contract price.

C. The amount of any adjustment in this contract price for authorized changes shall be agreed upon

before such changes become effective and shall be determined, through submission of a request for proposal, as follows:

1. By an acceptable fixed price proposal from the Contractor. Breakdowns shall include all takeoff sheets of each Contractor and subcontractor. Breakdown shall include a listing of each item of material with unit prices and number of hours of labor for each task. Labor costs per hour shall be included with labor burden identified, which shall be not less than the prevailing wage rate, etc. Overhead and profit shall be shown separately for each subcontractor and the Contractor.
2. By a cost-plus-fixed-fee (time and material) basis with maximum price, total cost not to exceed said maximum. Breakdown shall include a listing of each item of material with unit prices and number of hours of labor for each task. Labor costs per hour shall be included with labor burden identified, which shall be not less than the prevailing wage rate, etc. Overhead and profit shall be shown separately for each subcontractor and the Contractor.
3. By unit prices contained in Contractor's original bid form and incorporated in the construction contract.

D. Overhead and Profit on Contract Changes shall be applied as follows:

1. The overhead and profit charge by the Contractor and all subcontractors shall be considered to include, but is not limited to: incidental job burdens, small truck (under 1 ton) expense, mileage, small hand tools, warranty costs, company benefits and general office overhead. Project supervision including field supervision and job site office expense shall be considered a part of overhead and profit unless a compensable time extension is granted.
2. The percentages for overhead and profit charged on Contract Changes shall be subject to the following limits: (a) the percentage mark-up for the Contractor shall be limited to the Contractor's fee; (b) fifteen percent (15%) maximum for Work directly performed by employees of a subcontractor, or sub-subcontractor; (c) five percent (5%) maximum for the Work performed or passed through to the Owner by the Contractor; (d) five percent (5%) maximum subcontractor's mark-up for Work performed by a sub-subcontractor and passed through to the Owner by the subcontractor and Contractor; and (e) in no case shall the total overhead and profit paid by the Owner on any Contract Changes exceed twenty-five percent (25%) of the cost of materials, labor and equipment (exclusive of Contractor or any Subcontractor overhead and profit) necessary to put the contract change work in place.
3. The Contractor will be allowed to add the cost of Contractor's payment and performance bonding, builder's risk insurance, and general liability insurance to their cost of work. The above listed bonding and insurance cost shall not exceed 2% and shall be allowed on the total cost of the added work, including overhead and profit.
4. On proposals covering both increases and decreases in the amount of this contract, the application of overhead and profit shall be on the net change in the cost of the work.
5. The percentage(s) for overhead and profit to be credited to the Owner on Contract Changes that are solely decreases in the quantity of work or materials shall be the same as those for additive Contract Changes provided above.

E. No claim for an addition to this contract sum shall be valid unless authorized as aforesaid in writing by the Owner. In the event that none of the foregoing methods are agreed upon, the Owner may order the Contractor to perform work on a time and material basis. The cost of such work shall be determined by the Contractor's actual labor and material cost to perform the work plus overhead and profit as outlined herein. The Designer and Construction Representative shall approve the Contractor's daily time and material invoices for the work involved.

F. If the Contractor claims that any instructions involve extra cost under this contract, the Contractor shall give the Owner's Representative written notice thereof within a reasonable time after the receipt of such instructions, and in any event before proceeding to execute the work. No such claim shall be valid unless so made and authorized by the Owner, in writing.

G. In an emergency affecting the safety of life or of the structure or of adjoining property, the Contractor, without special instruction or authorization from the Construction Representative, is hereby permitted to act at their discretion to prevent such threatened loss or injury. The Contractor shall submit a claim for

compensation for such emergency work in writing to the Owner's Representative.

ARTICLE 4.2 – CHANGES IN COMPLETION TIME

A. Extension of the number of work days stipulated in the Contract for completion of the work with compensation may be made when:

1. The contractor documents that proposed Changes in the work, as provided in Article 4.1, extends construction activities critical to contract completion date, OR
2. The Owner suspends all work for convenience of the Owner as provided in Article 7.3, OR
3. An Owner caused delay extends construction activities critical to contract completion (except as provided elsewhere in these General Conditions). The Contractor is to review the work activities yet to begin and evaluate the possibility of rescheduling the work to minimize the overall project delay.

B. Extension of the number of work days stipulated in the Contract for completion of the work without compensation may be made when:

1. Weather-related delays occur, subject to provisions for the inclusion of a specified number of "bad weather" days when provided for in Section 012100-Allowances, OR
2. Labor strikes or acts of God occur, OR
3. The work of the Contractor is delayed on account of conditions which were beyond the control of the Contractor, subcontractors or suppliers, and were not the result of their fault or negligence.

C. No time extension or compensation will be provided for delays caused by or within the control of the Contractor, subcontractors or suppliers and for concurrent delays caused by the Owner.

D. The Contractor shall notify the Owner promptly of any occurrence or conditions which in the Contractor's opinion results in a need for an extension of time. The notice shall be in writing and shall include all necessary supporting materials with details of any resultant costs and be submitted in time to permit full investigation and evaluation of the Contractor's claim. The Owner shall promptly acknowledge the Contractor's notice and, after recommendation from the Owner's Representative and/or Designer, shall provide a decision to the Contractor. Failure on the part of the Contractor to provide such notice and to detail the costs shall constitute a waiver by the Contractor of any claim. Requests for extensions of time shall be for working days only.

ARTICLE 5 - CONSTRUCTION AND COMPLETION

ARTICLE 5.1 – CONSTRUCTION COMMENCEMENT

A. Upon receipt of the "Intent to Award" letter, the Contractor must submit the following properly executed instruments to the Owner:

1. Contract;
2. Performance/payment bond as described in Article 6.1;
3. Certificates of Insurance, or the actual policies themselves, showing that the Contractor has obtained the insurance coverage required by Article 6.2.
4. Written Affirmative Action Plans as required in Article 1.4.

Above referenced items must be received by the Owner within ten (10) working days after the effective date of the contract. If not received, the Owner may treat the failure to timely submit them as a refusal by the Contractor to accept a contract for this work and may retain as liquidated damages the Contractor's bid bond, cashier's check or certified check as provided in the Instructions to Bidders. Upon receipt the Owner will issue a "Notice to Proceed" with the work to the Contractor.

B. Within the time frame noted in Section 013200 - Schedules, following receipt of the "Notice to Proceed", the Contractor shall submit to the Owner a progress schedule and schedule of values, showing activities through the end of the contract period. Should the Contractor not receive written notification from the Owner of the disapproval of the schedule of values within fifteen (15) working days, the Contractor may consider it approved for purpose of determining when the first monthly Application and Certification for Payment may be submitted.

C. The Contractor may commence work upon receipt of the Division of Facilities Management, Design and Construction's "Notice to Proceed" letter. Contractor shall prosecute the work with faithfulness and energy, and shall complete the entire work on or before the completion time stated in the contract documents or pay to the Owner the damages resulting from the failure to timely complete the work as set out within Article 5.4.

ARTICLE 5.2 -- PROJECT CONSTRUCTION

A. Each Contractor shall submit for the Owner's approval, in reproducible form, a progress schedule showing the rate of progress and the order of the work proposed to carry on various phases of the project. The schedule shall be in conformance with the requirements outlined in Section 013200 – Schedules.

B. Contractor shall employ and supply a sufficient force of workers, material, and equipment and shall pay when due, any worker, subcontractor or supplier and otherwise prosecute the work with such diligence so as to maintain the rate of progress indicated on the progress schedule, prevent work stoppage, and insure completion of the project within the time specified.

ARTICLE 5.3 -- PROJECT COMPLETION

A. Substantial Completion. A Project is substantially complete when construction is essentially complete and work items remaining to be completed can be done without interfering with the Owner's ability to use the Project for its intended purpose.

1. Once the Contractor has reached what they believe is Substantial Completion, the Contractor shall notify the Designer and the Construction Representative of the following:

   a. That work is essentially complete with the exception of certain listed work items. The list shall be referred to as the "Contractor's Punch."

   b. That all Operation and Maintenance Manuals have been assembled and submitted in accordance with Article 3.5A.

   c. That the Work is ready for inspection by the Designer and Construction Representative. The Owner shall be entitled to a minimum of ten working days notice before the inspection shall be performed.

2. If the work is acceptable, the Owner shall issue a Certificate of Substantial Completion, which shall set forth the responsibilities of the Owner and the Contractor for utilities, security, maintenance, damage to the work and risk of loss. The Certificate shall also identify those remaining items of work to be performed by the Contractor. All such work items shall be complete within 30 working days of the date of the Certificate, unless the Certificate specifies a different time. If the Contractor shall be required to perform tests that must be delayed due to climatic conditions, it is understood that such tests and affected equipment will be identified on the Certificate and shall be accomplished by the Contractor at the earliest possible date. Performance of the tests may not be required before Substantial Completion can be issued. The date of the issuance of the Certificate of Substantial Completion shall determine whether or not the work was completed within the contract time and whether or not Liquidated Damages are due.

3. If the work is not acceptable, and the Owner does not issue a Certificate of Substantial Completion, the Owner shall be entitled to charge the Contractor with the Designer's and Owner's costs of re-inspection, including time and travel.

B. Partial Occupancy. Contractor agrees that the Owner shall be permitted to occupy and use any completed or partially completed portions of the Project, when such occupancy and use is in the Owner's best interest. Owner shall notify Contractor of its desire and intention to take Partial Occupancy as soon as possible but at least ten (10) working days before the Owner intends to occupy. If the Contractor believes that the portion of the work the Owner intends to occupy is not ready for occupancy, the Contractor shall notify the Owner immediately. The Designer shall inspect the work in accordance with the procedures above. If the Contractor claims increased cost of the project or delay in completion as a result of the occupancy, he shall notify the Owner immediately but in all cases before occupancy occurs.

C. Final Completion. The Project is finally complete when the Certificate of Substantial Completion has been issued and all work items identified therein as incomplete have been completed, and when all administrative items required by the contract have been completed. Final Completion entitles the Contractor to payment of the outstanding balance of the contract amount including all change orders and retainage. Within five (5) working days of the date of the Certificate of Substantial Completion, the Contractor shall identify the cost to complete any outstanding items of work. The Designer shall review the Contractor's estimate and either approve it or provide an independent estimate for all such items. If the Contractor fails to complete the remaining items within the time specified in the Certificate, the Owner may terminate the contract and go to the surety for project completion in accordance with Article 7.2 or release the contract balance to the Contractor less 150% of the

approved estimate to complete the outstanding items. Upon completion of the outstanding items, when a final cost has been established, any monies remaining shall be paid to the Contractor. Failure to complete items of work does not relieve the Contractor from the obligation to complete the administrative requirements of the contract, such as the provisions of Article 5.3 FAILURE TO COMPLETE ALL ITEMS OF WORK UNDER THE CONTRACT SHALL BE CONSIDERED A DEFAULT AND BE GROUNDS FOR CONTRACT TERMINATION AND DEBARMENT.

D. Liquidated Damages. Contractor agrees that the Owner may deduct from the contract price and retain as liquidated damages, and not as penalty or forfeiture, the sum stipulated in this contract for each work day after the Contract Completion Day on which work is not Substantially Complete. Assessment of Liquidated Damages shall not relieve the Contractor or the surety of any responsibility or obligation under the Contract. In addition, the Owner may, without prejudice to any other rights, claims, or remedies the Owner may have including the right to Liquidated Damages, charge the Contractor for all additional expenses incurred by the Owner and/or Designer as the result of the extended contract period through Final Completion. Additional Expenses shall include but not be limited to the costs of additional inspections.

E. Early Completion. The Contractor has the right to finish the work before the contract completion date; however, the Owner assumes no liability for any hindrances to the Contractor unless Owner caused delays result in a time extension to the contract completion date. The Contractor shall not be entitled to any claims for lost efficiencies or for delay if a Certificate of Substantial Completion is given on or before the Contract Completion Date.

ARTICLE 5.4 -- PAYMENT TO CONTRACTOR

A. Payments on account of this contract will be made monthly in proportion to the work which has been completed. Request for payment must be submitted on the Owner's forms. No other pay request will be processed. Supporting breakdowns must be in the same format as Owner's forms and must provide the same level of detail. The Designer will, within 5 working days from receipt of the contractor's request for payment either issue a Certificate for Payment to the Owner, for such amount as the Designer determines is properly due, or notify the Contractor in writing of reasons for withholding a Certificate. The Owner shall make payment within 30 calendar days after the "Application and Certification for Payment" has been received and certified by the Designer. The following items are to be attached to the contractor's pay request:

1. Updated construction schedule
2. Certified payrolls consisting of name, occupation and craft, number of hours worked and actual wages paid for each individual employee, of the Contractor and all subcontractors working on the project

B. The Owner shall retain 5 percent of the amount of each such payment application, except as allowed by Article 5.4, until final completion and acceptance of all work covered by this contract.

C. Each payment made to Contractor shall be on account of the total amount payable to Contractor and all material and work covered by paid partial payment shall thereupon become the sole property of Owner. This provision shall not be construed as relieving Contractor from sole responsibility for care and protection of materials and work upon which payments have been made or restoration of any damaged work or as a waiver of the right of Owner to require fulfillment of all terms of this contract.

D. Materials delivered to the work site and not incorporated in the work will be allowed in the Application and Certification for Payment on the basis of one hundred (100%) percent of value, subject to the 5% retainage providing that they are suitably stored on the site or in an approved warehouse in accordance with the following requirements:

1. Material has previously been approved through submittal and acceptance of shop drawings conforming to requirements of Article 3.2 of General Conditions.
2. Delivery is made in accordance with the time frame on the approved schedule.
3. Materials, equipment, etc., are properly stored and protected from damage and deterioration and remain so - if not, previously approved amounts will be deleted from subsequent pay applications.
4. The payment request is accompanied by a breakdown identifying the material equipment, etc. in sufficient detail to establish quantity and value.

E. The Contractor shall be allowed to include in the Application and Certification for Payment, one hundred (100%) of the value, subject to retainage,

of major equipment and material stored off the site if all of the following conditions are met:

1. The request for consideration of payment for materials stored off site is made at least 15 working days prior to submittal of the Application for Payment including such material. Only materials inspected will be considered for inclusion on Application for Payment requests.
2. Materials stored in one location off site are valued in excess of $25,000.
3. That a Certificate of Insurance is provided indicating adequate protection from loss, theft conversion or damage for materials stored off site. This Certificate shall show the State of Missouri as an additional insured for this loss.
4. The materials are stored in a facility approved and inspected, by the Construction Representative.
5. Contractor shall be responsible for, Owner costs to inspect out of state facilities, and any delays in the completion of the work caused by damage to the material or for any other failure of the Contractor to have access to this material for the execution of the work.

F. The Owner shall determine the amount, quality and acceptability of the work and materials which are to be paid for under this contract. In the event any questions shall arise between the parties, relative to this contract or specifications, determination or decision of the Owner or the Construction Representative and the Designer shall be a condition precedent to the right of the Contractor to receive any money or payment for work under this contract affected in any manner or to any extent by such question.

G. Payments Withheld: The Owner may withhold or nullify in whole or part any certificate to such extent as may be necessary to protect the Owner from loss on account of:

1. Defective work not remedied. When a notice of noncompliance is issued on an item or items, corrective action shall be undertaken immediately. Until corrective action is completed, no monies will be paid and no additional time will be allowed for the item or items. The cost of corrective action(s) shall be borne by the Contractor.
2. A reasonable doubt that this contract can be completed for the unpaid balance.
3. Failure of the Contractor to update as-built drawings monthly for review by the Construction Representative.
4. Failure of the Contractor to update the construction schedule.

When the Construction Representative is satisfied the Contractor has remedied above deficiencies, payment shall be released.

H. Final Payment: Upon receipt of written notice from the Contractor to the Designer and Project Representative that the work is ready for final inspection and acceptance, the Designer and Project Representative, with the Contractor, shall promptly make such inspection. If the work is acceptable and the contract fully performed, the Construction Representative shall complete a final acceptance report and the Contractor will be directed to submit a final Application and Certification for Payment. If the Owner approves the same, the entire balance shall be due and payable, with the exception of deductions as provided for under Article 5.4.

1. Where the specifications provide for the performance by the Contractor of (certain tests for the purpose of balancing and checking the air conditioning and heating equipment and the Contractor shall have furnished and installed all such equipment in accordance with the specifications, but said test cannot then be made because of climatic conditions, such test shall may be considered as required under the provisions of the specifications, Section 013300 and this contract may be substantial Full payment will not be made until the tests have been made and the equipment and system is finally accepted. If the tests are not completed when scheduled, the Owner may deduct 150% of the value of the tests from the final payment.
2. The final payment shall not become due until the Contractor delivers to the Construction Representative:

a) A complete file of releases, on the standard form included in the contract documents as "Final Receipt of Payment and Release Form", from subcontractors and material suppliers evidencing payment in full for services, equipment and materials, as the case may require, if the Owner approves, or a consent from the Surety to final payment accepting liability for any unpaid amounts.

b) An Affidavit of Compliance with Prevailing Wage Law, in the form as included in this contract specifications, properly executed by each subcontractor, and the Contractor

c) Certified copies of all payrolls

d) As-built drawings

3. If any claim remains unsatisfied after all payments are made, the Contractor shall refund to the Owner all monies that the latter may be compelled to pay in discharging such a claim including all costs and a reasonable attorney's fee.

4. Missouri statute requires prompt payment from the Owner to the Contractor within thirty calendar days and from the Contractor to his subcontractors within fifteen calendar days. Failure to make payments within the required time frame entitles the receiving party to charge interest at the rate of one and one half percent per month calculated from the expiration of the statutory time period until paid.

5. The value of all unused unit price allowances and/or 150% of the value of the outstanding work items, and/or liquidated damages may be deducted from the final pay request without executing a Contract Change. Any unit price items which exceed the number of units in the contract may be added by Contract Change.

ARTICLE 6 -- INSURANCE AND BONDS

ARTICLE 6.1 -- BOND

A. Contractor shall furnish a performance/payment bond in an amount equal to 100% of the contract price to guarantee faithful performance of the contract and 100% of the contract price to guarantee the payment of all persons performing labor on the project and furnishing materials in connection therewith under this contract as set forth in the standard form of performance and payment bond included in the contract documents. The surety on such bond shall be issued by a surety company authorized by the Missouri Department of Insurance to do business in the state of Missouri.

B. All Performance/Payment Bonds furnished in response to this provision shall be provided by a bonding company with a rating of B+ or higher as established by A.M. Best Company, Inc. in their most recent publication.

ARTICLE 6.2 – INSURANCE

A. The successful Contractor shall procure and maintain for the duration of the contract issued a policy or policies of insurance for the protection of both the Contractor and the Owner and their respective officers, officials, agents, consultants and employees. The Owner requires certification of insurance coverage from the Contractor prior to commencing work.

B. Minimum Scope and Extent of Coverage

1. General Liability

Commercial General Liability, ISO coverage form number or equivalent CG 00 01 ("occurrence" basis), or I-SO coverage form number CG 00 02, or ISO equivalent.

If ISO equivalent or manuscript general liability coverage forms are used, minimum coverage will be as follows: Premises/Operations; Independent Contractors; Products/Completed Operations; personal Injury; Broad Form Property Damage including Completed Operations; Broad Form Contractual Liability Coverage to include Contractor's obligations under Article 1.11 Indemnification and any other Special Hazards required by the work of the contract.

2. Automobile Liability

Business Automobile Liability Insurance, ISO Coverage form number or equivalent CA 00 01 covering automobile liability, code 1 "ANY AUTO".

3. Workers' Compensation and Employer's Liability

Statutory Workers' Compensation Insurance for Missouri and standard Employer's Liability Insurance, or the authorization to self-insure for such liability from the Missouri Division of Workers' Compensation.

4. Builder's Risk or Installation Floater Insurance

Insurance upon the work and all materials, equipment, supplies, temporary structures and similar items which may be incident to the performance of the work and located at or adjacent to the site, against loss or damage from fire and such other casualties as are included in extended coverage in broad "All Risk" form, including coverage for Flood and Earthquake, in an amount not less than the replacement cost of the work or this contact price, whichever is greater, with loss payable

to Contractor and Owner as their respective interests may appear.

Contractor shall maintain sufficient insurance to cover the full value of the work and materials as the work progresses, and shall furnish Owner copies of all endorsements. If Builder's Risk Reporting- Form of Endorsement is used, Contractor shall make all reports as required therein so as to keep in force an amount of insurance which will equal the replacement cost of the work, materials, equipment, supplies, temporary structures, and other property covered thereby; and if, as a result of Contractor's failure to make any such report, the amount of insurance so recoverable shall be less than such replacement cost, Contractor's interest in the proceeds of such insurance, if any, shall be subordinated to Owner's interest to the end that Owner may receive full reimbursement for its loss.

C. Minimum Limits of Insurance

1. General Liability

Contractor

$2,000,000	combined single limit per occurrence for bodily injury, personal injury, and property damage
$2,000,000	annual aggregate

2. Automobile Liability

$2,000,000	combined single limit per occurrence for bodily injury and property damage

3. Workers' Compensation and Employers Liability

Workers' Compensation limits as required by applicable State Statutes (generally unlimited) and minimum of $1,000,000 limit per accident for Employer's Liability.

General Liability and Automobile Liability insurance may be arranged under individual policies for the full limits required or by a combination of underlying policies with the balance provided by a form-following Excess or Umbrella Liability policy.

D. Deductibles and Self-Insured Retentions

All deductibles, co-payment clauses, and self-insured retentions must be declared to and approved by the Owner. The Owner reserves the right to request the reduction or elimination of unacceptable deductibles or self-insured retentions, as they would apply to the Owner, and their respective officers, officials, agents, consultants and employees. Alternatively, the Owner may request Contractor to procure a bond guaranteeing payment of losses and related investigations, claims administration, and defense expenses.

E. Other Insurance Provisions and Requirements

The respective insurance policies and coverage, as specified below, must contain, or be endorsed to contain the following conditions or provisions:

1. General Liability

The Owner, and its respective commissioners, officers, officials, agents, consultants and employees shall be endorsed as additional insured's by ISO form CG 20 26 Additional Insured - Designated Person or Organization. As additional insured's, they shall be covered as to work performed by or on behalf of the Contractor or as to liability which arises out of Contractor's activities or resulting from the performance of services or the delivery of goods called for by the Contract.

Contractor's insurance coverage shall be primary with respect to all additional insured's. Insurance of self-insurance programs maintained by the designated additional -insured's shall be excess of the Contractor's insurance and shall not contribute with it.

Additionally, the Contractor and Contractor's general liability insurer shall agree to waive all rights of subrogation against the Owner and any of their respective officers, officials, agents, consultants or employees for claims, losses, or expenses which arise out of Contractor's activities or result from the performance of services or the delivery of goods called for by the Contract.

Contractor's failure to comply with the terms and conditions of these insurance policies shall not affect or abridge coverage for the Owner, or for any of their officers, officials, agents, consultants or employees.

2. Automobile Insurance

The Owner, and their respective officers, officials, agents, consultants and employees shall be endorsed as additional insured's by ISO form CG 20 26 - Additional Insured Designated Person or Organization. As additional insured's, they shall be covered as to work performed by or on behalf of the Contractor or as to liability which arises out of Contractor's activities or resulting from the

performance of services or the delivery of goods called for by the Contract.

Contractor's insurance coverage shall be primary with respect to all additional insured's. Insurance or self-insurance programs maintained by the designated additional insured's shall be in excess of the Contractor's insurance and shall not contribute with it.

Additionally, the Contractor and Contractor's automobile insurer shall agree to waive all rights of subrogation against the Owner and any of their respective officers, officials, agents, consultants or employees for claims, losses, or expenses which arise out of Contractor's activities or result from the performance of services or the delivery of goods called for by the Contract.

Contractor's failure to comply with the terms and conditions of these insurance policies shall not affect or abridge coverage for the Owner or for any of its officers, officials, agents, consultants or employees.

3. Workers' Compensation/Employer's Liability

Contractor's workers' compensation insurance shall be endorsed with NCCI form WC 00 03 01 A - Alternative Employer Endorsement. The Alternative Employer Endorsement shall designate the Owner as "alternate employers."

4. All Coverages

Each insurance policy required by this section of the Contract shall contain a stipulation, endorsed if necessary, that the Owner will receive a minimum of a thirty (30) calendar day advance notice of any policy cancellation. Ten (10) calendar days advance notice is required for policy cancellation due to non-payment of premium.

F. Insurer Qualifications and Acceptability

Insurance required hereunder shall be issued by an A.M. Best, "B+" rated, Class IX insurance company approved to conduct insurance business in the state of Missouri.

G. Verification of Insurance Coverage

Prior to Owner issuing a Notice to Proceed, the Contractor-shall furnish the Owner with Certificate(s) of Insurance and with any applicable original endorsements evidencing the required insurance coverage. The insurance certificates and endorsements are to be signed by a person authorized by that insurer to bind coverage on its behalf. All certificates and endorsements received by the Owner are subject to review and approval by the Owner. The Owner reserves the right to require certified copies of all required policies at any time. If the scope of this contract will exceed one (1) year - or, if any of Contractor's applicable insurance coverage expires prior to completion of the work or services required under this contract - the Contractor will provide a renewal or replacement certificate before continuing work or services hereunder. If the Contractor fails to provide documentation of required insurance coverage, the Owner may issue a stop work order and no additional contract completion time and/or compensation shall be granted as a result thereof.

ARTICLE 7 – SUSPENSION OR TERMINATION OF CONTRACT

ARTICLE 7.1 - FOR SITE CONDITIONS

When conditions at the site of the proposed work are considered by the Owner to be unsatisfactory for prosecution of the work, the Contractor may be ordered in writing to suspend the work or any part thereof until reasonable conditions exist. When such suspension is not due to fault or negligence of the Contractor, time allowed for completion of such suspended work will be extended by a period of time equal to that lost due to delay occasioned by ordered suspension. This will be a no cost time extension.

ARTICLE 7.2 - FOR CAUSE

A. Termination or Suspension for Cause:

1. If the Contractor shall file for bankruptcy, or should make a general assignment for the benefit of the creditors, or if a receiver should be appointed on account of insolvency, or if the contractor should persistently or repeatedly refuse or fail to supply enough properly skilled workers or proper materials, or if the contractor should fail to make prompt payment to subcontractors or for material or labor, or persistently disregard laws, ordinances or the instructions of the Owner, or otherwise be guilty of a substantial violation of any provision of this contract, then the Owner may serve notice on the Contractor and the surety setting forth the violations and demanding compliance with this contract. Unless within ten (10) consecutive calendar days after serving such notice, such violations shall cease and satisfactory arrangements for correction be made, the Owner may suspend the Contractor's right to proceed with the work or terminate this contract.

2. In the event the Owner suspends Contractor's right to proceed with the work or terminates the contract, the Owner may demand that the Contractor's surety take over and complete the work on this contract, after the surety submits a written proposal to the Owner and receives written approval and upon the surety's failure or refusal to do so within ten (10) consecutive calendar days after demand therefore, the Owner may take over the work and prosecute the same to completion by bid or negotiated contract, or the Owner may elect to take possession of and utilize in completing the work such materials, supplies, appliances and plant as may be on the site of the work, and all subcontractors, if the Owner elects, shall be bound to perform their contracts.

B. The Contractor and its surety shall be and remain liable to the Owner for any excess cost or damages occasioned to the Owner as a result of the actions above set forth.

C. The Contractor in the event of such suspension or termination shall not be entitled to receive any further payments under this contract until the work is wholly finished. Then if the unpaid balance under this contract shall exceed all expenses of the Owner as certified by the Director, such excess shall be paid to the Contractor; but, if such expenses shall exceed the unpaid balance as certified by the Director, the Contractor and their surety shall be liable for and shall pay the difference and any damages to the Owner.

D. In exercising Owner's right to secure completion of the work under any of the provisions hereof, the Director shall have the right to exercise Owner's sole discretion as to the manner, methods and reasonableness of costs of completing the work.

E. The rights of the Owner to suspend or terminate as herein provided shall be cumulative and not exclusive and shall be in addition to any other remedy provided by law.

F. The Contractor in the event of such suspension or termination may be declared ineligible for Owner contracts for a minimal period of twelve (12) months. Further, no contract will be awarded to any Contractor who lists in their bid form any subcontractor whose prior performance has contributed, as determined by the Owner, to a breach of a contract. In order to be considered for state-awarded contracts after this period, the Contractor/subcontractor will be required to forward acceptance reports to the Owner regarding successful completion of non-state projects during the intervening twelve (12) months from the date of default. No contracts will be awarded to a subcontractor/Contractor until the ability to perform responsibly in the private sector has been proven to the Owner.

ARTICLE 7.3 -- FOR CONVENIENCE

A. The Owner may terminate or suspend the Contract or any portion of the Work without cause at any time, and at the Owner's convenience. Notification of a termination or suspension shall be in writing and shall be given to the Contractor and their surety. If the Contract is suspended, the notice will contain the anticipated duration of the suspension or the conditions under which work will be permitted to resume. If appropriate, the Contractor will be requested to demobilize and re-mobilize and will be reimbursed time and costs associated with the suspension.

B. Upon receipt of notification, the Contractor shall:

1. Cease operations when directed.

2. Take actions to protect the work and any stored materials.

3. Place no further subcontracts or orders for material, supplies, services or facilities except as may be necessary to complete the portion of the Contract that has not been terminated. No claim for payment of materials or supplies ordered after the termination date shall be considered.

4. Terminate all existing subcontracts, rentals, material, and equipment orders.

5. Settle all outstanding liabilities arising from termination with subcontractors and suppliers.

6. Transfer title and deliver to the Owner, work in progress, completed work, supplies and other material produced or acquire for the work terminated, and completed or partially completed plans, drawings information and other property that, if the Contract had been completed, would be required to be furnished to the Owner.

C. For termination without cause and at the Owner's convenience, in addition to payment for work completed prior to date of termination, the Contractor may be entitled to payment of other documented costs directly associated with the early termination of the contract. Payment for anticipated profit and unapplied overhead will not be allowed.

SECTION 007300 - SUPPLEMENTARY CONDITIONS

1.0 GENERAL:

A. These Supplementary General Conditions clarify, add, delete, or otherwise modify standard terms and conditions of DIVISION 0, BIDDING AND CONTRACTING REQUIREMENTS.

2.0 CONTACTS:

Designer:

Brad Pierce
Introba Inc.
6 South Old Orchard
St. Louis, MO 63119
Telephone: (314) 391-2188
Email: Brad.Pierce@introba.com

Construction Representative:

Bob Rehagen
Division of Facilities Management, Design and Construction
201 West Capitol Ave. Room B-2
Jefferson City, MO 65101
Telephone: (573) 616-6307
Email: Robert.Rehagen@oa.mo.gov

Project Manager:

Ryan Abbott
Division of Facilities Management, Design and Construction
301 West High Street, Room 730
Jefferson City, MO 65101
Telephone: (573) 298-1967
Email: Ryan.Abbott@oa.mo.gov

Contract Specialist:

Mandy Roberson
Division of Facilities Management, Design and Construction
301 West High Street, Room 730
Jefferson City, Missouri 65101
Telephone: 573-522-0074
Email: mandy.roberson@oa.mo.gov

3.0 NOTICE: ALL BID MATERIALS ARE DUE AT THE TIME OF BID SUBMITTAL. THERE IS NO SECOND SUBMITTAL FOR THIS PROJECT.

4.0 FURNISHING CONSTRUCTION DOCUMENTS:

A. The Owner will furnish the Contractor with approximately 3 complete sets of drawings and specifications at no charge.

B. The Owner will furnish the Contractor with approximately 3 sets of explanatory or change drawings at no charge.

C. The Contractor may make copies of the documents as needed with no additional cost to the Owner.

5.0 SAFETY REQUIREMENTS

Contractor and subcontractors at any tier shall comply with RSMo 292.675 and Article 1.3, E, of Section 007213, General Conditions.

Missouri
Division of Labor Standards
WAGE AND HOUR SECTION

MICHAEL L. PARSON, Governor

Annual Wage Order No. 31

Section 026
COLE COUNTY

In accordance with Section 290.262 RSMo 2000, within thirty (30) days after a certified copy of this Annual Wage Order has been filed with the Secretary of State as indicated below, any person who may be affected by this Annual Wage Order may object by filing an objection in triplicate with the Labor and Industrial Relations Commission, P.O. Box 599, Jefferson City, MO 65102-0599. Such objections must set forth in writing the specific grounds of objection. Each objection shall certify that a copy has been furnished to the Division of Labor Standards, P.O. Box 449, Jefferson City, MO 65102-0449 pursuant to 8 CSR 20-5.010(1). A certified copy of the Annual Wage Order has been filed with the Secretary of State of Missouri.

Original Signed by
Todd Smith, Director
Division of Labor Standards

Filed With Secretary of State: **March 8, 2024**

Last Date Objections May Be Filed: **April 8, 2024**

Prepared by Missouri Department of Labor and Industrial Relations

OCCUPATIONAL TITLE	**Prevailing Hourly Rate
Asbestos Worker	$62.47
Boilermaker	$30.53*
Bricklayer-Stone Mason	$54.17
Carpenter	$50.84
Lather	
Linoleum Layer	
Millwright	
Pile Driver	
Cement Mason	$43.74
Plasterer	
Communication Technician	$57.89
Electrician (Inside Wireman)	$58.31
Electrician Outside Lineman	$30.53*
Lineman Operator	
Lineman - Tree Trimmer	
Groundman	
Groundman - Tree Trimmer	
Elevator Constructor	$30.53*
Glazier	$56.48
Ironworker	$68.93
Laborer	$43.22
General Laborer	
First Semi-Skilled	
Second Semi-Skilled	
Mason	$30.53*
Marble Mason	
Marble Finisher	
Terrazzo Worker	
Terrazzo Finisher	
Tile Setter	
Tile Finisher	
Operating Engineer	$67.64
Group I	
Group II	
Group III	
Group III-A	
Group IV	
Group V	
Painter	$42.11
Plumber	$70.54
Pipe Fitter	
Roofer	$54.75
Sheet Metal Worker	$57.54
Sprinkler Fitter	$52.79
Truck Driver	$30.53*
Truck Control Service Driver	
Group I	
Group II	
Group III	
Group IV	

*The Division of Labor Standards received fewer than 1,000 reportable hours for this occupational title. The public works contracting minimum wage is established for this occupational title using data provided by Missouri Economic Research and Information Center.
**The Prevailing Hourly Rate includes any applicable fringe benefit amounts for each occupational title as defined in RSMo Section 290.210.

OCCUPATIONAL TITLE	**Prevailing Hourly Rate
Carpenter	$55.19
Millwright	
Pile Driver	
Electrician (Outside Lineman)	$80.11
Lineman Operator	
Lineman - Tree Trimmer	
Groundman	
Groundman - Tree Trimmer	
Laborer	$48.42
General Laborer	
Skilled Laborer	
Operating Engineer	$63.82
Group I	
Group II	
Group III	
Group IV	
Truck Driver	$48.68
Truck Control Service Driver	
Group I	
Group II	
Group III	
Group IV	

Use Heavy Construction Rates on Highway and Heavy construction in accordance with the classifications of construction work established in 8 CSR 30-3.040(3).

Use Building Construction Rates on Building construction in accordance with the classifications of construction work established in 8 CSR 30-3.040(2).

If a worker is performing work on a heavy construction project within an occupational title that is not listed on the Heavy Construction Rate Sheet, use the rate for that occupational title as shown on the Building Construction Rate Sheet.

*The Division of Labor Standards received fewer than 1,000 reportable hours for this occupational title. Public works contracting minimum wage is established for this occupational title using data provided by Missouri Economic Research and Information Center.

**The Prevailing Hourly Rate includes any applicable fringe benefit amounts for each occupational title.

OVERTIME
and
HOLIDAYS

OVERTIME

For all work performed on a Sunday or a holiday, not less than twice (2x) the prevailing hourly rate of wages for work of a similar character in the locality in which the work is performed or the public works contracting minimum wage, whichever is applicable, shall be paid to all workers employed by or on behalf of any public body engaged in the construction of public works, exclusive of maintenance work.

For all overtime work performed, not less than one and one-half (1½) the prevailing hourly rate of wages for work of a similar character in the locality in which the work is performed or the public works contracting minimum wage, whichever is applicable, shall be paid to all workers employed by or on behalf of any public body engaged in the construction of public works, exclusive of maintenance work or contractual obligation. For purposes of this subdivision, **"overtime work"** shall include work that exceeds ten hours in one day and work in excess of forty hours in one calendar week; and

A thirty-minute lunch period on each calendar day shall be allowed for each worker on a public works project, provided that such time shall not be considered as time worked.

HOLIDAYS

January first;
The last Monday in May;
July fourth;
The first Monday in September;
November eleventh;
The fourth Thursday in November; and
December twenty-fifth;

If any holiday falls on a Sunday, the following Monday shall be considered a holiday.

SECTION 011000 – SUMMARY OF WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 WORK COVERED BY CONTRACT DOCUMENTS

A. The Project consists of replacing 13 elevators and 6 escalators at Harry S Truman State Office Building.

1. Project Location: 301 West High Street, Jefferson City, Missouri 65102.
2. Owner: State of Missouri, Office of Administration, Division of Facilities Management, Design and Construction, Harry S Truman State Office Building, Post Office Box 809, 301 West High Street, Jefferson City, Missouri 65102.

B. Contract Documents dated **July 12, 2024** were prepared for the Project by Introba Inc. 6 South Old Orchard, St. Louis, MO 63119.

C. The Work consists of replacing 13 elevators and 6 escalators and related work:

1. Replace 13 elevators and 6 escalators with new elevators and escalators.
2. New motorized dampers at the top of all elevator shafts and connections to existing fire detections system for code compliance.
3. Replacement of HVAC units for the elevator machine rooms, to include all controls, wiring and related building work.

D. The Work will be constructed under a single prime contract.

E. Elevator contractor shall be responsible for costs of all elevators until they are installed or stored onsite. Contractor to procure bonded and insured storage warehouse space to be verified by the state.

1.3 WORK SEQUENCE

A. Refer to specification 142100 Electric passenger Elevators, 142400 Hydraulic Passenger Elevators and 143100 Escalators for Construction Sequence and Scheduling.

B. Submit long-lead items in a timely manner.

1.4 CONTRACTOR USE OF PREMISES

A. General: During the construction period the Contractor shall have full use of the premises for construction operations, including use of the site. The Contractor’s use of the premises limited only by the Owner’s right to perform work or to retain other contractors on portions of the Project.

B. Use of the Site: Limit use of the premises to work in areas indicated. Confine operations to areas within contract limits indicated. Do not disturb portions of the site beyond the areas in which the Work is indicated.

1. Owner Occupancy: Allow for Owner occupancy and use by the public.
2. Driveways and Entrances: Keep driveways and entrances serving the premises clear and available to the Owner, the Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

C. Use of the Existing Building: Maintain the existing building in a weathertight condition throughout the construction period. Repair damage cause by construction operations. Take all precautions necessary to protect the building and its occupants during the construction period.

1.5 OCCUPANCY REQUIREMENTS

A. Full Owner Occupancy: The Owner will occupy the site and existing building during the entire construction period. Cooperate with the Owner during construction operations to minimize conflicts and facilitate owner usage. Perform the Work so as not to interfere with the Owner's operations.

B. Partial Owner Occupancy: The Owner reserves the right to occupy and to place and install equipment in completed areas of the building prior to Substantial Completion, provided such occupancy does not interfere with completion of the Work. Such placing of equipment and partial occupancy shall not constitute acceptance of the total Work.

1. The Designer will prepare a Certificate of Partial Occupancy for each specific portion of the Work to be occupied prior to substantial completion.
2. Prior to partial Owner occupancy, mechanical and electrical systems shall be fully operational. Required inspections and tests shall have been successfully completed. Upon occupancy, the Owner will operate and maintain mechanical and electrical systems serving occupied portions for the building.
3. Upon occupancy, the Owner will assume responsibility for maintenance and custodial service for occupied portions for the building.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION 011000

SECTION 012100 – ALLOWANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements governing allowances.

1. Certain items are specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when additional information is available for evaluation. If necessary, additional requirements will be issued by Change Order.

B. Types of allowances include the following:

1. Lump-sum allowances.
2. Weather allowances.

C. Related Sections include the following:

1. Division 01 Section "Contract Modification Procedures" for procedures for submitting and handling Change Orders for allowances.
2. Division 01 Section "Unit Prices" for procedures for using unit prices.

1.3 WEATHER ALLOWANCE

A. Included within the completion period for this project are a specified number of “bad weather” days (see Schedule of Allowances).

B. The Contractor’s progress schedule shall clearly indicate the bad weather day allowance as an “activity” or “activities”. In the event weather conditions preclude performance of critical work activities for 50% or more of the Contractor’s scheduled workday, that day shall be declared unavailable for work due to weather (a “bad weather” day) and charged against the above allowance. Critical work activities will be determined by review of the Contractor’s current progress schedule.

C. The Contractor’s Representative and the Construction Representative shall agree monthly on the number of “bad weather” days to be charged against the allowance. This determination will be documented in writing and be signed by the Contractor and the Construction Representatives. If there is a failure to agree on all or part of the “bad weather” days for a particular month, that disagreement shall be noted on this written document and signed by each party’s representative. Failure of the Contractor’s representative to sign the “bad weather” day documentation after it is presented, with or

without the notes of disagreement, shall constitute agreement with the “bad weather” day determination contained in that document.

D. There will be no modification to the time of contract performance due solely to the failure to deplete the “bad weather” day allowance.

E. Once this allowance is depleted, a no cost Change Order time extension will be executed for “bad weather” days, as defined above, encountered during the remainder of the Project.

1.4 SELECTION AND PURCHASE

A. At the earliest practical date after award of the Contract, Designer of the date when final selection and purchase of each product or system described by an allowance must be completed to avoid delaying the Work.

B. At Designer's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.

C. Purchase products and systems selected by Designer from the designated supplier.

1.5 SUBMITTALS

A. Submit proposals for purchase of products or systems included in allowances, in the form specified for Change Orders.

B. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.

C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.6 COORDINATION

A. Coordinate allowance items with other portions of the Work. Furnish templates as required to coordinate installation.

1.7 ALLOWANCES

A. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials under allowance shall be included as part of the Contract Sum and not part of the allowance.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.3 SCHEDULE OF ALLOWANCES

A. Weather Allowance: Included within the completion period for this Project 5 (five) “bad weather” days.

END OF SECTION 012100

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SECTION 012200 – UNIT PRICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Quantities of Units to be included in the Base Bid are indicated in Section 004322 – Unit Prices.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for Unit Prices.

B. Related Sections include the following:

1. Division 1 Section "Allowances" for procedures for using Unit Prices to adjust quantity allowances.
2. Division 1 Section "Contract Modification Procedures" for procedures for submitting and handling Change Orders.

1.3 DEFINITIONS

A. Unit Price is a price per unit of measurement for materials or services added to or deducted from the Contract Sum by appropriate modification, if estimated quantities of Work required by the Contract Documents are increased or decreased.

1.4 PROCEDURES

A. Unit Prices include all necessary material plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.

B. Measurement and Payment: Refer to individual Specification Sections for work that requires establishment of Unit Prices. Methods of measurement and payment for Unit Prices are specified in those Sections.

C. Owner reserves the right to reject Contractor's measurement of Work in-place that involves use of established Unit Prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.

D. List of Unit Prices: A list of Unit Prices is included in Part 3. Specification Sections referenced in the schedule contain requirements for materials described under each Unit Price.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 LIST OF UNIT PRICES

A. Unit Price No. 1 – Cylinder Well Hole

1. Description: Should the well hole collapse during extraction of the existing cylinder, or the hole not be of the proper size, depth or plumbness to install the replacement cylinder with PVC casing, or any other unknown conditions which would require setting up a drill rig and re-drilling the well hole, the contractor shall complete the drilling of the well hole, and installation of any additional steel casing as indicated:

   a. Drill required well hole; remove excess excavated material from the site and install a steel casing. Additionally case the cylinder in capped, water-tight, PVC pipe, at least 1" larger in diameter than cylinder. The area between the steel casing and the PVC inner casing shall be back filled with clean, washed sand. Construct a PVC flange to create a water-tight seal between the PVC casing and the cylinder flange in the hoistway pit. Provide a means of testing the bottom seal and a means of evacuating any material that may enter the containment. The access risers should be capped to prevent water from entering the cavity should flooding occur in the hoistway pit. Include drilling hole in dirt, sand, rock, gravel, loam, boulders, hardpan, water, or other obstacles. Include the removal of all dirt and debris from the project site.

2. Unit of Measurement: Per well-hole.

END OF SECTION 012200

SECTION 012600 – CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements for handling and processing Contract Modifications.

B. Related Sections include the following:

1. Division 1, Section 013115 “Project Management Communications” for administrative requirements for communications.
2. Division 0, Section 007213, Article 3.1 "Acceptable Substitutions" for administrative procedures for handling Requests for Substitutions made after Contract award.
3. Division 0, Section 007213, Article 4.0 "Changes in the Work" for Change Order requirements.

1.3 REQUESTS FOR INFORMATION

A. In the event that the Contractor or Subcontractor, at any tier, determines that some portion of the Drawings, Specifications, or other Contract Documents requires clarification or interpretation, the Contractor shall submit a “Request for Information” (RFI) in writing to the Designer. A RFI may only be submitted by the Contractor and shall only be submitted on the RFI forms provided by the Owner. The Contractor shall clearly and concisely set forth the issue for which clarification or interpretation is sought and why a response is needed. In the RFI, the Contractor shall set forth an interpretation or understanding of the requirement along with reasons why such an understanding was reached.

B. Responses to RFI shall be issued within ten (10) working days of receipt of the Request from the Contractor unless the Designer determines that a longer time is necessary to provide an adequate response. If a longer time is determined necessary by the Designer, the Designer will, within five (5) working days of receipt of the request, notify the Contractor of the anticipated response time. If the Contactor submits a RFI on a time sensitive activity on the current project schedule, the Contractor shall not be entitled to any time extension due to the time it takes the Designer to respond to the request provided that the Designer responds within the ten (10) working days set forth above.

C. Responses from the Designer will not change any requirement of the Contract Documents. In the event the Contractor believes that a response to a RFI will cause a change to the requirements of the Contract Document, the Contractor shall give written notice to the Designer requesting a Change Order for the work. Failure to give such

written notice within ten (10) working days, shall waive the Contractor's right to seek additional time or cost under Article 4, "Changes in the Work" of the General Conditions.

1.4 MINOR CHANGES IN THE WORK

A. Designer will issue supplemental instructions authorizing Minor Changes in the Work, not involving adjustment to the Contract Amount or the Contract Time, on "Designer's Supplemental Instructions" (DSI).

1.5 PROPOSAL REQUESTS

A. The Designer or Owner Representative will issue a detailed description of proposed Changes in the Work that may require adjustment to the Contract Amount or the Contract Time. The proposed Change Description will be issued using the "Request for Proposal" (RFP) form. If necessary, the description will include supplemental or revised Drawings and Specifications.

1. Proposal Requests issued by the Designer or Owner Representative are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.

2. Within ten (10) working days after receipt of Proposal Request, submit a proposal for the cost adjustments to the Contract Amount and the Contract Time necessary to execute the Change. The Contractor shall submit his proposal on the appropriate Change Order Detailed Breakdown form. Subcontractors may use the appropriate Change Order Detailed Breakdown form or submit their proposal on their letterhead provided the same level of detail is included. All proposals shall include:

a. A detailed breakdown of costs per Article 4.1 of the General Conditions.

b. If requesting additional time per Article 4.2 of the General Conditions, include an updated Contractor's Construction Schedule that indicates the effect of the Change including, but not limited to, changes in activity duration, start and finish times, and activity relationship.

1.6 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Proposal Request, the Designer or Owner Representative will issue a Change Order for signatures of Owner and Contractor on the "Change Order" form.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION 012600

SECTION 013100 – COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative provisions for coordinating construction operations on Projects including, but not limited to, the following:

1. Coordination Drawings.
2. Administrative and supervisory personnel.
3. Project meetings.

B. Each Contractor shall participate in coordination requirements. Certain areas of responsibility will be assigned to a specific Contractor.

C. Related Sections include the following:

1. Division 1, Section 013200 "Schedules" for preparing and submitting Contractor's Construction Schedule.
2. Articles 1.8.B and 1.8.C of Section 007213 "General Conditions" for coordinating meetings onsite.
3. Article 5.4.H of Section 007213 "General Conditions" for coordinating Closeout of the Contract.

1.3 COORDINATION

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections, which depend on each other for proper installation, connection, and operation.

B. Coordination: Each Contractor shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each Contractor shall coordinate its operations with operations included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components with other Contractors to ensure maximum accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components including mechanical and electrical.

C. Prepare memoranda for distribution to each party involved outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Owner and separate Contractors if coordination of their Work is required.

D. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other Contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's Construction Schedule.
2. Preparation of the Schedule of Values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Startup and adjustment of systems.
8. Project Closeout activities.

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

1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. Refer to other Sections for disposition of salvaged materials that are designated as Owner's property.

1.4 SUBMITTALS

A. Coordination Drawings: Prepare Coordination Drawings if limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities.

B. Key Personnel Names: Within fifteen (15) work days of starting construction operations, submit a list of key personnel assignments including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers including home and office telephone numbers. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.

1. Post copies of list in Project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.5 PROJECT MEETINGS

A. The Owner's Construction Representative will schedule a Pre-Construction Meeting prior to beginning of construction. The date, time, and exact place of this meeting will be determined after Contract Award and notification of all interested parties. The Contractor shall arrange to have the Job Superintendent and all prime Subcontractors present at the meeting. During the Pre-Construction Meeting, the construction procedures and information necessary for submitting payment requests will be discussed and materials distributed along with any other pertinent information.

1. Minutes: Designer will record and distribute meeting minutes.

B. Progress Meetings: The Owner's Construction Representative will conduct Monthly Progress Meetings as stated in Articles 1.8.B and 1.8.C of Section 007213 "General Conditions".

1. Minutes: Designer will record and distribute to Contractor the meeting minutes.

C. Preinstallation Conferences: Contractor shall conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.

1. Attendees: Installer and representatives of Manufacturers and Fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Designer and Construction Representative of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration including requirements for the following:

a. Contract Documents
b. Options
c. Related RFIs
d. Related Change Orders
e. Purchases
f. Deliveries
g. Submittals
h. Review of mockups
i. Possible conflicts
j. Compatibility problems
k. Time schedules
l. Weather limitations
m. Manufacturer's written recommendations
n. Warranty requirements
o. Compatibility of materials
p. Acceptability of substrates
q. Temporary facilities and controls
r. Space and access limitations
s. Regulations of authorities having jurisdiction

t. Testing and inspecting requirements.
u. Installation procedures
v. Coordination with other Work
w. Required performance results.
x. Protection of adjacent Work
y. Protection of construction and personnel

3. Contractor shall record significant conference discussions, agreements, and disagreements including required corrective measures and actions.
4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.
5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
6. Revise paragraph below if Project requires holding progress meetings at different intervals. Insert special intervals such as "every third Tuesday" to suit special circumstances.
7. Project name
8. Name and address of Contractor
9. Name and address of Designer
10. RFI number including RFIs that were dropped and not submitted.
11. RFI description
12. Date the RFI was submitted.
13. Date Designer's response was received.
14. Identification of related DSI or Proposal Request, as appropriate

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION 013100

SECTION 013115 - PROJECT MANAGEMENT COMMUNICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Division 01, Section 013300 - Submittals

C. Division 01, Section 012600 – Contract Modification Procedures

1.2 SUMMARY

A. Project Management Communications: The Contractor shall use the Internet web based project management communications tool, E-Builder® ASP software, and protocols included in that software during this project. The use of project management communications as herein described does not replace or change any contractual responsibilities of the participants.

1. Project management communications is available through E-Builder® as provided by "e-Builder®" in the form and manner required by the Owner.
2. The project communications database is on-line and fully functional. User registration, electronic and computer equipment, and Internet connections are the responsibility of each project participant. The sharing of user accounts is prohibited.

B. Support: E-Builder® will provide on-going support through on-line help files.

C. Copyrights and Ownership: Nothing in this specification or the subsequent communications supersedes the parties' obligations and rights for copyright or document ownership as established by the Contract Documents. The use of CAD files, processes or design information distributed in this system is intended only for the project specified herein.

D. Purpose: The intent of using E-Builder® is to improve project work efforts by promoting timely initial communications and responses. Secondly, to reduce the number of paper documents while providing improved record keeping by creation of electronic document files

E. Authorized Users: Access to the web site will be by individuals who are authorized users.

1. Individuals shall complete the E-Builder New Company/User Request Form located at the following web site: https://oa.mo.gov/facilities/vendor-links/contractor-forms. Completed forms shall be emailed to the following email address: OA.FMDCE-BuilderSupport@oa.mo.gov.
2. Authorized users will be contacted directly and assigned a temporary user password.
3. Individuals shall be responsible for the proper use of their passwords and access to data as agents of the company in which they are employed.

F. Administrative Users: Administrative users have access and control of user licenses and all posted items. DO NOT POST PRIVATE OR YOUR COMPANY CONFIDENTIAL ITEMS IN THE DATABASE! Improper or abusive language toward any party or repeated posting of items

intended to deceive or disrupt the work of the project will not be tolerated and will result in deletion of the offensive items and revocation of user license at the sole discretion of the Administrative User(s).

G. Communications: The use of fax, email and courier communication for this project is discouraged in favor of using E-Builder® to send messages. Communication functions are as follows:

1. Document Integrity and Revisions:

a. Documents, comments, drawings and other records posted to the system shall remain for the project record. The authorship time and date shall be recorded for each document submitted to the system. Submitting a new document or record with a unique ID, authorship, and time stamp shall be the method used to make modifications or corrections.
b. The system shall make it easy to identify revised or superseded documents and their predecessors.
c. Server or Client side software enhancements during the life of the project shall not alter or restrict the content of data published by the system. System upgrades shall not affect access to older documents or software.

2. Document Security:

a. The system shall provide a method for communication of documents. Documents shall allow security group assignment to respect the contractual parties communication except for Administrative Users. DO NOT POST PRIVATE OR YOUR COMPANY CONFIDENTIAL ITEMS IN THE DATABASE!

3. Document Integration:

a. Documents of various types shall be logically related to one another and discoverable. For example, requests for information, daily field reports, supplemental sketches and photographs shall be capable of reference as related records.

4. Reporting:

a. The system shall be capable of generating reports for work in progress, and logs for each document type. Summary reports generated by the system shall be available for team members.

5. Notifications and Distribution:

a. Document distribution to project members shall be accomplished both within the extranet system and via email as appropriate. Project document distribution to parties outside of the project communication system shall be accomplished by secure email of outgoing documents and attachments, readable by a standard email client.

6. Required Document Types:

a. RFI, Request for Information.
b. Submittals, including record numbering by drawing and specification section.
c. Transmittals, including record of documents and materials delivered in hard copy.
d. Meeting Minutes.
e. Application for Payments (Draft or Pencil).
f. Review Comments.
g. Field Reports.
h. Construction Photographs.
i. Drawings.
j. Supplemental Sketches.
k. Schedules.
l. Specifications.
m. Request for Proposals
n. Designer's Supplemental Instructions
o. Punch Lists

H. Record Keeping: Except for paper documents, which require original signatures and large format documents (greater than 8½ x 11 inches), all other 8½ x 11 inches documents shall be submitted by transmission in electronic form to the E-Builder® web site by licensed users.

1. The Owner and his representatives, the Designer and his consultants, and the Contractor and his Sub Contractors and suppliers at every tier shall respond to documents received in electronic form on the web site, and consider them as if received in paper document form.
2. The Owner and his representatives, the Designer and his consultants, and the Contractor and his Sub Contractors and suppliers at every tier reserves the right to and shall reply or respond by transmissions in electronic form on the web site to documents actually received in paper document form.
3. The Owner and his representatives, the Designer and his consultants, and the Contractor and his Sub Contractors and suppliers at every tier reserves the right to and shall copy any paper document into electronic form and make same available on the web site.

I. Minimum Equipment and Internet Connection: In addition to other requirements specified in this Section, the Owner and his representatives, the Construction Manager and his representatives, the Architect and his consultants, and the Contractor and his sub-contractors and suppliers at every tier required to have a user license(s) shall be responsible for the following:

1. Providing suitable computer systems for each licensed user at the users normal work location[1] with high-speed Internet access, i.e. DSL, local cable company's Internet connection, or T1 connection.
2. Each of the above referenced computer systems shall have the following minimum system[2] and software requirements:

a. Desktop configuration (Laptop configurations are similar and should be equal to or exceed desktop system.)

[1] The normal work location is the place where the user is assigned for more than one-half of his time working on this project.
[2] The minimum system herein will not be sufficient for many tasks and may not be able to process all documents and files stored in the E-Builder® Documents area.

1) Operating System: Windows XP or newer
2) Internet Browser: Internet Explorer 6.01SP2+ (Recommend IE7.0+)
3) Minimum Recommend Connection Speed: 256K or above.
4) Processor Speed: 1 Gigahertz and above
5) RAM: 512 mb
6) Operating system and software shall be properly licensed.
7) Internet Explorer version 7 (current version is a free distribution for download). This specification is not intended to restrict the host server or client computers provided that industry standard HTTP clients may access the published content.
8) Adobe Acrobat Reader (current version is a free distribution for download).
9) Users should have the standard Microsoft Office Suite (current version must be purchased) or the equivalent.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE.)

END OF SECTION 013115

SECTION 013200 – SCHEDULE – BAR CHART

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes requirements for a Bar Chart Schedule for the project construction activities, schedule of submittals, and schedule for testing.

PART 2 - PRODUCTS – (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 SUBMITTAL PROCEDURES

A. The Contractor shall submit to the Designer, within ten (10) working days following the Notice to Proceed, a Progress Schedule including Schedule of Values showing the rate of progress the Contractor agrees to maintain and the order in which he proposed to carry out the various phases of Work. No payments shall be made to the Contractor until the Progress Schedule has been approved by the Owner.

1. The Schedule of Values must have the following line items included with the value of the item as indicated below:

a. O&M's (Owner's Manual)

1) $1,000,000.00 (One million) and under – 2% of the total contract amount
2) Over $1,000,000.00 (One million) – 1% of the total contract amount

b. Close Out Documents

1) $1,000,000.00 (One million) and under – 2% of the total contract amount
2) Over $1,000,000.00 (One million) – 1% of the total contract amount

c. General Conditions

1) No more than 10%

B. The Contractor shall submit an updated Schedule for presentation at each Monthly Progress Meeting. The Schedule shall be updated by the Contractor as necessary to reflect the current Schedule and its relationship to the original Schedule. The updated

Schedule shall reflect any changes in the logic, sequence, durations, or completion date. Payments to the Contractor shall be suspended if the Progress Schedule is not adequately updated to reflect actual conditions.

C. The Contractor shall submit Progress Schedules to Subcontractors to permit coordinating their Progress Schedules to the general construction Work. The Contractor shall coordinate preparation and processing of Schedules and reports with performance of other construction activities.

3.2 CONSTRUCTION PROGRESS SCHEDULE – BAR CHART SCHEDULE

A. Bar-Chart Schedule: The Contractor shall prepare a comprehensive, fully developed, horizontal bar chart-type Contractor's Construction Schedule. The Contractor for general construction shall prepare the Construction Schedule for the entire Project. The Schedule shall show the percentage of work to be completed at any time, anticipated monthly payments by Owner, as well as significant dates (such as completion of excavation, concrete foundation work, underground lines, superstructure, rough-ins, enclosure, hanging of fixtures, etc.) which shall serve as check points to determine compliance with the approved Schedule. The Schedule shall also include an activity for the number of "bad" weather days specified in Section 012100 – Allowances.

1. The Contractor shall provide a separate time bar for each significant construction activity. Provide a continuous vertical line to identify the first working day of each week.

    a. If practical, use the same Schedule of Values breakdown for schedule time bars.

2. The Contractor shall provide a base activity time bar showing duration for each construction activity. Each bar is to indicate start and completion dates for the activity. The Contractor is to place a contrasting bar below each original schedule activity time for indicating actual progress and planned remaining duration for the activity.
3. The Contractor shall prepare the Schedule on a minimal number of separate sheets to readily show the data for the entire construction period.
4. Secure time commitments for performing critical elements of the Work from parties involved. Coordinate each element on schedule with other construction activities. Include minor elements involved in the overall sequence of the Work. Show each activity in proper sequence. Indicate graphically the sequences necessary for completion of related portions of the Work.
5. Coordinate the Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, Submittal Schedule, progress reports, payment requests, and other required schedules and reports.
6. Indicate the Intent to Award and the Contract Substantial Completion dates on the schedule.

B. Phasing: Provide notations on the schedule to show how the sequence of the Work is affected by the following:

1. Requirement for Phased completion

2. Work by separate Contractors
3. Work by the Owner
4. Pre-purchased materials
5. Coordination with existing construction
6. Limitations of continued occupancies
7. Un-interruptible services
8. Partial Occupancy prior to Substantial Completion
9. Site restrictions
10. Provisions for future construction
11. Seasonal variations
12. Environmental control

C. Work Stages: Use crosshatched bars to indicate important stages of construction for each major portion of the Work. Such stages include, but are not necessarily limited to, the following:

1. Subcontract awards
2. Submittals
3. Purchases
4. Mockups
5. Fabrication
6. Sample testing
7. Deliveries
8. Installation
9. Testing
10. Adjusting
11. Curing
12. Startup and placement into final use and operation

D. Area Separations: Provide a separate time bar to identify each major area of construction for each major portion of the Work. For the purposes of this Article, a “major area” is a story of construction, a separate building, or a similar significant construction element.

1. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:

a. Structural completion.
b. Permanent space enclosure
c. Completion of mechanical installation
d. Completion of the electrical portion of the Work
e. Substantial Completion

3.3 SCHEDULE OF SUBMITTALS

A. Upon acceptance of the Construction Progress Schedule, prepare and submit a complete schedule of submittals. Coordinate the submittal schedule with Section 013300 SUBMITTALS, the approved Construction Progress Schedule, list of subcontracts, Schedule of Values and the list of products.

B. Prepare the schedule in chronological order. Provide the following information.

1. Scheduled date for the first submittal
2. Related Section number
3. Submittal category
4. Name of the Subcontractor
5. Description of the part of the Work covered.
6. Scheduled date for resubmittal
7. Scheduled date for the Designer's final release or approval

C. Distribution: Following the Designer's response to the initial submittal schedule, print and distribute copies to the Designer, Owner, subcontractors, and other parties required to comply with submittal dates indicated.

1. Post copies in the Project meeting room and temporary field office.
2. When revisions are made, distribute to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned part of the Work and are no longer involved in construction activities.

D. Schedule Updating: Revise the schedule after each meeting or other activity where revisions have been recognized or made. Issue the updated schedule concurrently with the report of each meeting.

3.4 SCHEDULE OF INSPECTIONS AND TESTS

A. Prepare a schedule of inspections, tests, and similar services required by the Contract Documents. Submit the schedule with (15) days of the date established for commencement of the Contract Work. The Contractor is to notify the testing agency at least (5) working days in advance of the required tests unless otherwise specified.

B. Form: This schedule shall be in tabular form and shall include, but not be limited to, the following:

1. Specification Section number
2. Description of the test
3. Identification of applicable standards
4. Identification of test methods
5. Number of tests required.
6. Time schedule or time span for tests
7. Entity responsible for performing tests.
8. Requirements for taking samples.
9. Unique characteristics of each service

C. Distribution: Distribute the schedule to the Owner, Architect, and each party involved in performance of portions of the Work where inspections and tests are required.

END OF SECTION 013200

SECTION 013300 – SUBMITTALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Division 01, Section 013115 "Project Management Communications" for administrative requirements for communications.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for submittals required for performance of the Work including the following:

1. Shop Drawings
2. Product Data
3. Samples
4. Quality Assurance Submittals
5. Construction Photographs
6. Operating and Maintenance Manuals
7. Warranties

B. Administrative Submittals: Refer to General and Supplementary Conditions other applicable Division 1 Sections and other Contract Documents for requirements for administrative submittals. Such submittals include, but are not limited to, the following:

1. Construction Progress Schedule including Schedule of Values
2. Performance and Payment Bonds
3. Insurance Certificates
4. Applications for Payment
5. Certified Payroll Reports
6. Partial and Final Receipt of Payment and Release Forms
7. Affidavit – Compliance with Prevailing Wage Law
8. Record Drawings
9. Notifications, Permits, etc.

C. The Contractor is obliged and responsible to check all shop drawings and schedules to assure compliance with contract plans and specifications. The Contractor is responsible for the content of the shop drawings and coordination with other contract work. Shop drawings and schedules shall indicate, in detail, all parts of an Item or Work including erection and setting instructions and integration with the Work of other trades.

D. The Contractor shall at all times make a copy, of all approved submittals, available on site to the Construction Representative.

1.3 SUBMITTAL PROCEDURES

A. The Contractor shall comply with the General and Supplementary Conditions and other applicable sections of the Contract Documents. The Contractor shall submit, with such promptness as to cause no delay in his work or in that of any other contractors, all required submittals indicated in Part 3.1 of this section and elsewhere in the Contract Documents. Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Coordinate transmittal of different types of submittals for related elements of the Work so processing will not be delayed by the need to review submittals concurrently for coordination.

    a. The Designer reserves the right to withhold action on a submittal requiring coordination with other submittals until all related submittals are received.

B. Each drawing and/or series of drawings submitted must be accompanied by a letter of transmittal giving a list of the titles and numbers of the drawings. Each series shall be numbered consecutively for ready reference and each drawing shall be marked with the following information:

1. Date of Submission
2. Name of Project
3. Location
4. Section Number of Specification
5. State Project Number
6. Name of Submitting Contractor
7. Name of Subcontractor
8. Indicate if Item is submitted as specified or as a substitution.

1.4 SHOP DRAWINGS

A. Comply with the General Conditions, Article 3.2.

B. The Contractor shall submit newly prepared information drawn accurately to scale. Highlight, encircle, or otherwise indicate deviations from the Contract Documents. Do not reproduce Contract Documents or copy standard information as the basis of Shop Drawings. Standard information prepared without specific reference to the Project is not a Shop Drawing.

C. Shop Drawings include fabrication and installation drawings, setting diagrams, schedules, patterns, templates, and similar drawings including the following information:

1. Dimensions
2. Identification of products and materials included by sheet and detail number.
3. Compliance with specified standards

4. Notation of coordination requirements
5. Notation of dimensions established by field measurement.
6. Sheet Size: Except for templates, patterns and similar full-size Drawings, submit Shop Drawings on sheets at least 8½”x11” but no larger than 36”x48”.

1.5 PRODUCT DATA

A. The Contractor shall comply with the General Conditions, Article 3.2.

B. The Contractor shall collect Product Data into a single submittal for each element of construction or system. Product Data includes printed information, such as manufacturer’s installation instructions, catalog cuts, standard color charts, roughing-in diagrams and templates, standard wiring diagrams, and performance curves.

1. Mark each copy to show applicable choices and options. Where printed Product Data includes information on several products that are not required, mark copies to indicate the applicable information including the following information:

   a. Manufacturer’s printed recommendations
   b. Compliance with Trade Association standards
   c. Compliance with recognized Testing Agency standards
   d. Application of Testing Agency labels and seals
   e. Notation of dimensions verified by field measurement.
   f. Notation of coordination requirements

2. Do not submit Product Data until compliance with requirements of the Contract Documents has been confirmed.

1.6 SAMPLES

A. The Contractor shall comply with the General Conditions, Article 3.2.

B. The Contractor shall submit full-size, fully fabricated samples, cured and finished as specified, and physically identical with the material or product proposed. Samples include partial sections of manufactured or fabricated components, cuts or containers of materials, color range sets, and swatches showing color, texture, and pattern.

1. The Contractor shall mount or display samples in the manner to facilitate review of qualities indicated. Prepare samples to match the Designer’s sample including the following:

   a. Specification Section number and reference
   b. Generic description of the Sample
   c. Sample source
   d. Product name or name of the Manufacturer
   e. Compliance with recognized standards
   f. Availability and delivery time

2. The Contractor shall submit samples for review of size, kind, color, pattern, and texture. Submit samples for a final check of these characteristics with other

elements and a comparison of these characteristics between the final submittal and the actual component as delivered and installed.

a. Where variation in color, pattern, texture, or other characteristic is inherent in the material or product represented, submit at least three (3) multiple units that show approximate limits of the variations.
b. Refer to other Specification Sections for requirements for samples that illustrate workmanship, fabrication techniques, details of assembly, connections, operation, and similar construction characteristics.
c. Refer to other Sections for samples to be returned to the Contractor for incorporation in the Work. Such samples must be undamaged at time of use. On the transmittal, indicate special requests regarding disposition of sample submittals.
d. Samples not incorporated into the Work, or otherwise designated as the Owner's property, are the property of the Contractor and shall be removed from the site prior to Substantial Completion.

3. Field samples are full-size examples erected onsite to illustrate finishes, coatings, or finish materials and to establish the Project standard.

a. The Contractor shall comply with submittal requirements to the fullest extent possible. The Contractor shall process transmittal forms to provide a record of activity.

1.7 QUALITY ASSURANCE DOCUMENTS

A. The Contractor shall comply with the General Conditions, Article 3.2

B. The Contractor shall submit quality control submittals including design data, certifications, manufacturer's instructions, manufacturer's field reports, and other quality-control submittals as required under other Sections of the Specifications.

C. Certifications: Where other Sections of the Specifications require certification that a product, material, or installation complies with specified requirements, submit a notarized certification from the Manufacturer certifying compliance with specified requirements.

1. Signature: Certification shall be signed by an officer of the Manufacturer or other individual authorized to contractually bind the Company.

D. Inspection and Test Reports: The Contractor shall submit the required inspection and test reports from independent testing agencies as specified in this Section and in other Sections of the Contract Documents.

E. Construction Photographs: The Contractor shall submit record construction photographs as specified in this Section and in other Sections of the Contract Documents.

1. The Contractor shall submit digital photographs. The Construction Administrator shall determine the quantity and naming convention at the preconstruction meeting.

2. The Contractor shall identify each photograph with project name, location, number, date, time, and orientation.
3. The Contractor shall submit progress photographs monthly unless specified otherwise. Photographs shall be taken one (1) week prior to submitting.
4. The Contractor shall take four (4) site photographs from differing directions and a minimum of five (5) interior photographs indicating the relative progress of the Work.

1.8 OPERATING AND MAINTENANCE MANUALS AND WARRANTIES

A. The Contractor shall submit all required manufacturer's operating instructions, maintenance/service manuals, and warranties in accordance with the General Conditions, Article 3.5, and Supplementary Conditions along with this and other Sections of the Contract Documents.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 REQUIRED SUBMITTALS

A. Contractor shall submit the following information for materials and equipment to be provided under this contract.

SPEC SECTION	TITLE	CATEGORY
078400	Firestopping	Schedule of Values
078400	Firestopping	Product Data
078400	Firestopping	Certification
079200	Joint Sealants	Product Data
079200	Joint Sealants	Warranty
096813	Tile Carpeting	Product Data
096813	Tile Carpeting	Sample
096813	Tile Carpeting	Operation / Maintenance Manual
099123	Interior Painting	Sample
099123	Interior Painting	Product Data
102600	Wall and Door Protection	Product Data
102600	Wall and Door Protection	Shop Drawings
102600	Wall and Door Protection	Warranty
142100	Electric Passenger Elevators	Product Data
142100	Electric Passenger Elevators	Shop Drawings
142100	Electric Passenger Elevators	Sample
142100	Electric Passenger Elevators	Certification
142400	Hydraulic Passenger Elevator	Product Data
142400	Hydraulic Passenger Elevator	Shop Drawings
142400	Hydraulic Passenger Elevator	Sample
142400	Hydraulic Passenger Elevator	Certification
142700	Elevator Cab Interiors	Product Data
142700	Elevator Cab Interiors	Shop Drawings
142700	Elevator Cab Interiors	Sample
143100	Escalators	Product Data
143100	Escalators	Shop Drawings
143100	Escalators	Operation / Maintenance Manual
143100	Escalators	Certification
210500	Common Work Results for Fire Suppression	Product Data
210500	Common Work Results for Fire Suppression	Certification
211313	Wet-Pipe Sprinkler Systems	Shop Drawings
211313	Wet-Pipe Sprinkler Systems	Certification
211313	Wet-Pipe Sprinkler Systems	Operation / Maintenance Manual
220500	Basic Plumbing Materials and Methods	Product Data
220500	Basic Plumbing Materials and Methods	Shop Drawings
220500	Basic Plumbing Materials and Methods	Sample
220529	Hanger & Supports for Plumbing Piping & Equipment	Product Data
220529	Hanger & Supports for Plumbing Piping & Equipment	Shop Drawings
220529	Hanger & Supports for Plumbing Piping & Equipment	Certification
221316	Sanitary Waste and Vent Piping	Product Data
221319	Sanitary Waste Piping Specialties	Product Data
221319	Sanitary Waste Piping Specialties	Shop Drawings
221429	Sump Pumps	Product Data

230500	Basic Mechanical Materials and Methods	Product Data
230500	Basic Mechanical Materials and Methods	Shop Drawings
230500	Basic Mechanical Materials and Methods	Sample
230513	Motors	Product Data
230513	Motors	Shop Drawings
230513	Motors	Test Report
230513	Motors	Operation / Maintenance Manual
230529	Hangers and Supports	Product Data
230529	Hangers and Supports	Shop Drawings
230529	Hangers and Supports	Certification
230900	HVAC Instrumentation and Controls	Product Data
230900	HVAC Instrumentation and Controls	Certification
230900	HVAC Instrumentation and Controls	Sample
230900	HVAC Instrumentation and Controls	Operation / Maintenance Manual
232300	Refrigeration Piping	Product Data
232300	Refrigeration Piping	Shop Drawings
232300	Refrigeration Piping	Certification
232300	Refrigeration Piping	Test Report
232300	Refrigeration Piping	Operation / Maintenance Manual
233423	Fans and Ventiltors	Product Data
233423	Fans and Ventiltors	Shop Drawings
233423	Fans and Ventiltors	Test Report
233423	Fans and Ventiltors	Operation / Maintenance Manual
238126	Split-System Air-Conditioners	Product Data
238126	Split-System Air-Conditioners	Operation / Maintenance Manual
238126	Split-System Air-Conditioners	Warranty
260533	Raceways	Product Data
260573	Power System Studies	Certification
260573	Power System Studies	Test Report
262413	Switchboards	Product Data
262413	Switchboards	Shop Drawings
262413	Switchboards	Certification
262413	Switchboards	Test Report
262413	Switchboards	Operation / Maintenance Manual
262416	Panelboards	Product Data
262416	Panelboards	Shop Drawings
262416	Panelboards	Certification
262726	Wiring Devices	Product Data
262816	Enclosed Switches	Product Data
263600	Transfer Switches	Shop Drawings
263600	Transfer Switches	Certification
263600	Transfer Switches	Operation / Maintenance Manual
265100	Interior Lighting	Product Data
283111	Digital Addressable Fire Alarm System	Product Data
283111	Digital Addressable Fire Alarm System	Shop Drawings
283111	Digital Addressable Fire Alarm System	Test Report
283111	Digital Addressable Fire Alarm System	Operation / Maintenance Manual

END OF SECTION 013300

SECTION 013513.10 - SITE SECURITY AND HEALTH REQUIREMENTS (OA)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUBMITTALS

A. List of required submittals:

1. Materials Safety Data Sheets for all hazardous materials to be brought onsite.
2. Schedule of proposed shutdowns, if applicable.
3. A list of the names of all employees who will submit fingerprints for a background check, and the signed privacy documents identified below for each employee.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 ACCESS TO THE SITE

A. The Contractor shall arrange with Facility Representatives to establish procedures for the controlled entry of workers and materials into the work areas at the Facility.

B. The Contractor shall establish regular working hours with Facility Representatives. The Contractor must report changes in working hours or overtime to Facility Representatives and obtain approval twenty-four (24) hours ahead of time. The Contractor shall report emergency overtime to Facility Representatives as soon as it is evident that overtime is needed. The Contractor must obtain approval from Facility Representatives for all work performed after dark.

C. The Contractor shall provide the name and phone number of the Contractor’s employee or agent who is in charge onsite; this individual must be able to be contacted in case of emergency. The Contractor must be able to furnish names and address of all employees upon request.

D. All construction personnel shall visibly display issued identification cards.

3.2 FIRE PROTECTION, SAFETY, AND HEALTH CONTROLS

A. The Contractor shall take all necessary precautions to guard against and eliminate possible fire hazards.

1. Onsite burning is prohibited.
2. The Contractor shall store all flammable or hazardous materials in proper containers located outside the buildings or offsite, if possible.
3. The Contractor shall provide and maintain, in good order, during construction fire

extinguishers as required by the National Fire Protection Association. In areas of flammable liquids, asphalt, or electrical hazards, 15-pound carbon dioxide or 20-pound dry chemical extinguishers shall be provided.

B. The Contractor shall not obstruct streets or walks without permission from the Owner's Construction Representative and Facility Representatives.

C. The Contractor's personnel shall not exceed the speed limit of 15 mph while at the Facility unless otherwise posted.

D. The Contractor shall take all necessary, reasonable measures to reduce air and water pollution by any material or equipment used during construction. The Contractor shall keep volatile wastes in covered containers, and shall not dispose of volatile wastes or oils in storm or sanitary drains.

E. The Contractor shall keep the project site neat, orderly, and in a safe condition at all times. The Contractor shall immediately remove all hazardous waste, and shall not allow rubbish to accumulate. The Contractor shall provide onsite containers for collection of rubbish and shall dispose of it at frequent intervals during the progress of the Work.

F. Fire exits, alarm systems, and sprinkler systems shall remain fully operational at all times, unless written approval is received from the Owner's Construction Representative and the appropriate Facility Representative at least twenty-four (24) hours in advance. The Contractor shall submit a written time schedule for any proposed shutdowns.

G. For all hazardous materials brought onsite, Material Safety Data Sheets shall be on site and readily available upon request at least a day before delivery.

H. Alcoholic beverages or illegal substances shall not be brought upon the Facility premises. The Contractor's workers shall not be under the influence of any intoxicating substances while on the Facility premises.

3.3 SECURITY CLEARANCES AND RESTRICTIONS

A. FMDC Contractor Background and Id Badge Process

1. All employees of an OA/FDMC contractor (or subcontractor performing work under an OA/FMDC contract) are required to submit a fingerprint check through the Missouri State Highway Patrol (MSHP) and the FBI enabling OA/FMDC to obtain state and national criminal background checks on the employees, unless stated otherwise in the Contractor's contract.
2. FMDC reserves the right to prohibit any employee of the Contractor from performing work in or on the premises of any facility owned, operated, or utilized by the State of Missouri for any reason.
3. The Contractor shall ensure all of its employees submit fingerprints to the Missouri State Highway Patrol and pay for the cost of such background checks. The Contractor shall submit to FMDC via email to FMDCSecurity@oa.mo.gov a list of the names of the Contractor's employees who will be fingerprinted and a signed OA/FMDC Authorization for Release of Information Confidentiality Oath for each employee. All employees of the Contractor approved by FMDC to work at a State facility must obtain a contractor ID

badge from FMDC prior to beginning work on-site, unless the Director of FMDC, at the Director's discretion, waives the requirement for a contractor ID badge. The Contractor and its employees must comply with the process for background checks and contractor ID badges found on FMDC's website at: https://oa.mo.gov/facilities/facilities-operations/security-information/fmdc-contractor-background-and-id-badge

4. Fingerprints and Authorization for Release of Information Confidentiality Oath form are valid for one (1) year and must be renewed annually. Changing or adding locations may result in additional required documentation. Certain employees may be required to be fingerprinted more frequently. OA/FMDC reserves the right to request additional background checks at any time for any reason.
5. The Contractor shall notify FMDC via email to FMDCSecurity@oa.mo.gov within 48 hours of anyone severing employment with their company.

3.4 DISRUPTION OF UTILITIES

A. The Contractor shall give a minimum of seventy-two (72) hours written notice to the Construction Representative and the Facility Representative before disconnecting electric, gas, water, fire protection, or sewer service to any building.

B. The Contractor shall give a minimum of seventy-two (72) hours written notice to the Construction Representative and Facility Representative before closing any access drives, and shall make temporary access available, if possible. The Contractor shall not obstruct streets, walks, or parking.

3.5 PROTECTION OF PERSONS AND PROPERTY

A. Safety Precautions and Programs

1. The Contractor shall at all times conduct operations under this Contract in a manner to avoid the risk of bodily harm to persons or risk of damage to any property. The Contractor shall promptly take precautions which are necessary and adequate against conditions created during the progress of the Contractor's activities hereunder which involve a risk of bodily harm to persons or a risk of damage to property. The Contractor shall continuously inspect Work, materials, and equipment to discover and determine any such conditions and shall be solely responsible for discovery, determination, and correction of any such conditions. The Contractor shall comply with applicable safety laws, standards, codes, and regulations in the jurisdiction where the Work is being performed, specifically, but without limiting the generality of the foregoing, with rules regulations, and standards adopted pursuant to the Williams-Steiger Occupational Safety and Health Act of 1970 and applicable amendments.
2. All contractors, subcontractors and workers on this project are subject to the Construction Safety Training provisions 292.675 RSMo.
3. In the event the Contractor encounters on the site, material reasonably believed to be asbestos, polychlorinated biphenyl (PCB), lead, mercury, or other material known to be hazardous, which has not been rendered harmless, the Contractor shall immediately stop Work in the area affected and report the condition to the Owner's Representative and the Architect in writing. The Work in the affected area shall not thereafter be resumed except by written agreement of the Owner's Representative and Contractor if in fact the material is asbestos or polychlorinated biphenyl (PCB) and has not been rendered harmless. The Work in the affected area shall be resumed in the absence of asbestos or polychlorinated

biphenyl (PCB), or when it has been rendered harmless by written agreement of the Owner's Representative and the Contractor. “Rendered Harmless” shall mean that levels of such materials are less than any applicable exposure standards, including but limited to OSHA regulations.

B. Safety Of Persons and Property

1. The Contractor shall take reasonable precautions for safety of, and shall provide protection to prevent damage, injury, or loss to:

   a. clients, staff, the public, construction personnel, and other persons who may be affected thereby;
   b. the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody, or control of the Contractor or the Contractor's Subcontractors of any tier; and
   c. other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction.

2. The Contractor shall give notices and comply with applicable laws, standards, codes, ordinances, rules, regulations, and lawful orders of public authorities bearing on safety of persons or property or their protection from damage, injury, or loss.
3. The Contractor shall erect and maintain, as required by existing conditions and performance of the Contract, safeguards for safety and protection, including, but not limited to, posting danger signs and other warnings against hazards, promulgating safety regulations, and notifying owners and users of adjacent sites and utilities.
4. When use or storage of explosives or other hazardous materials or equipment or unusual methods are necessary for execution of the Work, the Contractor shall exercise the highest degree of care and carry on such activities under supervision of properly qualified personnel.
5. The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in this Section caused in whole or in part by the Contractor, a Subcontractor of any tier, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable, and for which the Contractor is responsible under this Section, except damage or loss attributable solely to acts or omissions of Owner or the Architect or anyone directly or indirectly employed by either of them, or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor's other obligations stated elsewhere in the Contract.
6. The Contractor shall designate a responsible member of the Contractor's organization at the site whose duty shall be the prevention of accidents, and the maintaining, enforcing and supervising of safety precautions and programs. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner's Representative and Architect. The Contractor shall hold regularly scheduled safety meetings to instruct Contractor personnel on safety practices, accident avoidance and prevention, and the Project Safety Program. The Contractor shall furnish safety equipment and enforce the use of such equipment by its employees and its subcontractors of any tier.

7. The Contractor shall not load or permit any part of the construction or site to be loaded so as to endanger its safety.
8. The Contractor shall promptly report in writing to the Owner all accidents arising out of or in connection with the Work which cause death, lost time injury, personal injury, or property damage, giving full details and statements of any witnesses. In addition, if death, serious personal injuries, or serious property damages are caused, the accident shall be reported immediately.
9. The Contractor shall promptly notify in writing to the Owner of any claims for injury or damage to personal property related to the work, either by or against the Contractor.
10. The Owner assumes no responsibility or liability for the physical condition or safety of the Work site or any improvements located on the Work site. The Contractor shall be solely responsible for providing a safe place for the performance of the Work. The Owner shall not be required to make any adjustment in either the Contract Sum or Contract Time concerning any failure by the Contractor or any Subcontractor to comply with the requirements of this Paragraph.
11. In no event shall the Owner have control over, charge of, or any responsibility for construction means, methods, techniques, sequences or procedures or for safety precautions and programs in connection with the Work, notwithstanding any of the rights and authority granted the Owner in the Contract Documents.
12. The Contractor shall maintain at his own cost and expense, adequate, safe and sufficient walkways, platforms, scaffolds, ladders, hoists and all necessary, proper, and adequate equipment, apparatus, and appliances useful in carrying on the Work and which are necessary to make the place of Work safe and free from avoidable danger for clients, staff, the public and construction personnel, and as may be required by safety provisions of applicable laws, ordinances, rules regulations and building and construction codes.

END OF SECTION 013513.10

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SECTION 015000 – CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes requirements for construction facilities and temporary controls including temporary utilities, support facilities, security, and protection.

B. Temporary utilities include, but are not limited to, the following:

1. Water service and distribution
2. Temporary electric power and light
3. Temporary heat
4. Ventilation
5. Telephone service
6. Sanitary facilities, including drinking water
7. Storm and sanitary sewer

C. Support facilities include, but are not limited to, the following:

1. Field offices and storage areas
2. Temporary enclosures
3. Hoists and temporary elevator use
4. Temporary project identification signs and bulletin boards
5. Waste disposal services
6. Construction aids and miscellaneous services and facilities

D. Security and protection facilities include, but are not limited to, to following:

1. Temporary fire protection
2. Barricades, warning signs, and lights
3. Environmental protection

1.3 SUBMITTALS

A. Temporary Utilities: Submit reports of tests, inspections, meter readings, and similar procedures performed on temporary utilities.

B. Implementation and Termination Schedule: Within (15) days of the date established for commencement of the Work, submit a schedule indicating implementation and termination of each temporary utility.

1.4 QUALITY ASSURANCE

A. Regulations: Comply with industry standards and applicable laws and regulations including, but not limited to, the following:

1. Building code requirements
2. Health and safety regulations
3. Utility company regulations
4. Police, fire department, and rescue squad rules
5. Environmental protection regulations

B. Standards: Comply with NFPA 241 “Standard for Safeguarding Construction, Alterations, and Demolition Operations”. ANSI A10 Series standards for “Safety Requirements for Construction and Demolition”, and NECA Electrical Design Library “Temporary Electrical Facilities”.

1. Electrical Service: Comply with NEMA, NECA, and UL standards and regulations for temporary electric service. Install service in compliance with NFPA 70 “National Electric Code”.

C. Inspections: Arrange for authorities having jurisdiction to inspect and test each temporary utility before use. Obtain required certifications and permits.

1.5 PROJECT CONDITIONS

A. Temporary Utilities: Prepare a schedule indicating dates for implementation and termination of each temporary utility. At the earliest feasible time, when acceptable to the Owner, change over from use of temporary service to use of permanent service.

B. Conditions of Use: Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Relocate temporary services and facilities as the Work progresses. Do not overload facilities or permit them to interfere with progress. Take necessary fire-prevention measures. Do not allow hazardous, dangerous, or unsanitary conditions, or public nuisances to develop or persist onsite.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide new materials. If acceptable to the Designer, the Contractor may use undamaged, previously used materials in serviceable condition. Provide materials suitable for use intended.

B. Lumber and Plywood: Comply with requirements in Division 6 Section “Rough Carpentry”.

1. For job-built temporary office, shops, and sheds within the construction area, provide UL-labeled, fire-treated lumber and plywood for framing, sheathing, and siding.

2. For signs and directory boards, provide exterior-type, Grade B-B high-density concrete form overlay plywood of sized and thicknesses indicated.
3. For fences and vision barriers, provide minimum 3/9" (9.5mm) thick exterior plywood.
4. For safety barriers, sidewalk bridges, and similar uses, provide minimum 5/8" (16mm) thick exterior plywood

C. Paint: Comply with requirements of Division 9 Section "Painting".

1. For job-built temporary offices, shops, sheds, fences, and other exposed lumber and plywood, provide exterior-grade acrylic-latex emulsion over exterior primer.
2. For sign panels and applying graphics, provide exterior-grade alkyd gloss enamel over exterior primer.
3. For interior walls of temporary offices, provide two (2) quarts interior latex-flat wall paint.

D. Tarpaulins: Provide waterproof, fire-resistant, UL-labeled tarpaulins with flame-spread rating of (15) or less. For temporary enclosures, provide translucent, nylon-reinforced laminated polyethylene or polyvinyl chloride, fire-retardant tarpaulins.

E. Water: Provide potable water approved by local health authorities.

F. Open-Mesh Fencing: Provide 0.120" (3mm) thick, galvanized 2" (50mm) chainlink fabric fencing 6' (2m) high with galvanized steel pipe posts, 1½" (38mm) ID for line posts and 2½" (64mm) ID for corner posts.

2.2 EQUIPMENT

A. General: Provide new equipment. If acceptable to the Designer, the Contractor may use undamaged, previously used equipment in serviceable condition. Provide equipment suitable for use intended.

B. Water Hoses: Provide ¾" (19mm), heavy-duty, abrasion-resistant, flexible rubber hoses 100' (30m) long, with pressure rating greater than the maximum pressure of the water distribution system. Provide adjustable shutoff nozzles at hose discharge.

C. Electrical Outlets: Provide properly configured, NEMA-polarized outlets to prevent insertion of 110 to 120V plugs into higher voltage outlets. Provide receptacle outlets equipped with ground-fault circuit interrupters, reset button, and pilot light for connection of power tools and equipment.

D. Electrical Power Cords: Provide grounded extension cords. Use hard-service cords where exposed to abrasion and traffic. Provide waterproof connectors to connect separate lengths of electric cords if single lengths will not reach areas where construction activities are in progress. Do not exceed safe length-voltage rating.

E. Lamps and Light Fixtures: Provide general service incandescent lamps of wattage required for adequate illumination. Provide guard cages or tempered-glass enclosures where exposed to breakage. Provide exterior fixture where exposed to moisture.

F. Heating Units: Provide temporary heating units that have been tested and labeled by UL, FM, or another recognized trade association related to the type of fuel being consumed.

G. Fire Extinguishers: Provide hand-carried, portable, UL-rated, Class A fire extinguishers for temporary offices and similar spaces. In other locations, provide hand-carried, portable, UL-rated, Class ABC, dry-chemical extinguishers, or a combination of extinguishers of NFPA-recommended classes for the exposures.

1. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Use qualified personnel for installation of temporary facilities. Locate facilities where they will serve the Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required.

B. Provide each Facility ready for use when needed to avoid delay. Maintain and modify as required. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

A. Temporary Water Service: The Owner will provide water for construction purposes from the existing building system. All required temporary extensions shall be provided and removed by the Contractor. Connection points and methods of connection shall be designated and approved by the Construction Representative.

B. Temporary Electric Power Service: The Owner will provide electric power for construction lighting and power tools. Contractors using such services shall pay all costs of temporary services, circuits, outlet, extensions, etc.

C. Temporary Heating: Provide temporary heat required by construction activities for curing or drying of completed installations or for protection of installed construction from adverse effects of low temperatures or high humidity. Select safe equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce the ambient condition required and minimize consumption of energy.

1. Heating Facilities: Except where the Owner authorizes use of the permanent system, provide vented, self-contained, LP gas or fuel-oil heaters with individual space thermostatic control.
2. Use of gasoline-burning space heaters, open flame, or salamander heating units is prohibited.

D. Temporary Heating and Cooling: The normal heating and/or cooling system of the building shall be maintained in operation during the construction. Should the Contractor find it necessary to interrupt the normal HVAC service to spaces, which have not been vacated for construction, such interruptions shall be pre-scheduled with the Construction Representative.

E. Temporary Toilets: Use of the Owner's existing toilet facilities will be permitted, so long as facilities are cleaned and maintained in a condition acceptable to the Owner. All construction personnel will be allowed access only to those specific facilities designed by the Construction Representative. At substantial completion, restore these facilities to the condition prevalent at the time of initial use.

F. Wash Facilities: The Owner will provide wash facilities within the building. All construction personnel will be allowed access only to those specific facilities designated by the Construction Representative.

G. Drinking-Water Facilities: The Owner will provide drinking water facilities within the building. All construction personnel will be allowed access only to those specific facilities designated by the Construction Representative.

3.3 SUPPORT FACILITIES INSTALLATION

A. General: Locate field offices, storage sheds, and other temporary construction and support facilities for easy access.

1. Maintain support facilities until near Substantial Completion. Remove prior to Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to the Owner.

B. Field Offices: Provide insulated, weathertight temporary offices of sufficient size to accommodate required office personnel at the Project site. Keep the office clean and orderly for use for small progress meetings. Furnish and equip office as follows:

1. Furnish with a desk and chairs, a 4-drawer file cabinet, plan table, plan rack, and a 6-shelf bookcase.
2. Equip with a water cooler and private toilet complete with water closet, lavatory, and medicine cabinet unit with a mirror.

C. Storage Facilities: The Owner will provide storage onsite as designated by the Facility Representative or the Construction Representative. Areas for use by the Contractor for storage will be identified at the Pre-Bid Meeting. In addition to interior floor space provided at the facility, the Contractor shall provide Conex boxes which can be placed in a designated area in Lot 13.

D. Construction Parking: Parking at the site will be provided in the areas designated at the Pre-Construction Meeting.

E. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities.

1. Where heat is needed and the permanent building enclosure is not complete, provide temporary enclosures where there is no other provision for containment of heat. Coordinate enclosure with ventilating and materials drying or curing requirements to avoid dangerous conditions and effects.
2. Install tarpaulins securely with incombustible wood framing and other materials. Close openings of 25SqFt (2.3SqM) or less with plywood or similar materials.
3. Close openings through floor or roof decks and horizontal surfaces with load-bearing, wood-framed construction.
4. Where temporary wood or plywood enclosure exceeds 100SqFt (9.2SqM) in area, use UL-labeled, fire-retardant-treated material for framing and main sheathing.

F. Temporary Elevator Use: The Owner will allow use of elevators within the building. All construction personnel will be allowed access only to those specific elevators designated by the Construction Representative.

G. Project Identification and Temporary Signs: Prepare project identification and other signs of size indicated. Install signs where indicated to inform the public and persons seeking entrance to the Project. Support on posts or framing of preservative-treated wood or steel. Do not permit installation of unauthorized signs.

1. Project Identification Signs: Engage an experienced sign painter to apply graphics. Comply with details indicated.
2. Temporary Signs: Prepare signs to provide directional information to construction personnel and visitors.

H. Collection and Disposal of Waste: Collect waste from construction areas and elsewhere daily. Comply with requirements of NFPA 241 for removal of combustible waste material and debris. Enforce requirements strictly. Do not hold materials more than seven (7) days during normal weather or three (3) days when the temperature is expected to rise above 80°F (27°C). Handle hazardous, dangerous, or unsanitary waste materials separately from other waste by containerizing properly. Dispose of material lawfully.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Except for use of permanent fire protection as soon as available, do not change over from use of temporary security and protection facilities to permanent facilities until Substantial Completion, or longer, as requested by the Designer.

B. Temporary Fire Protection: Until fire-protection needs are supplied by permanent facilities, install and maintain temporary fire-protection facilities of the types needed to protect against reasonable predictable and controllable fire losses. Comply with NFPA 10 “Standard for Portable Fire Extinguishers” and NFPA 241 “Standard for Safeguarding Construction, Alterations, and Demolition Operations”.

1. Locate fire extinguishers where convenient and effective for their intended purpose, but not less than one (1) extinguisher on each floor at or near each usable stairwell.
2. Store combustible materials in containers in fire-safe locations.
3. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire-protection facilities, stairways, and other access routes for fighting fires. Prohibit smoking in hazardous fire-exposure areas.
4. Provide supervision of welding operations, combustion-type temporary heating units, and similar sources of fire ignition.

C. Permanent Fire Protection: At the earliest feasible date in each area of the Project complete installation of the permanent fire-protection facility including connected services and place into operation and use. Instruct key personnel on use of facilities.

D. Barricades, Warning Signs, and Lights: Comply with standards and code requirements for erection of structurally adequate barricades. Paint with appropriate colors, graphics, and warning signs to inform personnel and the public of the hazard being protected against. Where appropriate and needed, provide lighting including flashing red or amber lights.

E. Enclosure Fence: Before excavation begins, install an enclosure fence with lockable entrance gates. Locate where indicated, or enclose the entire site or the portion determined sufficient to accommodate construction operations. Install in a manner that will prevent people, dogs, and other animals from easily entering the site, except by the entrance gates.

1. Provide open-mesh, chainlink fencing with posts set in a compacted mixture of gravel and earth.
2. Provide plywood fence, 8’ (2.5m) high, framed with (4) 2”x4” (50mm x 100mm) rails, and preservative-treated wood posts spaced not more than 8’ (2.5m) apart.

F. Security Enclosure and Lockup: Install substantial temporary enclosure of partially completed areas of construction. Provide locking entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.

1. Storage: Where materials and equipment must be stored and are of value or attractive for theft, provide a secure lockup. Enforce discipline in connection with the installation and release of material to minimize the opportunity for theft and vandalism.

G. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and minimize the possibility that air, waterways, and subsoil might be contaminated or polluted or that other undesirable effects might result. Avoid use of tools and equipment that produce harmful noise. Restrict use of noisemaking tools and equipment to hours that will minimize complaints from persons or firms near the site.

3.5 OPERATION, TERMINATION AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. Limit availability of temporary facilities to essential and intended uses to minimize waste and abuse.

B. Maintenance: Maintain facilities in good operating condition until removal. Protect from damage by freezing temperatures and similar elements.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
2. Protection: Prevent water-filled piping from freezing. Maintain markers for underground lines. Protect from damage during excavation operations.

C. Termination and Removal: Unless the Designer requests that it be maintained longer, remove each temporary facility when the need has ended, when replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with the temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are the Contractor's property. The Owner reserves the right to take possession of project identification signs.
2. Remove temporary paving not intended for or acceptable for integration into permanent paving. Where the area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil in the area. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at the temporary entrances as required by the governing authority.
3. At Substantial Completion, clean and renovate permanent facilities used during the construction period including, but not limited to, the following:

    a. Replace air filters and clean inside of ductwork and housing.
    b. Replace significantly worn parts and parts subject to unusual operating conditions.
    c. Replace lamps burned out or noticeably dimmed by hours of use.

END OF SECTION 015000

SECTION 017400 – CLEANING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for cleaning during the Project.

B. Environmental Requirements: Conduct cleaning and waste-disposal operations in compliance with local laws and ordinances. Comply fully with federal and local environmental and anti-pollution regulations.

1. Do not dispose of volatile wastes such as mineral spirits, oil, or paint thinner in storm or sanitary drains.
2. Burning or burying of debris, rubbish, or other waste material on the premises is not permitted.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by the manufacturer or fabricator for the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 PROGRESS CLEANING

A. General

1. Retain all stored items in an orderly arrangement allowing maximum access, not impending drainage or traffic, and providing the required protection of materials.
2. Do not allow the accumulation of scrap, debris, waste material, and other items not required for construction of this Work.
3. At least twice each month, and more often if necessary, completely remove all scrap, debris, and waste material from the jobsite.
4. Provide adequate storage for all items awaiting removal from the jobsite, observing all requirements for fire protection and protection of the ecology.

B. Site

1. Daily, inspect the site and pick up all scrap, debris, and waste material. Remove all such items to the place designated for their storage.

2. Weekly, inspect all arrangements of materials stored onsite. Re-stack, tidy, or otherwise service all material arrangements. Maintain the site in a neat and orderly condition at all times.

C. Structures

1. Daily, inspect the structures and pick up all scrap, debris, and waste material. Remove all such items to the place designated for their storage.
2. Weekly, sweep all interior spaces clean. “Clean” for the purposes of this paragraph, shall be interpreted as meaning free from dust and other material capable of being removed by use of reasonable effort and handheld broom.
3. In preparation for installation of succeeding materials, clean the structures or pertinent portions thereof to the degree of cleanliness recommended by the manufacturer of the succeeding material, using all equipment and materials required to achieve the required cleanliness.
4. Following the installation of finish floor materials, clean the finish floor daily while work is being performed in the space in which finish materials have been installed. “Clean” for the purposes of this subparagraph, shall be interpreted as meaning free from all foreign material which, in the opinion of the Construction Representative, may be injurious to the finish of the finish floor material.

3.2 FINAL CLEANING

A. General: Provide final cleaning operations when indicated. Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit of Work to the condition expected from a commercial building cleaning and maintenance program. Comply with manufacturer’s instructions.

B. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for the entire Project or a portion of the Project.

1. Clean the Project Site, yard and grounds, in areas disturbed by construction activities including landscape development areas, of rubbish, waste material, litter, and foreign substances.
2. Sweep paved areas broom clean. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
3. Remove petrochemical spills, stains, and other foreign deposits.
4. Remove tools, construction equipment, machinery, and surplus material from the site.
5. Remove snow and ice to provide safe access to the building.
6. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
7. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
8. Broom clean concrete floors in unoccupied spaces.
9. Vacuum clean carpet and similar soft surfaces removing debris and excess nap. Shampoo, if required.
10. Clean transparent material, including mirrors and glass in doors and windows. Remove glazing compounds and other substances that are noticeable vision-

obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.

11. Remove labels that are not permanent labels.
12. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.

    a. Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.

13. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
14. Clean plumbing fixtures to a sanitary condition free of stains, including stains resulting from water exposure.
15. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
16. Clean ducts, blowers, and coils if units were operated without filters during construction
17. Clean food-service equipment to a sanitary condition, ready and acceptable for its intended use.
18. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs and defective and noisy starters in fluorescent and mercury vapor fixtures.
19. Leave the Project clean and ready for occupancy.

C. Pest Control: Engage an experienced, licensed exterminator to make a final inspection and rid the Project of rodents, insects, and other pests. Comply with regulations of local authorities.

D. Removal of Protection: Remove temporary protection and facilities installed during construction to protect previously completed installations during the remainder of the construction period.

E. Compliances: Comply with governing regulations and safety standards for cleaning operations. Remove waste materials from the site and dispose of lawfully.

1. Where extra materials of value remain after Final Acceptance by the Owner, they become the Owner's property.

END OF SECTION 017400

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SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:

1. Demonstration of operation of systems, subsystems, and equipment.
2. Training in operation and maintenance of systems, subsystems, and equipment.
3. Demonstration and training video recordings.

1.3 INFORMATIONAL SUBMITTALS

A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.

B. Attendance Record: For each training module, submit list of participants and length of instruction time.

C. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.4 CLOSEOUT SUBMITTALS

A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.

1. Identification: On each copy, provide an applied label with the following information:

a. Name of Project.
b. Name and address of videographer.
c. Name of Architect.
d. Name of Construction Manager.
e. Name of Contractor.
f. Date of video recording.

2. Transcript: Prepared in PDF electronic format. Include a cover sheet with same label information as the corresponding video recording and a table of contents with links to corresponding training components. Include name of Project and date of video recording on each page.

3. At completion of training, submit complete training manual(s) for Owner's use in PDF electronic file format on compact disc.

1.5 QUALITY ASSURANCE

A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

B. Instructor Qualifications: A factory-authorized service representative experienced in operation and maintenance procedures and training.

C. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Coordination". Review methods and procedures related to demonstration and training including, but not limited to, the following:

1. Inspect and discuss locations and other facilities required for instruction.
2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
3. Review required content of instruction.
4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.6 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:

a. System, subsystem, and equipment descriptions.
b. Performance and design criteria if Contractor is delegated design responsibility.
c. Operating standards.
d. Regulatory requirements.
e. Equipment function.
f. Operating characteristics.
g. Limiting conditions.
h. Performance curves.

2. Documentation: Review the following items in detail:

a. Emergency manuals.
b. Operations manuals.
c. Maintenance manuals.
d. Project record documents.
e. Identification systems.
f. Warranties and bonds.
g. Maintenance service agreements and similar continuing commitments.

3. Emergencies: Include the following, as applicable:

a. Instructions on meaning of warnings, trouble indications, and error messages.
b. Instructions on stopping.
c. Shutdown instructions for each type of emergency.
d. Operating instructions for conditions outside of normal operating limits.
e. Sequences for electric or electronic systems.
f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:

a. Startup procedures.
b. Equipment or system break-in procedures.
c. Routine and normal operating instructions.
d. Regulation and control procedures.
e. Control sequences.
f. Safety procedures.
g. Instructions on stopping.
h. Normal shutdown instructions.
i. Operating procedures for emergencies.
j. Operating procedures for system, subsystem, or equipment failure.
k. Seasonal and weekend operating instructions.
l. Required sequences for electric or electronic systems.
m. Special operating instructions and procedures.

5. Adjustments: Include the following:

a. Alignments.
b. Checking adjustments.
c. Noise and vibration adjustments.
d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:

    a. Diagnostic instructions.
    b. Test and inspection procedures.

7. Maintenance: Include the following:

    a. Inspection procedures.
    b. Types of cleaning agents to be used and methods of cleaning.
    c. List of cleaning agents and methods of cleaning detrimental to product.
    d. Procedures for routine cleaning
    e. Procedures for preventive maintenance.
    f. Procedures for routine maintenance.
    g. Instruction on use of special tools.

8. Repairs: Include the following:

    a. Diagnosis instructions.
    b. Repair instructions.
    c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
    d. Instructions for identifying parts and components.
    e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 007213 "General Conditions".

B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

1. Architect will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
2. Owner will furnish an instructor to describe Owner's operational philosophy.
3. Owner will furnish Contractor with names and positions of participants.

B. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.

1. Schedule training with Owner with at least seven days' advance notice.

C. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

D. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

3.3 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.

1. At beginning of each training module, record each chart containing learning objective and lesson outline.

B. Video: Provide minimum 640 x 480 video resolution converted to format file type acceptable to Owner, on electronic media.

1. Electronic Media: Read-only format compact disc acceptable to Owner, with commercial-grade graphic label.
2. File Hierarchy: Organize folder structure and file locations according to project manual table of contents. Provide complete screen-based menu.
3. File Names: Utilize file names based upon name of equipment generally described in video segment, as identified in Project specifications.
4. Contractor and Installer Contact File: Using appropriate software, create a file for inclusion on the Equipment Demonstration and Training DVD that describes the following for each Contractor involved on the Project, arranged according to Project table of contents:

    a. Name of Contractor/Installer.
    b. Business address.
    c. Business phone number.
    d. Point of contact.
    e. E-mail address.

C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.

1. Film training session(s) in segments not to exceed 15 minutes.

    a. Produce segments to present a single significant piece of equipment per segment.
    b. Organize segments with multiple pieces of equipment to follow order of Project Manual table of contents.
    c. Where a training session on a particular piece of equipment exceeds 15 minutes, stop filming and pause training session. Begin training session again upon commencement of new filming segment.

D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.

1. Furnish additional portable lighting as required.

E. Narration: Describe scenes on video recording by audio narration by microphone while video recording is recorded. Include description of items being viewed.

F. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.

G. Preproduced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

END OF SECTION 017900

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Salvage of existing items to be reused or recycled.

B. Related Requirements:

1. Section 011000 "Summary of Work" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
2. Section 015000 “Construction Facilities and Temporary Controls” for construction waste management, temporary utilities, support facilities, security and protection.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.

B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.

C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.

D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For refrigerant recovery technician.

B. Engineering Survey: Submit engineering survey of condition of building.

C. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.

D. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's building manager's and other tenants' on-site operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Use of elevator and stairs.
5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

E. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

F. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

1.7 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

1.8 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.9 FIELD CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. Hazardous materials will be removed by Owner before start of the Work.
2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

E. Hazardous Materials: Present in buildings and structures to be selectively demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.

1. Hazardous material remediation is specified elsewhere in the Contract Documents.
2. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.
3. Owner will provide material safety data sheets for suspected hazardous materials that are known to be present in buildings and structures to be selectively demolished because of building operations or processes performed there.

F. Storage or sale of removed items or materials on-site is not permitted.

G. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

1.10 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties. Notify warrantor before proceeding. Existing warranties include the following:

B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

1.11 COORDINATION

A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

C. Steel Tendons: Locate tensioned steel tendons and include recommendations for de-tensioning.

D. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

E. Survey of Existing Conditions: Record existing conditions by use of measured drawings preconstruction photographs or video and templates.

1. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.
2. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.2 PREPARATION

A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
2. Arrange to shut off utilities with utility companies.
3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.

    a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
    c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
    d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
    e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
    f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
    g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

3.4 PROTECTION

A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Cover and protect furniture, furnishings, and equipment that have not been removed.
5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."

B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

C. Remove temporary barricades and protections where hazards no longer exist.

3.5 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
5. Maintain fire watch during and for at least 2 hours after flame-cutting operations.
6. Maintain adequate ventilation when using cutting torches.
7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
10. Dispose of demolished items and materials promptly. Comply with requirements in Section 015000 "Construction Facilities and Temporary Controls."

B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

C. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

D. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.

4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch (19 mm) at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.

B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.

C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.

D. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.

E. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings." Do not use methods requiring solvent-based adhesive strippers.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and recycle or dispose of them according to Section 015000 "Construction Facilities and Temporary Controls."

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

B. Burning: Do not burn demolished materials.

3.8 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119

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SECTION 078400 - FIRESTOPPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

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

1.2 REFERENCE STANDARDS

A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems 2023a.

B. ITS (DIR) - Directory of Listed Products Current Edition.

C. FM 4991 - Approval Standard of Firestop Contractors 2013.

D. FM (AG) - FM Approval Guide Current Edition.

E. SCAQMD 1168 - Adhesive and Sealant Applications 1989, with Amendment (2022).

F. UL 1479 - Standard for Fire Tests of Penetration Firestops Current Edition, Including All Revisions.

G. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems Current Edition, Including All Revisions.

H. UL (DIR) - Online Certifications Directory Current Edition.

I. UL (FRD) - Fire Resistance Directory Current Edition.

1.3 SUBMITTALS

A. See Section 0133000 - Submittals for submittal procedures.

B. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.

C. Product Data: Provide data on product characteristics, performance ratings, and limitations.

D. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.

E. Installer's qualification statement.

1.4 QUALITY ASSURANCE

A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.

1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.
2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at www.icc-es.org will be considered as constituting an acceptable test report.
3. Submission of actual test reports is required for assemblies for which none of the above substantiation exists.

B. Installer Qualifications: Company specializing in performing the work of this section and:

1. Trained by manufacturer.
2. Approved by Factory Mutual Research Corporation under FM 4991, or meeting any two of the following requirements:
3. Verification of minimum three years documented experience installing work of this type.
4. Verification of at least five satisfactorily completed projects of comparable size and type.
5. Licensed by local authorities having jurisdiction (AHJ).

1.5 FIELD CONDITIONS

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

B. Provide ventilation in areas where solvent-cured materials are being installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Firestopping Manufacturers:

1. 3M Fire Protection Products: www.3m.com/firestop/#sle.
2. Hilti, Inc: www.hilti.com/#sle.
3. Specified Technologies Inc: www.stifirestop.com/#sle.

2.2 MATERIALS

A. Firestopping Materials: Any materials meeting requirements.

B. Volatile Organic Compound (VOC) Content: Provide products having VOC content lower than that required by SCAQMD 1168.

C. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.

D. Fire Ratings: Refer to drawings for required systems and ratings.

2.3 FIRESTOPPING ASSEMBLY REQUIREMENTS

A. Through Penetration Firestopping: Use system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.

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

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.

B. Remove incompatible materials that could adversely affect bond.

C. Install backing materials to prevent liquid material from leakage.

3.3 INSTALLATION

A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.

B. Do not cover installed firestopping until inspected by Owner's Independent Testing Agency.

C. Do not cover installed firestopping until inspected by authorities having jurisdiction.

D. Install labeling required by code.

3.4 CLEANING

A. Clean adjacent surfaces of firestopping materials.

3.5 PROTECTION

A. Protect adjacent surfaces from damage by material installation.

END OF SECTION 078400

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SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Nonsag gunnable joint sealants.

B. Joint backings and accessories.

1.2 RELATED REQUIREMENTS

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

1.3 REFERENCE STANDARDS

A. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications 2022.

B. ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.

C. ASTM C1193 - Standard Guide for Use of Joint Sealants 2016 (Reapproved 2023).

D. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants 2023.

E. SCAQMD 1168 - Adhesive and Sealant Applications 1989, with Amendment (2022).

1.4 SUBMITTALS

A. See Section 013300 - Submittals for submittal procedures.

B. Product Data: Submit manufacturer's technical datasheets for each product to be used; include the following:

1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
2. List of backing materials approved for use with the specific product.
3. Backing material recommended by sealant manufacturer.
4. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
5. Substrates the product should not be used on.

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. Executed warranty.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the work of this section and with at least three years of documented experience.

B. Field Adhesion Test Procedures:

1. Allow sealants to fully cure as recommended by manufacturer before testing.
2. Have a copy of the test method document available during tests.
3. Record the type of failure that occurred, other information required by test method, and the information required on the Field Quality Control Log.
4. If any combination of sealant type and substrate does not show evidence of minimum adhesion or shows cohesion failure before minimum adhesion, report results to Architect.

1.6 WARRANTY

A. Manufacturer Warranty: Provide 2-year manufacturer warranty for installed sealants and accessories that fail to achieve a watertight seal, exhibit loss of adhesion or cohesion, or do not cure. Complete forms in Owner's name and register with manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Nonsag Sealants:

1. Dow: www.dow.com/#sle.
2. Pecora Corporation: www.pecora.com/#sle.
3. Sika Corporation: www.usa.sika.com/#sle.
4. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.

2.2 JOINT SEALANT APPLICATIONS

A. Scope:

1. Interior Joints:

a. Seal open joints except specific open joints indicated on drawings as not sealed.
b. Seal the following joints:

1) Joints between door frames and window frames and adjacent construction.
2) In sound-rated wall and ceiling assemblies, gaps at electrical outlets, wiring devices, and piping penetrations.
3) In sound-rated wall and ceiling assemblies, seal joints between wall assemblies and ceiling assemblies; between wall assemblies and other construction; between ceiling assemblies and other construction.

B. Sound-Rated Assemblies: Walls and ceilings identified as STC-rated, sound-rated, or acoustical.

2.3 JOINT SEALANTS - GENERAL

A. Sealants and Primers: Provide products having lower volatile organic compound (VOC) content than indicated in SCAQMD 1168.

B. Colors: As indicated on drawings.

2.4 NONSAG JOINT SEALANTS

A. Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.

1. Movement Capability: Plus and minus 25 percent, minimum.

2.5 ACCESSORIES

A. Sealant Backing Materials, General: Materials placed in joint before applying sealants; assists sealant performance and service life by developing optimum sealant profile and preventing three-sided adhesion; type and size recommended by sealant manufacturer for compatibility with sealant, substrate, and application.

B. Sealant Backing Rod, Closed-Cell Type:

1. Cylindrical flexible sealant backings complying with ASTM C1330 Type C.
2. Size: 25 to 50 percent larger in diameter than joint width.

C. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.

D. Masking Tape: Self-adhesive, nonabsorbent, nonstaining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.

E. Joint Cleaner: Noncorrosive and nonstaining type, type recommended by sealant manufacturer; compatible with joint forming materials.

F. Primers: Type recommended by sealant manufacturer to suit application; nonstaining.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that joints are ready to receive work.

B. Verify that backing materials are compatible with sealants.

3.2 PREPARATION

A. Remove loose materials and foreign matter that could impair adhesion of sealant.

B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.

C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.

D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

3.3 INSTALLATION

A. Install this work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

B. Provide joint sealant installations complying with ASTM C1193.

C. Install acoustical sealant application work in accordance with ASTM C919.

D. Install bond breaker backing tape where backer rod cannot be used.

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.

3.4 FIELD QUALITY CONTROL

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

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

END OF SECTION 079200

SECTION 096813 - TILE CARPETING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Carpet tile fully adhered.

B. Removal of existing carpet tile.

1.2 RELATED REQUIREMENTS

A. Section 016116 - Volatile Organic Compound (VOC) Content Restrictions.

B. Section 090561 - Common Work Results for Flooring Preparation: Removal of existing floor coverings, cleaning, and preparation.

1.3 REFERENCE STANDARDS

A. ASTM D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials; 2016 (Reapproved 2021).

B. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2019a, with Editorial Revision (2020).

C. CRI 104 - Standard for Installation of Commercial Carpet; 2015.

D. CRI (GLP) - Green Label Plus Testing Program - Certified Products; Current Edition.

E. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; 2023.

1.4 SUBMITTALS

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

B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.

C. Samples: Submit two carpet tiles illustrating color and pattern design for each carpet color selected.

D. Operation and Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing specified carpet tile with minimum three years documented experience.

1.6 FIELD CONDITIONS

A. Store materials in area of installation for minimum period of 24 hours prior to installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Tile Carpeting:

1. Interface, Inc: www.interface.com.
2. Milliken & Company: www.milliken.com.
3. J&J Flooring, www.jjflooringgroup.com.

2.2 MATERIALS

A. Tile Carpeting: Tufted, manufactured in one color dye lot.

1. Tile Size: 19.6 in x 19.6 in (50 cm x 50cm), nominal.
2. Dye Method: Solution Dyed.
3. Pattern: As listed on Material Finish Legend..
4. Critical Radiant Flux: Minimum of 0.22 watts/sq cm, when tested in accordance with ASTM E648 or NFPA 253.
5. Surface Flammability Ignition: Pass ASTM D2859 (the "pill test").
6. Fiber: 100% Recycled Content Nylon, Aquafil.
7. Gauge: 1/12 inch (4.72 rows/cm).
8. Stitches: 10 per inch (39.37ends/10 per cm).
9. Pile Density: 7,654 oz/yd 3.
10. Pile Height: 0.17 in (4.30 mm)
11. Primary Backing Material: Glas Bac

2.3 ACCESSORIES

A. Edge Strips: Embossed aluminum, color as selected by Architect.

B. Adhesives:

1. Compatible with materials being adhered; maximum VOC content as specified in Section 016116.

C. Carpet Tile Adhesive: Recommended by carpet tile manufacturer; releasable type.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that subfloor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.

B. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to subfloor surfaces.

3.2 PREPARATION

A. Remove existing carpet tile.

B. Prepare floor substrates as recommended by flooring and adhesive manufacturers.

3.3 INSTALLATION

A. Starting installation constitutes acceptance of subfloor conditions.

B. Install carpet tile in accordance with manufacturer's instructions.

C. Blend carpet from different cartons to ensure minimal variation in color match.

D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.

E. Lay carpet tile in square pattern, with pile direction parallel to next unit, set parallel to building lines.

F. Trim carpet tile neatly at walls and around interruptions.

G. Complete installation of edge strips, concealing exposed edges.

END OF SECTION 096813

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SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints.

C. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.

1. Elevator pit ladders.
2. Exposed walls and bottom of escalators.

D. Do Not Paint or Finish the Following Items:

1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
2. Items indicated to receive other finishes.
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. Floors, unless specifically indicated.
6. Glass.
7. Concealed pipes, ducts, and conduits.

1.2 RELATED REQUIREMENTS

A. Section 081113 – Hollow Metal Doors and Frames

1.3 DEFINITIONS

A. Comply with ASTM D16 for interpretation of terms used in this section.

1.4 REFERENCE STANDARDS

A. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2024.

B. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board; 2020.

C. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association; Current Edition.

D. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.

E. SSPC V2 (PM2) - Systems and Specifications: Steel Structures Painting Manual Volume 2; 2021.

F. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).

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

1.5 SUBMITTALS

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

B. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches (216 by 279 mm) in size, illustrating range of colors available for each finishing product specified.

1. Where sheen is specified, submit samples in only that sheen.

C. 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.

1.6 QUALITY ASSURANCE

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

1.7 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. Paint Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

1.8 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. Provide lighting level of 80 fc (860 lux) measured mid-height at substrate surface.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Paints:

1. PPG Paints: www.ppgpaints.com/#sle.
2. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
3. Benjamin Moore Paint, www.benjaminmoore.com.

B. Primer Sealers: Same manufacturer as top coats.

C. Substitutions: See Section 016000 - Product Requirements.

2.2 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. Supply each paint material in quantity required to complete entire project's work from a single production run.
3. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

2.3 PAINT SYSTEMS - INTERIOR

A. Paint I-OP - Interior Surfaces to be Painted, Unless Otherwise Indicated: Including gypsum board, concrete, concrete masonry units, brick, wood, plaster, uncoated steel, shop primed steel, galvanized steel, aluminum, and acoustical ceilings.

1. Two top coats and one coat primer.
2. Top Coat(s): Interior Low Odor/VOC Modified Acrylic Metallic Paint. MPI#161

a. Paint shall be an advanced acrylic emulsion, waterborne, corrosion resistant coating for both new construction and industrial applications. It can be used as a primer under most water based topcoats or alone as a primer-topcoat system.
b. Features:
1) Flash-Early rust resistant.
2) Corrosion resistant
3) Single component
4) Early moisture resistant
5) Fast dry

3. Top Coat Sheen:

a. Flat: MPI gloss level 1; use this sheen at all locations.

4. Primer: As recommended by top coat manufacturer for specific substrate.

2.4 PRIMERS

A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

C. Test shop-applied primer for compatibility with subsequent cover materials.

3.2 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 mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

D. Seal surfaces that might cause bleed through or staining of topcoat.

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

F. Galvanized Surfaces:

G. 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.

3.3 APPLICATION

A. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

C. Apply each coat to uniform appearance in thicknesses specified by manufacturer.

D. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

E. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.4 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.5 PROTECTION

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION 099123

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SECTION 102600 - WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Door and frame protection.

1.2 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

B. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics; 2023, with Editorial Revision.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023c.

D. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.

E. ASTM F476 - Standard Test Methods for Security of Swinging Door Assemblies; 2023.

F. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

1.3 SUBMITTALS

A. See Section 013300 - Administrative Requirements for submittal procedures.

B. Product Data: Indicate physical dimensions, features, wall mounting brackets with mounted measurements, anchorage details, and rough-in measurements.

C. Shop Drawings: Include plans, elevation, sections, and attachment details. Show design and spacing of supports for protective corridor handrails, required to withstand structural loads.

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

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver wall and door protection items in original, undamaged protective packaging. Label items to designate installation locations.

B. Protect work from moisture damage.

1.5 WARRANTY

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Metal Door and Frame Protection:

1. CS Group Acrovyn: www.c-sgroup.com
2. Hiawatha, Inc, an Activar Construction Products Group company: www.activarcpg.com/hiawatha/#sle.
3. Inpro: www.inprocorp.com/#sle.

2.2 PERFORMANCE CRITERIA

A. Impact Strength: Unless otherwise noted, provide protection products and assemblies that have been successfully tested for compliance with applicable provisions of ASTM D256 and/or ASTM F476.

2.3 PRODUCT TYPES

A. Elevator Frame Guard/Doorway Protection:

1. Frames Protection: Formed to fit frame profile.

a. Material: High-impact acrylic-modified vinyl.
b. Profile: One-piece.
c. Configuration: For Factory-formed return legs, field radiused to the elevator door frame..
d. Leg Return: 6 inches.
e. Leg Angle: 90 Degrees
f. Thickness: 0.060 inch (1.52 mm).
g. Length at Frame: 48 inches (1219 mm).
h. Color: As selected from manufacturer's standard colors.

2.4 FABRICATION

A. Fabricate components with tight joints, corners and seams.

END OF SECTION 102600

SECTION 142100 - ELECTRIC PASSENGER ELEVATORS

PART 1 - GENERAL

1.1 GENERAL NOTES

A. General Provisions of Contract, including general and supplementary conditions and Division 01 Specification sections, apply to work of this section.

B. Provide all labor, materials, services, and equipment necessary to complete the renovation of the elevators as specified herein.

C. Specifications are intended to depict general design and extent of work.

D. Anything not mentioned in these specifications, as well as any work which is obviously necessary to complete the Project, within the limits established by the specifications and codes, although not described therein, shall be performed by the Contractor as part of his work.

1.2 DESCRIPTION OF WORK

A. Extent of work is to renovate ten (10) existing electric traction passenger Elevator Nos. 1, 2, 3, 4, 5, 6, 7, 8, 13, 14 as two (2) five-car groups in the Truman State Office Building, 301 W High Street, Jefferson City , Missouri, as noted in the elevator schedule below. The schedule indicates elevators to be renovated, required performance, control, capacities, features, and finishes for the group of elevators.

B. Electric traction elevators are hereby defined to include elevators in which cars are hoisted by ropes over power driven traction sheaves, complete with components, equipment, machines, controls, and devices as indicated and as required for safely operating elevators at rated speed and capacity.

C. Construction Sequence and Scheduling: Per the construction schedule outlined below, the Contractor shall perform the renovations on the Passenger Elevator Nos. 1 - 4, 13 and 5 - 8, 14 in the building, two (2) elevators at a time.

1. All tasks to be performed that will require more than one (1) elevator per group to be taken from service at a time shall be scheduled with the Owner and performed outside of the Owner’s normal working hours.
2. Prior to commencement of the work specified herein, the Contractor shall submit to the Owner a task-specific schedule for the elevator renovations. This schedule shall identify critical dates and dates for which owner-provided work is to be performed and completed so as to provide for uninterrupted progress of the work.

1.3 QUALITY ASSURANCE

A. Installer Qualification: The elevator manufacturer, or a licensee of the manufacturer, who has a record of successful experience with the renovation of similar elevators. The contractors shall have, as a minimum, the following qualifications and documentation verifying these qualifications shall be submitted prior to award:

1. Minimum of five (5) years successful experience in installing and servicing similar elevator installations.
2. Installed at least ten (10) completed and accepted elevator systems of similar size, scope, logic control, and motion control required by this contract.
3. An existing in house administrative and technical organization within 150 miles of the project location staffed with competent personnel who are experienced in the elevator related work required to install and service the elevator systems as specified.

B. Elevator Code: Except for more stringent requirements as indicated or imposed by governing regulations (which must be complied with), comply with applicable alteration requirements of the 2016 ASME A17.1 Safety Code for Elevators and Escalators and the 2018 International Building Code (hereinafter referred to as the “Building Code”).

1. The phone component of the elevator systems shall comply with 2019 A17.1 means for two way text, two way voice and one way video. A variance shall be sought from the State of Missouri Elevator Safety Division, by the contractor in this section, for these devices to be installed.

C. NFPA Code: Comply with applicable NFPA Codes and specifically with sections relating to electrical work and elevators.

D. Accessibility Standards: Comply with ANSI A117.1 - 2009 American National Standard for Accessible and Usable Buildings. Comply with the guidelines stipulated by the "Americans with Disability Act" (2010).

E. Performance Requirements: Provide elevators which meet the following performance requirements:

1. Speed - +/- 2% of contract speed under any loading condition.
2. Capacity - Safely lower, stop, and hold up to 125% of rated load.
3. Stopping Accuracy - 1/4 inch under any loading condition.
4. Floor to Floor Performance Time - 11.0 seconds (based on the typical floor height of 13'-0") from start of doors closing until doors are 3/4 open and car is level and stopped at the next successive floor under any loading condition or travel direction.
5. Door Close Time - 3.0 seconds.
6. Door Open Time - 2.0 seconds.
7. Door Open Dwell Time Car Call - 3.0 seconds.
8. Door Open Dwell Time Hall Call - 7.0 seconds.
9. Dwell time shall be canceled upon activation of any car call button.
10. Nudging Time – 30 seconds
11. Smooth acceleration and deceleration for comfort of ride.

1.4 SUBMITTALS

A. Refer to Division 1 for additional information regarding submittals, including submittal requirements, processing procedures, and limitations of review.

B. Pre-Construction Submittals: The following shall be submitted for review prior to manufacturing of equipment.

1. Product Data: Submit manufacturer's technical product data and instructions for each principal component or product. List and describe features of control system, performances, and operating characteristics. Submit brochures of all signal and operational fixtures, control and drive equipment, hoistway door equipment, door operator, and door protective device.
2. Shop Drawings: Shop drawings shall be prepared by skilled draftsmen and presented in a clear and thorough manner as follows:

    a. Job-specific Elevator Layout Drawings: Drawings shall include dimensional layout drawings for the elevators, showing plans, elevations, sections, and large scale details of hoistway and machine room indicating service at each landing, coordination with building structure, and relationships with other construction including, but not limited to, electrical and HVAC equipment. Indicate maximum dynamic and static loads imposed on building structure at points of support per the ASME A17.1 Safety Code for Elevators and Escalators. Indicate capacities, speeds, sizes, performances, operations, safety features, controls, finishes, and similar information on the layout drawings.
    b. Machine Room Layout Drawing: Submit job-specific, straight line dimensional drawings of elevator machine rooms, with locations where other trades equipment are can be provided.
    c. Fixture drawings: Submit job-specific, straight line dimensional drawings of all signal and operational fixtures.
    d. Car Enclosures: Submit job-specific plans, elevations, and details of car enclosures and finishes.
    e. Approval of shop drawings is for general arrangement only and does not include measurement, which is the contractor's responsibility, or approval of variations from the contract documents. The purpose of the shop drawing submittals by the contractor is to demonstrate to the owner the contractor understands the design concept and demonstrates an understanding of the equipment and materials to be furnished.

3. Samples: Submit samples of exposed finishes of car enclosures, hoistway entrances, and signal equipment per Division 1 requirements.
4. Maintenance Certification: The Contractor shall submit a written certification, signed by the Contractor and the manufacturer of the equipment, making a commitment to provide direct support to the Owner, or the Owner’s elevator maintenance service representative, including availability of parts (for inventory, not on an “exchange only” basis), diagnostic tools, and technical & engineering support. In addition, all parts and support shall be provided at a reasonable cost in line for which the original manufacturer would charge to its own customer base and response shall be in a timely manner. This commitment shall remain in effect for a minimum of twenty-five (25) years after substantial completion of the project.
5. Provide verification that all Information Technology systems and/or services provided to the State of Missouri must comply with National Institute of Standards and Technology (NIST) 800-53 or International Organization for Standardization (ISO) 27001 standards. The solution shall provide capabilities that support the state’s ability to remain in compliance with applicable federal laws and regulations related to the security and hosting services for the term of the contract.

a. The contractor must internally comply with NIST 800-53 or ISO27001 standards. The contractor must document how they have internally adopted and comply with NIST 800-53 or ISO27001 by providing a list of titles of the cyber security policies currently in use to designated personnel in the State of Missouri, including proof of any certifications obtained by the contractor (i.e. SOC2, ISO27001/2).

C. Post Construction Submittals: Prior to completion and acceptance of the project, the following shall be submitted for review and acceptance.

1. Diagnostic Device: Upon completion of work provide diagnostic testing device, or maintenance terminal, suitable for all troubleshooting and testing procedures related to the specific type of microprocessor control. This diagnostic testing device, or maintenance terminal, shall conform to the operating procedures under the testing section of these specifications. If onboard diagnostics are provided in the controller to meet this requirement, provide Adjustors Manual for proper interpretation of onboard diagnostics (see 1.3.C.2.b below).
2. Maintenance Manuals: Submit job-specific bound manuals for each elevator or group of elevators. Submit the required number in hard copy plus a minimum of one (1) electronic copy in .pdf format.

a. Operating and maintenance instructions, lubricating schedule and instructions, parts listing, recommended parts inventory listing for motor and critical components, diagnostic device operations manual, emergency instructions and similar information. Include description of any manufacturer specific safety features that are beyond code requirements.
b. The diagnostic device operations manual shall be complete with adjustment settings, sequence of operation, and other diagnostic technical data required for adjustments, tuning, maintenance, and operation of the elevators including performance of all required acceptance and periodic testing required by the Elevator Code. User's instruction manual shall include access codes required for accessing microprocessor equipment for adjusting or programming.
c. Detailed "Maintenance Control Program" - specific to the elevator as required by Elevator Code. The MCP shall be in place to maintain the equipment in compliance with Elevator Code. The MCP shall specify examinations, tests, cleaning, lubrication, and adjustments to applicable components at regular intervals and shall comply with Section 8.6.1 of the Elevator Code. The MCP shall include "On-Site Documentation" and a method for "Maintenance Records" and "On-Site Maintenance Records" as described in Elevator Code. One (1) hard copy of the "Maintenance Control Program," identical to the MCP provided in the Maintenance Manual, shall be placed for use in the elevator control room.
d. Wiring Diagrams: Complete electrical circuit diagrams for control and operational features as installed, showing location and wiring for power, signal and control systems. The diagrams shall differentiate clearly between manufacturer-installed wiring and field installed wiring.

3. On-Site Wiring Diagrams: Provide job-specific wiring diagrams located near the elevator controller in the elevator control room. Provide one (1) hard copy sized at 11″ x 17″ minimum, clear-laminated wiring diagrams.
4. Keys: Provide a total of six (6) sets of keys for each type of key fixture on the elevator equipment. Keys shall be tagged with permanent marking, identifying function and use.

5. Certificate Frame: Provide a certificate frame in the elevator machine room mounted in a conspicuous location. Frame shall be made of a quality metal with a window size to house the operating certificate from the State of Missouri.
6. Certificates and Permits: Provide Owner with copies of all inspection/acceptance certificates and operating permits as required by governing authorities to allow normal, unrestricted use of elevator. If any variances are required from the State of Missouri for the product installed they shall be obtained by the Contractor. Provide a copy of any variances to the Owner upon completion of the project.

1.5 MAINTENANCE AND WARRANTY

A. Maintenance Service: Furnish maintenance and callback service on all thirteen (13) elevator nos. 1-14 minus the out of service elevator no. 12, from thirty (30) days prior to start of construction on the project until a period of twelve (12) months after substantial completion of all Project work as specified herein. The maintenance and call back service shall include at a minimum, but not be limited to, the full maintenance requirements as follows:

1. Maintenance service shall be performed by skilled elevator personnel directly employed and supervised by the same company that furnished and installed the elevator equipment specified herein. This service shall include:

    a. Bi weekly examination of each traction elevator unit as a minimum, and monthly examination of each hydraulic elevator. Include all required, routine maintenance as depicted in the "Maintenance Control Program".
    b. Lubricating, adjusting, repairing and replacing of all parts as necessary to keep the equipment (including battery packs) in a first class condition and properly working.
    c. Maintain the performance requirements specified herein.
    d. Furnish all lubricants, cleaning materials, parts and tools necessary to perform the work required.
    e. Equalizing tension, shorten, or renew hoisting ropes where necessary to maintain safety factor.
    f. Assure smooth and consistent operation of automatic hoistway doors and car doors.
    g. Assure smooth starting and stopping and accurate leveling at all times.
    h. Provide all periodic annual and maintenance testing in accordance with the Elevator Code.
    i. The Contractor shall keep clean of all dirt and debris the guide rails, tops of cars, bottom of platforms, machine rooms, elevator hoistways and pits. All necessary cleaning supplies and equipment shall be furnished by the contractor.
    j. An annual inspection, as described in the Elevator Code and as required by governing authorities, shall be performed by the contractor during the maintenance service period. Coordinate exact dates with Owner and Owner supplied Qualified Elevator Inspector (QEI).

2. The maintenance service shall not include the performance of any work required as a result of improper use, accidents or negligence, for which the contractor is not directly responsible.
3. All work shall be completed by trained employees of the Contractor and performed during normal working hours (7 AM – 4:30 PM). Include 24 hour/day, 7 days/week emergency callback service. Exclude only repair/replacement due to misuse, abuse, accidents, or neglect caused by persons other than installer's personnel. Response to non-emergency

callbacks shall be within 2 hours of the call and response to emergency callbacks shall be within 1 hour of the call. Emergency callbacks include, but are not limited to, the following:

a. Incidents resulting in injury.
b. Entrapments.

4. The Contractor shall respond to callbacks as follows:

a. Upon receiving a call, the service representative shall immediately send an email to the Facilities Manager with an estimated arrival time. Exact email address will be provided to the successful installer.
b. Upon arrival at the site, during normal working hours (7:00AM - 4:30PM Mon.-Fri.), the service representative shall immediately call the On-Site Maintenance Tech, or his authorized representative, and inform them of their arrival. Exact phone number will be provided to the successful installer.
c. After work has been completed, the service representative shall send an email to the Facilities Manager stating the status of the elevator and repair. The status shall include how long the elevator was or will be shut down and a description of the problem and solution.

5. The contractor shall maintain a log in the elevator machine room. The log shall list the date and time of weekly examinations and all trouble calls. Each trouble call shall be fully described including the nature of the call, necessary corrections performed and or parts replaced.

B. General Warranty: The elevator warranty specified in this section shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

C. Warranty: Provide special project warranty, signed by Contractor, Installer, and Manufacturer, agreeing to replace, repair/restore defective materials and workmanship of elevator work during warranty period. "Defective" is hereby defined to include, but not by way of limitation, operation or control system failures, performances below required minimums, excessive wear, unusual deterioration or aging of materials or finishes, unsafe conditions, the need for excessive maintenance, abnormal noise or vibration, and similar unusual, unexpected and unsatisfactory conditions. The warranty period is twelve (12) months starting on date of substantial completion of the Project work and shall be extended until "defects" as defined in this warranty are corrected.

PART 2 - MATERIALS AND COMPONENTS

2.1 GENERAL

A. Provide manufacturer's standard pre-engineered elevator system which will comply with or fulfill the requirements of elevator schedule sheets or, at manufacturer's option, provide custom manufactured elevator systems which will fulfill requirements. Where components are not otherwise indicated, provide standard components, published by manufacturer as included in standard pre-engineered elevator systems, and as required for a complete system.

2.2 ELEVATOR MACHINERY AND CONTROL EQUIPMENT

A. Elevator Machines: Remove the existing geared machines and bed plates and provide new gearless traction type drive machines and bed plates for each of these elevators.

1. The machines shall be of the traction type, with motor, dual brake, and traction drive sheaves compactly mounted on continuous bed plates. The existing steel machine beams may be re-used when determined by the Contractor and machine manufacturer to be acceptable. Sound isolation pads shall be installed beneath the machine bedplates to reduce vibration and noise transmission to the building structure. All blocking beams between the machine beams and machine shall be provided by the contractors in this section.
2. All bearings for the machine shall be field replaceable.
3. The drive machine motors shall be an alternating current type designed for elevator service with high starting torque and low starting current incorporating devices to protect against overloading.
4. Any required deflector sheaves shall be provided with rope spacing to match the new drive sheave. The deflector sheave shall be provided with roller type bearings.
5. The brakes shall be spring applied and electrically released designed for smooth stops with variable loads.
6. Provide a redundant braking means for each elevator drive machine, sized appropriately for the application. This redundant means shall serve as a protection device against unintended movement of the elevator car away from the landing in either direction with the hoistway door not in the locked position and the car door not in the closed position, as a result of failure in the electric driving machine motor, brake, coupling shaft, gearing, control system, or any other component on which the speed of the car depends, except for the hoist ropes and the drive sheave of the machine.

B. Power Control: The existing drives shall be replaced with new regenerative, VVVF elevator drive converters designed for use with the present elevator drive machines.

1. The drives shall provide the elevators with automatic self leveling that shall bring the elevator cars level with the floor landing regardless of load or direction of travel. The automatic self leveling shall correct for over travel, under travel, and rope stretch.
2. A digital encoder shall provide the speed feed back for accurate speed control under varying loads and temperature conditions in both directions. The speed control shall provide optimal speed patterns for each run regardless of distance to provide minimum floor to floor times.
3. Provide isolation transformers, line filters, and chokes to prevent electrical peaks or spikes from feeding back into the building power system from the solid state converters. Provide chokes to omit airborne electrical noise.
4. When elevators are running on the backup emergency power system, the regenerative drives shall dissipate generated electricity as heat and not send electricity back to the building system.

C. Controllers: A microprocessor computer based control system shall be provided to perform all of the functions of safe elevator motion and elevator door control and shall be one of the following:

1. Controller shall be one of the following:

a. MCE iControl (with On-Board Diagnostic Keyboard and Display)
b. GAL Galaxy 4 (with On-Board Diagnostic Keyboard and Display)
c. SMARTRISE SRA (with On-Board Diagnostic Keyboard and Display)
d. Elevator Controls Pixel AC (with On-Board Diagnostic Keyboard and Display)

2. The controller shall include all the hardware required to connect, transfer, and interrupt power and protect car operational and group supervisory control and subgroup supervisory control.
3. Identify each device, module and fuse (with ampere rating) by name, letter, or standard symbol, in an indelible and legible manner on the device or panel. Coordinated identification markings with identical markings on wiring diagrams. Use light emitting diodes (LED) for visual monitoring of individual modules. Components shall have interlocking circuits to assure fail-safe operation and to prevent unwarranted elevator movement should any component fail to function properly. Modules shall be of the type that plug into pre-wired mounting racks. Field wiring or alteration shall not be necessary in order to replace defective modules.
4. Design the system so that it will start properly when power is restored in the event of a power failure or interruption and sequence re-starting of elevators to prevent simultaneous starting of all elevators. Provide system memory so that data is retained in the event of power failure or disturbance.
5. Provide manufacturer's standard pre-engineered microprocessor system which shall control car movements in real time information, not predetermined operational profiles. Provide automatic dispatching of selected cars in response to hall calls with automatic response of system to changes in demand for different traffic conditions.
6. A car control station shall be furnished for each elevator that shall contain a bank of buttons numbered to correspond to the landing served. A dual riser of hall buttons shall be furnished. At each terminal landing single push button fixtures shall be provided and at each intermediate landing button fixtures shall be provided containing up and down push buttons.
7. When a call is registered by momentary pressure by a car or landing button, that button shall become illuminated and remain illuminated until the call is answered. Illuminated buttons serve as a visual indication that a call has been registered and that the car will stop at that landing.
8. Operation shall be automatic by means of the car and landing buttons. Response to hall calls shall be achieved by computing response time for each registered hall call. The computation of each car's response time to a hall call shall be based on factors such as distance, service to previously assigned car and hall calls, car load, direction, door and car motion status and coincidence of car and hall calls. The car with the least response time for total system dispatching optimization shall have the call assigned to it. Response computations for each hall call shall be repeated several times a second and hall call assignments changed if a more suitable car is found.
9. Load weighing transducers shall be furnished on the car platform or sling to operate at an adjustable fixed percentage of the load in the car (initially set at 60%). The car shall bypass hall calls when this device is actuated. This device shall also be used in determining load for hall call response analysis.
10. A diagnostic testing device, or maintenance terminal, suitable for all troubleshooting and testing procedures related to the specific type of microprocessor control, shall be installed on this project and provided at the final acceptance. This diagnostic testing device, or

maintenance terminal, shall conform to the operating procedures under the testing section of these specifications.

a. After successful testing of the diagnostic device, in conjunction with the microprocessor control, the testing device shall become the property of the Owner. The diagnostic testing device shall not become inoperative after a period of time requiring factory rehabilitation. The contract shall provide written certification that repair and support of the diagnostic tool components is readily available to the Owner in the future.
b. When repairs or replacement to the testing device become necessary prior to the final acceptance, the repairs, or replacement, shall be provided at no cost to the Owner.

11. Cross Dispatching Operation: Cross dispatching operation shall be provided during the renovation work to allow the new elevator control equipment to work in conjunction with the existing Otis controls in the building. The panel shall provide an effective method to utilize the newly installed two (2) risers of hall push buttons on the existing elevator group to provide basic dispatching of the elevators between the new and old groups. No temporary buttons shall be required during the renovation.
12. Additional special operations shall be included with the elevator control system:

a. Independent Service: A key switch shall be provided in the car control station of each elevator, which when actuated, shall disconnect the elevator from the hall buttons and permit operation from the car buttons only. Close doors by constant pressure on desired destination floor button. Open doors automatically upon arrival at selected floor.
b. Inspection Operation: Provide an operating fixture on top of the car containing continuous pressure "Up" and "Down" buttons for operating the elevator, an emergency stop button, a light and duplex receptacle, and a toggle switch which will make the top of car operating device operative.
c. Fireman's Emergency Service: Furnish emergency operation to return the elevators to Floor 1 and provide return to alternate Floor 2 when emergency is at Floor 2. Furnish "in car" control of each elevator during emergency operation by means of a key switch in the car. The respective fireman’s service visual indicators inside the cars shall blink intermediately upon activation of smoke sensors in the elevator machine room or hoistway as required by Elevator Code.
d. Access Key Switch Operation: Key operated switches shall be provided in the car and at the terminal landings for selecting hoistway access operation. When the inspection switch in the car is turned to the "ON" position, the car is put on inspection operation and can only be run by use of the switches at the terminal landings.

1) The car parks with the doors open and the closing circuit rendered operative. The inspector runs the car at low speed with the doors open by constant operation of the switch located in the elevator lobby. The car can be run up from the bottom floor to gain access to the pit and can be run down from the top floor to gain access to the top of the car. Travel is limited at both terminals by hoistway limit switches so that the car can be run away from the landing only as far as necessary for access to the pit or car top.

e. Communications System Verification Operation: Per Elevator Code, rule 2.27.1.1.6, provide a means within each elevator car that shall verify operability of the telephone line (or equivalent means). Verification of the telephone line (or equivalent means) operability must be automatically performed at least daily and shall not require activation of the two-way communications links. If the verification means determines that the telephone line (or equivalent means) is not functional, an audible and illuminated signal shall be activated. The visual signal shall be labeled "ELEVATOR COMMUNICATIONS FAILURE". The means to silence the audible signal shall be accessible only to authorized personnel. All operations shall be per Elevator Code requirements.

f. Emergency Power Operation: When the normal power fails, an emergency power source supplied by others is applied to each of the elevator nos. 1-4, 13 and 5-8, 14 disconnect switches. A signal shall also be provided by others from the emergency power transfer switch feeding elevator nos. 1-4, 13 and 5-8, 14 to each elevator group controller in the respective elevator machine room to indicate to the elevator control system that emergency power is available for emergency use.

1) When the elevators are on emergency power operation the elevators shall operate such that all car calls and hall calls for all elevators shall be made ineffective and the cars are initially rendered inoperative.
2) One car at a time shall be automatically selected to return to the first floor. A selected car stopped between floors by the disruption of normal power will first run at low speed to the nearest floor and then return at high speed to the return floor. If the selected car does not start running within a predetermined time, the selection proceeds to the next car.
3) When the selected car arrives at the return floor the doors open. After the normal door open time, the doors close, the car is rendered in-operative, except for door reopening, and the selection proceeds to the next car. After all cars have returned to the first floor, one car is automatically selected to run on normal operation under emergency power. The hall calls shall be made effective and the selected car responds to all hall calls and car calls as a normal operation.
4) An automatic and override selection key switch shall be provided in the elevator status panel in the Floor 1 lobby to allow manual selection of passenger car nos. 1, 2, 3, & 4, 13 and 5, 6, 7, 8, 14 to run on normal operation. When the switch is turned to the automatic position, the automatic selection feature is made effective. Selection of a particular car to run on normal operation is done by turning the selection switch to the position that represents that car. The switch shall be made such that each position is interlocked from the other position and only one car is allowed to run at a time.
5) When normal operation is restored, the Emergency Power Jewel shall extinguish and all cars shall continue on normal operation.

g. Elevator Emergency Power Pre-transfer Operation: Upon transferring power back from emergency power to normal (or vice versa during testing) the elevator group control system will receive a pre-transfer signal by other sections from the respective ATS to indicate to the elevator control system that the power source is about to transfer. There are two potential automatic transfer switches (ATS) that could provide the pre-transfer signal (they will never happen simultaneously). Signals

have been provided to the group controller in each elevator machine room, to indicate to the elevator control system that the respective ATS is about to change state. Upon receipt of the pre-transfer signal an elevator at a floor shall remain at that floor with the doors open and an elevator in motion shall proceed to the next available floor and open its doors. After the transfer of power is complete normal operation shall be restored.

h. Car-To-Lobby Operation: The elevators shall be provided with car-to-lobby operation such that a key switch is located at the elevator status panel at Floor 1 lobby for each elevator. When the key switch is activated, the respective elevator shall answer the existing car calls and return to the Floor 1 level, open the doors, and shut down. When the key switch is turned to the off position, the elevator shall return to group operation.

i. Swing Car Operation: Activation through the elevator status panel shall provide a selection for simplex service for Elevator No. 1. When the feature is activated, elevator no. 1 is taken out of normal automatic group operation and allowed to operate as a simplex collective elevator from its car buttons and a second set of hall buttons only.

   1) When the elevator returns to group operation, all simplex car calls are canceled, and Elevator No. 1 shall return back to normal group operation.

j. Door Hold Operation: For Elevator No. 1 provide a “Door Hold” button on the car control station panel on the elevator such that when the button is activated it shall illuminate and the door dwell time shall increase to 30 seconds for the movement of carts on and off the elevator. The timing devices shall be adjustable to increase or decrease the additional door dwell time from zero to one hundred twenty seconds. The increased door time shall be canceled upon initiation of any car button. After increased door dwell time has expired the doors shall close and the elevator shall return to normal operation.

k. Controlled Access Operation - Card Reader: Car calls from inconspicuous riser or main car operating panel may be entered only in conjunction with the access control system which provides the elevator controller with signals to enable/disable car calls. A card reader, provided by others, shall be installed in the inconspicuous riser and car station to provide authorized persons with ability to enter car calls for individual openings as determined by the access control system.

   1) The contractor shall surface mount the card reader (as provided by other Sections) at the proper ADA/accessibility height on the face of the inconspicuous riser and car control station panel. Wiring from the card reader shall be brought from the elevator car, through the traveling cable or wiring trough, and to the elevator machine room. Reader shall have a controller in the elevator machine room which shall be hard wired into the elevator control system under this section to individually enable/disable each car or hall call button. Coordinate with other Sections and provide wiring between readers and controllers as directed by Access Control Installer.

l. Interactive Monitoring System: Provide system access to microprocessor software. The system shall be coordinated with the State’s UC team. Install and set up a complete interactive elevator management system that includes the following:

1) For on premise solutions, provide windows-based or web based user interface system or for cloud solutions, provide web-browser interface compatible with current versions of Chrome or Edge web browsers that will provide monitoring and interaction with Elevator Nos. 1-14. The functions shall include displaying all elevators in real-time displays, floor status, car status, mode of operation (fire service, emergency power, normal operation, etc.) hall calls, date and time, as well as any other functions provided under the manufacturer's standard system. Interactive functions shall include at a minimum hall security functions, hall call initiation, car security (disabling/enabling calls to specific floors), the capability to change the door open and close times, elevator door dwell times, up peak, down peak, load weighing bypass, and pre-dispatch car load capabilities. The system shall display emergency conditions or events. Additionally, the system shall provide immediate fault notification and system performance reporting. System shall work via Ethernet connections. If software is required to access this system, a minimum of three (3) copies shall be made available for Owner's use. The system shall be completely set up and made operational by the Contactor on the Owner's hardware system prior to final acceptance. Set up shall include a minimum of (but not be limited to) four (4) hours of training of the Owner's personnel. Additionally, the manufacturer of the system shall be available for support and answering questions about the specific system installed at no cost to the Owner. Monitoring system shall not be proprietary to one elevator control manufacturers equipment and shall provide support to any elevator maintenance contractor at this facility.
2) There is a security system in place for the building, provided by Gallager Security Systems. Contractor after award is to coordinate with the State UC team to define interoperability and system interface capabilities once awarded contractor systems are identified.

D. Governors & Tail Sheave Assemblies: The existing governors, ropes, and tail sheave assemblies shall be removed and replaced with new and made to work in conjunction with the new control equipment. The car safety shall be activated by the governor in the elevator machine room when overspeed occurs. When the car over speeds the governor shall actuate an electrical switch prior to mechanical activation of the safeties which shall disconnect power to the motor and apply the brake. The electrical switch shall work in both directions per Elevator Code. The governor shall be fully enclosed with guarding to prevent accidental contact.

E. Machine Room Painting: Upon completion of the elevator work in the machine room all floors shall be patched flush from removal of old equipment and the floor shall be painted with one coat of quality floor paint, color to be gray.

2.3 CAR STRUCTURES

A. Platforms, Car Frames & Safeties: The existing platforms, car frames, and safeties shall be retained. All components shall be thoroughly cleaned and lubricated, and the safeties checked for proper operation. The cab steadiers shall be repaired and worn parts replaced.

1. The car frames and platforms shall be wire brushed of all dirt and loose paint and painted with two coats of a quality rust preventative type paint, color to be black.

2. The crosshead on top of each car shall be provided with a painted identification number of at least 4 inches in height. The crosshead data tags for each car shall be provided new, reflecting appropriate information per Elevator Code.
3. The vertical face of the platform guards on the front of each elevator car underneath the cab entrances shall be replaced with 48 inch guards. Guards shall be painted black or galvanized steel.

B. Roller Guides: The existing car roller guide assemblies shall be removed and provided with new. The new roller guides shall be spring loaded with a minimum of 6″ roller. Roller guide assemblies shall be adjusted for a smooth quality of ride upon completion of the renovation.

C. Top of Car Handrails: A standard railing, consisting of a top rail, intermediate rail, posts, and toe-board, shall be provided on the top of each elevator car where required by code. The top rail shall have a smooth surface and the upper surface shall be located at a vertical height of 42″ from the top of the car. The intermediate rail shall be located approximately half-way between the top rail and the top of the car. Posts shall be located not more than 7′-10″ apart. The toe-board shall be securely fastened to the posts and extend from the top of the car to a height not less than 4″.

D. Balance: After all components are assembled on the car structures, the elevator cars shall be properly balanced, and adjusted for alignment with the guide rails to equalize pressure on the roller guides for a smooth ride upon completion of the renovation.

E. Car Door Sills: The existing car door sills shall be replaced with new. The Elevator No. 1 car door sills shall be replaced with nickel silver sills and all others shall be aluminum.

2.4 HOISTWAY COMPONENTS

A. Guide Rails: The present guide rails for the cars and counterweights shall be retained. Rails shall be cleaned and realigned as required to assure smoothness of ride.

B. Hoistway Operating Devices: Normal terminal stopping devices shall be provided. When an emergency terminal stopping device is also required, it shall be furnished and the controller switches and circuitry arranged in accordance with the requirements of the Elevator Code.

C. Pit Stop Switches: New run/stop switches shall be provided in the pit and located at the pit access point for each elevator. The switches shall be located 18″ above the sill and 48″ above the pit floor, adjacent to the pit ladder.

D. Top of Car Operating Devices: A new top of car operating device shall be provided for each elevator and made to work with the new control equipment. The device shall have the proper buttons, switches, and stop switch to operate the elevator from on top of the car under inspection operation. The device shall be provided with a GFCI duplex receptacle and a guarded light providing 10 foot candles of illumination at any maintainable point on the car top.

1. If the stop switch on the top of car operating device is not within reach of the hoistway landing at either the front or rear entrance, a second stop switch shall be provided on the car top that is within reach of the hoistway landing.

E. Wiring: All hoistway and machine room wiring shall be installed new. The wiring and electrical interconnections shall comply with the governing codes. Insulated wiring shall have flame

retardant and moisture-proof outer covering, and shall be run in conduit, tubing or electrical wireways.

F. Traveling Cables: New traveling cables shall be provided for each elevator and shall be flexible, with a flame and moisture resistant outer cover, and shall be suspended with kellum grip hangers to relieve strain on individual conductors. Include the required number in addition to six (6) twisted pair spare sets of shielded communication wires and car lighting circuits from the machine room to the car connection points on the elevator.

1. Wire meshing, or similar means, shall be provided behind the traveling cable, between the elevator hoistways, to prevent the traveling cable from rubbing, chaffing against hoistway or car items, snagging, or swaying into the adjacent hoistway
2. Traveling cable shall include two (2) spare coax cables.

G. Oil Buffers: The present oil buffers for the cars and counterweights shall be retained as a means for retarding the movement of the car and counterweight at the bottom limits of travel. The buffers shall be drained, flushed and filled with new lubricants. The buffer channels and associated pit equipment shall be wire brushed and cleaned of all dirt and rust and provided with two (2) coats of a quality rust preventative type paint, color to be black.

H. Counterweights: The present structural steel frames and filler weights shall be retained. Filler weights shall be added or deleted to provide proper counterbalance upon completion of the renovations. Cars shall be counterbalanced after all new equipment has been installed and modifications to the elevator cabs has been completed as specified. Upon completion of the counterbalancing, all counterweight components shall be wire brushed and thoroughly cleaned of dirt and loose paint and painted with two coats of a quality rust preventative type paint, color to be black.

1. The existing counterweight roller guide assemblies shall be retained and provided with new rollers and springs. The assemblies shall be properly adjusted and aligned with the rails to provide a smooth quality of ride upon completion of the renovation.
2. There shall be new maximum counterweight runby signs installed on the rear wall of each pit for each elevator, per Elevator Code.

I. Suspension Means: Provide all new hoist ropes. Hoist ropes shall be traction steel of size, construction, and number to ensure proper operation of the elevator and give satisfactory wearing qualities. Ropes shall be ½” minimum.

J. Pit Ladders: The pit ladders for elevator nos. 1, 3, 5, 7, and 14 shall be moved to the interlock side of the elevator. All ladders shall be provided with a means to unlock the hoistway doors from inside the hoistway within 39″ of the ladder.

2.5 DOOR OPERATING SYSTEM

A. Door Operators: Doors on the cars and at the hoistway entrances shall be power operated by means of new heavy duty, closed loop, master door operators mounted on top of each car with all new associated operating linkages, door clutches, and gate switches. The motors shall have positive control over door movement for smooth operation. Each car door shall have a safety device to cause instant reopening should an obstruction be detected during the closing cycle.

1. Door operation shall be automatic at each landing with door opening being initiated as the car arrives at the landing and closing taking place after expiration of a time interval. A car door electric contact shall prevent starting the elevator away from the landing unless the car door is in the closed position.
2. Door close shall be arranged to start within a time consistent with ADA/accessibility code requirements. The time interval for which the elevator doors remain open when a car stops at a landing shall be independently adjustable for response to car calls and response to hall calls. The door dwell time interval shall be reduced to 1.0 second with the initiation of any car floor button.

B. Interlocks: A new positive interlock and pick up roller assembly shall be provided for each hoistway entrance and work in conjunction with the new, closed loop, door operator to be provided for each elevator. The interlocks shall prevent operation of the elevator unless all doors for that elevator are closed and shall maintain the doors in their closed position while the elevator is away from the landing.

1. New hoistway door unlocking devices shall be provided at all landings to permit access to the top of the car. All unlocking devices shall be actuated by a special key and access holes in hoistway door shall be protected by a naturally finished, barrel type escutcheon plate. New access holes shall be located at the proper height to meet code requirements. Old access holes shall be covered with a blank, paintable escutcheon plate.

C. Car Door Safety Devices: A new, full screen, infra red door protection device shall be provided for each elevator with the operation to be as follows:

1. The doors shall be prevented from closing from their full open position if a person or object comes within the zone of detection. The detection zone shall move with the doors and if a person or object enters the zone as the doors are closing, the doors shall reverse and reopen prior to physical contact. The doors shall reclose after a minimal time interval. After a stop is made, the doors shall remain open for a time interval to permit passenger transfer, after which the doors shall close automatically. This interval shall be less for a car call stop than for a hall call stop or a coincident car/hall call stop.
2. If the doors are prevented from closing for a fixed time period an audible chime shall sound on the car. When the object is removed form the zone of detection the doors shall close at reduced power and speed to below 2-½ ft.-lbs. of kinetic energy. If an object enters the zone of detection while the doors are closing at reduced power and speed the doors shall stall and not reopen. Once the object is removed from the zone of detection the doors will continue to close at reduced power and speed. This operation will continue until the doors are totally closed. Normal operation shall resume at the next landing reached by the car.

D. Car Door Restrictors: The door operating mechanism for each elevator shall be arranged so that the car and hoistway doors shall not be capable of be opened by hand more than four inches from within the elevator car when the car is outside the unlocking zone. Design of door restricting mechanism shall permit opening of car doors from outside of the elevator car without the use of special tools. Only mechanical type restrictors shall be used.

2.6 OPERATIONAL FIXTURES

A. Car Control Stations: Provide a new, applied car control station panel in each car. For Elevator No. 1, the panel shall be mounted on the front return. The panels shall contain a bank of

mechanically illuminated buttons marked to correspond to the landings served and containing other buttons, key switches, and controls required for specified car operation and control. Mount the panel at height of ADA/accessibility code requirements.

1. The car control station panel for each elevator shall incorporate the fireman's phase II key switch and associated fire operation fixtures inside a locked cabinet located at the upper portion of the panel. The phase II key switch, instructions, call cancel button, fire jewel, door open and door close buttons, stop switch and fireman's phone jack shall all be located within this locked panel. The front of the cabinet shall be labeled "Firefighters' Operation". The cover to the cabinet shall be openable with the same key that is used to operate the phase II key switch. The phase II instructions shall be provided inside the cabinet. This cabinet shall meet Elevator Code requirements.
2. All cars shall be provided with an illuminated alarm button. Button to illuminate when alarm active.
3. Elevator No. 1 shall be provided with an illuminated door hold button on the car operating panel.
4. The elevator number shall be permanently engraved at the top of the car control panel and the car capacity shall be permanently engraved at the bottom of the panel. Lettering shall be not less than ½″ high and both shall be black filled.
5. Each car control station panel shall also contain emergency car lights and the emergency power unit employing a sealed rechargeable battery and static circuits, or a portion of the cab ceiling lights shall be made to work on a similar emergency power unit. The battery shall be 6-volt minimum, sealed, maintenance free, of either lead acid or gel cell construction, and designed to give a life expectancy of not less than 5 years. Illumination for the elevator car and power for alarm bell shall be provided in the event of power failure.
6. Car Position Indicators: For each elevator, provide an "Elite PI+" as manufactured by C.E. Electronics (or another approved equal product). This fixture shall be mounted in the car control station and shall be arranged with portrait orientation. The fixture shall provide for a digital representation of the floor the car is passing or stopped and provide for electronic voice annunciation to indicate to the passengers the floor the car is stopped and the direction of travel when the doors open (i.e. "Level 01, Going Up"). In addition to displaying car position, the fixture shall be a multi-functional unit designed to display both custom graphics and text, such as advertisements, tenant or building information and text-based messages. The C.E. Electronics Elite PI EX121-AP2 shall be the model utilized for pricing. The model may change based on the determined needs of the Owner. Provide programming software and all required equipment for updating and changing displays. The fixture will have the ability to incorporate live News Stations, Stock Market info, etc. via a subscription service.
7. Two-Way Communication System: Provide a two-way communication system that is compatible with the existing phone system in the building per the following requirements:

    a. A speakerphone shall be located in the car control station of each elevator and be of the automatic dialing type and have the capability to automatically identify its location upon receipt of the call to the party answering the call.
    b. Provide an activation button for each car speakerphone, with integral legend, and identification plate adjacent to the button. Illuminate button to indicate call registration. Provide means to cause indicator light to flash when call is answered. Provide engraved legend below indicator light explaining phone instruction. The speakerphone shall meet the requirements of ADA/Accessibility guidelines.

c. Necessary shielded wires shall be provided by the Contractor for this section from the speakerphone in each elevator car, through the traveling cables, and shall terminate in a junction box on the elevator controller in the elevator machine room. Reconnecting to the existing building service system shall be provided by the Contractor for this section.

d. The elevator rise is greater than 60 feet, the phone system shall be designed to work in accordance with Elevator Code, Rule 2.27.1.1.4, providing a redundant emergency two-way communication system. Provide two-way voice communication between the lobby status panel and each elevator car. The emergency communication means shall enable emergency personnel to establish two-way voice communication to each car individually. It shall not require intervention by a person in the car and shall override communication outside of the building. The two-way communication shall be disconnected only when emergency personnel outside the car terminate the call.

e. Necessary shielded wires shall be provided by the Contractor in this section from the speakerphone in each elevator car, through the traveling cables, and to the master phone station in the respective elevator machine room. Connections to the existing building service system shall be provided by the Contractor in this section.

f. Once the two-way communication is established, a visual signal inside the car shall illuminate. The visual signal shall extinguish when the two-way communication is terminated.

g. Operating instructions shall be incorporated with or adjacent to the two-way voice communication device outside the car. Instructions shall comply with elevator code.

h. If the two-way communications devices are normally connected to the building's main power supply, then they shall be capable of automatically transferring to an alternate power source upon loss of power, such as a battery back-up system. The alternate power source shall be capable of sustaining operation and illumination of all signals for the devices for up to four (4) hours.

i. The master station in the lobby status panel shall be capable of handling an incoming separate line for each elevator. Necessary shielded wiring between the car and the master phone station be provided by the Contractor in this section.

j. On the same panel as the phone activation button, provide a display for messages from authorized personnel that acknowledge when two-way communication has been established and allow for further communication. Additionally, provide means for authorized personnel to obtain responses from entrapped passengers, including those who cannot verbally communicate or cannot hear.

k. Provide all required equipment, including any necessary software, in-car cameras, displays, computers, etc. required for authorized personnel receiving emergency calls from these elevators.

l. Authorized personnel receiving the call shall be provided with a means to display video of passengers at any location on the car floor.

m. The complete two-way communications system shall not be proprietary and shall not require any ongoing elevator maintenance agreement or elevator emergency call monitoring agreement from the elevator installer or any manufacturer. The building Owner shall have the option of having this system monitored by authorized personnel of their choosing.

n. The communications system shall provide for all operations necessary to comply with 2019 ASME A17.1 Rule 2.27.1.

o. The contractor in this section shall be responsible for phone, text and video monitoring during the maintenance and warranty period.
p. Exact requirements and connections shall be coordinated with State's UC team.

B. Hall Push Button Stations: The existing riser of hall buttons for each elevator group shall be replaced with new dual risers. The second riser to be placed on the wall opposite the existing single riser. At each terminal landing, a single button fixture shall be provided, and at each intermediate landing a two-button fixture shall be provided, containing the appropriate "Up" and "Down" buttons. All fixtures shall be installed at proper height in accordance with ADA/accessibility requirements. The hall button fixtures shall be the applied type with flat, flush stainless steel face plate. When a call is registered by any momentary pressure on the landing button, the button shall become illuminated and remain illuminated until the call is answered.

1. Other sections shall be responsible for cutting any new holes in the lobby walls. The Contractor in this section is responsible for coordinating the location and timing of all cutting.
2. The Contractor shall install the new hall button fixtures. The face plate of the new fixture shall be large enough to cover the new and old hall button access holes such that no refinishing of the front wall around the new fixture will be required.
3. The face plate of the Floor 1 hall button shall additionally contain the fireman's phase I key switch. The fireman's keyswitch shall be of a tubular, 7 pin, style 137 construction and shall have a bitting code of 6143521. The key shall be coded "FEO-K1." The fireman's phase I instructions shall be permanently engraved on the face plate or on an inset plate mechanically fastened flush with the face of the hall button fixture.
4. The faceplate of the Floor 1 hall button shall additionally contain the audible and visual alarm for the elevator group's "Emergency Communications System Failure Verification" in addition to the keyswitch for temporary silence of the alarm.
5. The face plate of the Floor 1 hall button fixture shall additionally contain an emergency power indicator.
6. The call buttons in the hall button fixture shall be centered at 42 inches above the finished floor. Assure there is space between the actual hall buttons and any other items on the fixture to avoid any confusion as to which button is the hall call button.

C. Inconspicuous Riser: For Elevator No. 1, provide inconspicuous riser hall button stations (single buttons at terminal landings and up and down buttons at intermediate landings) such that this car can be utilized in a simplex collective mode when needed, outside of their respective dispatch groups. Risers shall only be located at the front lobby locations.

1. All inconspicuous riser hall buttons shall be provided with a digital position indicator in the fixture.
2. On the inconspicuous fixture, a space for a card reader shall be provided. Hall calls shall only be able to be input with an acceptable card reader activation.

D. Hoistway Access Key Switch Fixtures: At the upper and lower terminal landings for each elevator, there shall be installed in the lobby wall, adjacent to the entrance jambs, a hoistway access key switch to work in conjunction with Hoistway Access Operation, as specified herein. The key switch shall be a three position, Up-Off-Down, key switch with spring return to the Off position and removable in the Off position only. The centerline of the key switch shall be located between 48″ and 72″ above the finished lobby floor and within 12″ of the entrance frame.

1. For elevator no. 1, the hoistway access key switch can be installed in the inconspicuous riser at the contractors discretion.

E. Hall Lanterns: The existing hall lanterns shall be removed and replaced with new fixtures. The operating function of the hall lanterns shall incorporate the appropriate direction gongs per accessibility requirements. Terminal floor hall lantern fixtures shall include a single lantern, whereas intermediate floors shall include two (2) lanterns, one for UP and one for DOWN. An electronic adjustable tone shall sound to announce the arrival of the elevator car. The tone shall sound once for the "UP" direction and twice for the "DOWN" direction four seconds prior to the arrival of the car.

F. Elevator Status Panel: For each group of elevators in this section, the existing elevator status panel in the Floor 1 lobby shall be removed and discarded. A new elevator status panel shall be provided and installed for each group in the existing location. The elevator status panel fixture shall incorporate digital position indicators and a car status light for Passenger Elevator Nos. 1-4, 13 and 5-8, 14. The position indicators and car status lights shall be properly identified with engraved nomenclature, lettering to be black filled and a minimum of ¼″ high.

1. The fixture shall be of the flush mounted type. The contractor shall be responsible for all wiring to the elevator status panel and for mounting of the fixture. The existing conduit between the hoistways and the elevator status panel shall be reused.
2. The lobby status panel shall also include an illuminated signal that indicates when each elevator is operational and when it is at the designated emergency return level with doors open. Provide illuminated signal that indicates when normal power supply has failed and when elevators are on emergency power.
3. The lobby status panel shall include an auxiliary firemen’s phase I key switch for the group of Elevator Nos. 1-4, 13 and 5-8, 14.
4. The lobby status panel shall include car-to-lobby key switches for each respective elevator. The car-to-lobby key switches shall operate such that, when turned to the “ON” position, the respective elevator shall answer the existing car calls and return to the Floor 1 level, open the doors, and shut down. When the key switch is turned to the “OFF” position, the elevator shall return to group operation. The key switch shall be removable in either position.
5. Each lobby status panel shall include function for the master phone station to comply with 2019 A17.1, with elevator rise greater than 60 feet. The functions shall be located behind a locked panel, with “Emergency Phone” engraved on the panel face, minimum ¼″ high, back filled black. Lock shall be slam to lock, keying shall be FEO-K1.

G. Fixtures: The hall lanterns shall be of the standard digital type. All newly provided car fixtures shall be constructed of stainless steel and all hall fixtures shall be constructed of stainless steel. All fixtures shall be provided with a no. 4 satin grain finish. Vandal resistant screws shall be provided for mounting all signal and operational fixture faceplates. Fixtures shall be as manufactured by the following or approved equal:

Elevator No. 1:

1. Otis – M3 Vandal Resistant
2. TK Elevator – Vandal Resistant with V2 Buttons
3. Innovation – Bruiser Line
4. PTL – Centurion Series

Elevator Nos. 2-4, 14 and 5-8, 14:

1. Otis – Luxury
2. TKE – Traditional Sherman Classic with V7 Buttons
3. Innovation – Universal
4. PTL – Performer

2.7 ELEVATOR CAR ENCLOSURES

A. For Elevator Nos. 2-8, 13 & 14, the existing steel car enclosures shall be removed and replaced as follows:

1. The elevator cab shall be a steel shell cab with exterior sound deadening mastic. The car side and rear walls shall each consist of formed steel panels, bolted together to form a complete steel shell cab. Cab shell panels shall be a maximum of 24″ wide and made of a minimum of 16-gauge steel (or, at Contractor's option, provide 14 gauge steel with a maximum panel width of 36″). All vents in the cab walls shall be concealed. The clear inside height of the cab shell shall be the manufacturer's standard 8′-0″ cab.
2. The interior finishes and ceilings shall be provided per Division 142700.
3. The front return panel shall incorporate an integral entrance column, shall be brushed stainless steel a minimum of 16 gauge, and shall extend from finished floor to underside of fascia. The front return panel shall be arranged for mounting the car control station panels. A full width fascia of brushed stainless steel shall be furnished over the return panel and car entrance.
4. The canopy shall be provided with two (2) coats of matte white paint on the car side.

    a. The existing top emergency exit panels shall be retained and provided with an electrical device that will prevent operation of the elevator cars if the exit cover is open more than 2 inches. Devices shall be designed in accordance with Elevator Code requirements.
    b. A new cab exhaust blower fan shall be provided and installed on each car top. Mount with rubber grommets and adjust for smooth, quiet operation. The fans shall be Morrison Model OE or approved equal.
    c. One light fixture shall be connected to the emergency power circuit and shall operate as the emergency power light for inside the cab upon power loss.

5. The car entrances shall be provided with new single-speed, center-opening car door panels with a brushed stainless steel facing on the car side suitably reinforced with applied hangers with track. The door shall be of hollow metal construction. Hangers shall be of the sheave type, two sheaves per door, rotating on a precision ball bearing. The roller shall be on an eccentric stud to provide adjustment. Car doors shall be provided with two phenolic gibs per car door panel.
6. The car door sill shall retained and thoroughly cleaned. The car door sill shall accept the car flooring so the flooring is flush with the car door sill upon completion of the installation. The existing car flooring shall be removed and replaced with new flooring, to be provided and installed by other trades. Exact flooring and subflooring thicknesses to be verified by contractor with flooring manufacturer. The Contractor in this section shall allow for the thickness and weight of the flooring, provide any necessary subflooring, and set the car entrance sills accordingly so as to avoid any tripping hazard.

7. The car enclosures shall comply with the ASME A17.1 Safety Code for Elevators and Escalators. All stainless steel shall be provided with #4 brushed finish.

B. For Elevator No. 1, the existing steel car enclosures shall be removed and replaced as follows:

1. The elevator cab shall be a steel shell cab. The elevator cab side walls shall consist of formed rigidized stainless steel panels, bolted together to form a complete steel shell cab. Cab shell panels shall be a maximum of 24″ wide and made of a minimum of 16 gauge rigidized stainless steel (or, at Contractor's option, provide 14 gauge rigidized stainless steel with a maximum panel width of 36″). Panels shall be provided with sound deadening exterior matting. Rigidized stainless steel shall have a 5WL pattern with a satin finish. The clear inside height of the cab shell shall be the manufacturer's standard 8′-0″ cab.
2. The front and rear return panels shall incorporate an integral entrance column, shall be brushed stainless steel a minimum of 16 gauge, and shall extend from finished floor to underside of fascia. The strike jamb shall also be stainless steel a minimum of 16 gauge. The front and rear return panels shall be arranged for mounting the car control station panel. A full width fascia of brushed stainless steel shall be furnished over the return panel and car entrance.
3. The car top shall consist of a panel which shall be clad with sheet metal and contain a hinged top emergency exit panel 17" x 24", or code compliant equal. The car top material shall be a minimum of 12 gauge steel suitably reinforced with matte white painted finish.

    a. Provide an interlock on the top of car emergency exit that will prevent operation of the elevator car if the exit cover is open more than 2″. Interlock shall be designed in accordance with code requirements.
    b. The ceiling shall be furnished with a concealed suspended frame supporting individual wood-core panels incorporating a brushed stainless steel finish on the exposed surfaces. Each panel shall contain a down light fixture with LED bulbs. A dimmer switch shall be provided on the car top to adjust the car lighting in the elevator car.
    c. A two-speed fan shall be mounted in the car top above the ceiling. Mount with rubber grommets and adjust for smooth, quiet operation. Fan shall be Morrison Model OE or approved equal.

4. The car entrances shall be provided with a single-speed, center-opening car door on the front and a two-speed, side-opening car door on the rear with a brushed stainless steel facing on the car side suitably reinforced with applied hangers with track. The door shall be of hollow metal construction. Hangers shall be of the sheave type, two sheaves per door, rotating on a precision ball bearing. The roller shall be on an eccentric stud to provide adjustment. Car doors shall be provided with two phenolic gibs per car door panel.
5. New nickel silver car sills shall be installed such that the platform is recessed below the car door sill to accept the car flooring so the flooring is flush with the car door sill upon completion of the installation. The car flooring shall be stainless steel checker plate, with Mill 2B finish.
6. A stainless steel handrail shall be furnished on the side walls of the elevator cab and shall be mounted such that the top of the handrail is 34" above the finished floor. The handrail shall be a minimum of ⅜″ by 2″ square and the ends shall return back to the cab walls. Provide one continuous handrail on each wall. There shall be a minimum of four (4) supports on each side rail. Additionally, a ⅜″ by 8″ stainless steel bumper plate shall be installed on the side and rear walls of the elevator cab and mounted flush to the cab wall.

The bumper plate shall be mounted at 10” from the finished floor to the top of the bumper. Handrail and bumper plate to be provided with a brushed, stainless-steel finish. Rails shall terminate within 6″ of cab walls.

7. The elevator cab shall be provided with protective stainless steel pad buttons permanently installed on the sides, and front and rear return panels. Pad buttons shall be bolted through to the back side of the cab wall. The contractor shall supply one (1) set of protective pads for the elevator upon substantial completion of the elevator work, pad color to be chosen from manufacturer’s standards.
8. The car enclosures shall comply with the ASME A17.1 Safety Code for Elevators and Escalators. All stainless steel shall be provided with #4 brushed finish.

2.8 HOISTWAY ENTRANCES

Elevator Nos. 1-4, 13 and 5-8, 14 Passenger Entrance Summary

Total Number -	Eighty-eight (88)
Type-	Front Entrances: Center Opening, Single Speed Elevator no. 1 Rear Entrances: Side Opening, Two Speed
Entrance Jamb-	Retain Side & Head Jambs and Transoms. Provide Stainless Steel Wrapping.
Clear Opening-	Front Entrances: 3'-6" Wide by 7'-0" High Elevator no. 1 Rear Entrances: 4'-0" Wide by 7'-0" High

A. The existing hoistway entrance assemblies shall be retained and modified as follows:

1. Frames: The existing frames shall be retained. At all bronze floors, new 18-gauge satin stainless steel wraps shall be installed and securely adhered/fastened in a professional manner to the existing frames. The new wraps shall extend all the way up past the transoms to make certain all bronze finish is covered.
2. Sills: The existing hoistway door sills shall be retained. The sills shall be thoroughly cleaned upon completion of the renovation.
3. Fascia Plates, Toe Guard & Dust Covers: The existing components may be retained. The contractor is responsible for checking the components and providing any additional required fastenings to assure they are totally secured to the hoistway structure. Any missing fascia or hanger covers shall be replaced with new. Upon completion, all fascia plates, hanger covers, toe guard, and dust cover shall be painted. The surfaces shall be wire brushed and thoroughly cleaned upon which time painted with one coat of a quality rust preventative type paint, color to be black.
4. Headers: The existing headers shall be retained. The plates shall be checked and any additional fasteners provided to assure they are secure to the hoistway entrances.
5. Hangers and Tracks: New hangers and tracks shall be provided for all entrances. Hangers shall be of the sheave type, two sheaves per door, rotating on a precision ball bearing shall be provided. The roller shall be on an eccentric stud to provide adjustment. Hangers shall be applied or integral on the top of the doors. Hanger fascia dust covers shall be provided over all hangers and shall be galvanized or painted steel. New steel tracks shall be provided and securely mounted to the entrance header.
6. Closers: The existing closers shall be replaced with new. All closers shall be adjusted to assure proper automatic closing of the doors when the car is away from the respective floor. Adjust all equipment for smooth operation.

7. Door Panels: At all front entrances, except Floor 1 for Elevator Nos. 1-4, 13 and the rear entrance of Elevator No. 1 at Floor 1, the existing door panels shall removed and provided with new. Provide steel hollow metal doors of the size and type to match existing, fabricated from steel sheet material with vertical internal channel reinforcements spaced at not more than 6″ on centers and welded to face sheets. Panels shall be provided with a brushed stainless steel finish on the lobby side. For all rear entrances except Floor 1 and front entrances for Elevator Nos. 1-4, 13 at Floor 1, the panels shall be retained. Bottom of doors shall be provided with two (2) removable phenolic guides per door panel, which run in the sill slots with minimum clearance. The door panels shall be furnished with barrel type, naturally finished, escutcheon plates for the door unlocking devices at each landing.

    a. Hoistway doors shall be manufactured in accordance with the procedure established by Underwriters Laboratories and shall be so labeled. Four-inch decals indicating floor identification shall be applied on the hoistway side of the hoistway door panels.
    b. Steel sight guards shall be furnished on the leading edge of the doors to conceal the hoistway beyond the doors. Finish to match door panels.

8. Handicap Jamb Markings: The existing jamb Braille markings shall be removed and replaced with new. Provide stainless steel jamb marking plates with raised floor markings, a black background, and braille to identify each landing on both jambs of each hoistway entrance. Jamb marking plates shall be mechanically fastened to the entrance jambs utilizing stainless steel drive pins in the four corners of the plates.
9. Elevator Identification Signs: Provide new applied elevator identification signs with black raised number markings and a stainless steel background to identify the elevator on both jambs of the main and alternate fire recall floor hoistway entrances. Signs to be mounted directly below handicap jamb markings, vertically in line with handicap jamb markings, with ¼″ to ½″ inch space between signs.
10. Fire Evacuation Signs: Provide applied fire evacuation signs incorporating a pictograph as depicted in 2.27.9 of the Elevator Code and mount above each hall button in the elevator lobbies. Signs to be made from stainless steel, brushed finish, and engraved.
11. All stainless steel shall be provided with #4 brushed finish unless stated otherwise.

PART 3 - EXECUTION

3.1 PREPARATIONS

A. Site Inspection: Prior to commencing elevator renovation inspect hoistways, hoistway openings, pits, and machine room as constructed. Contractor is responsible for all dimensions as field measured by the Contractor for proper installation and performance of elevator work.

    1. Contractor shall be responsible for inspecting and determining extent of work to be performed at the site to complete the work. Contractor must take into account all requirements for installation of new work, access, code requirements, and removal or demolition, which shall be performed without additional cost to the Owner.

B. Demolition: The removal of all elevator equipment, which is not to be retained in the renovation, shall be completed by the Contractor. The old elevator equipment removed becomes the property of the Contractor and it is his responsibility to remove this equipment from the project site. Include all work necessary to protect the public, building occupants, building employees, and building property during removal of demolished materials.

1. When barricades are required for protection of the hoistway they shall be provided by the Contractor. Do not start demolition of an area until all temporary protection and temporary partitions are in place as furnished by the contractor. Temporary screening between adjacent hoistways shall be provided during the renovation and shall be removed after completion of the elevator work.

C. Prior to renovation/installation of elevator systems, contractor shall supply information regarding the software required for use with controllers or connections to the State network. Please see the cybersecurity requirements.

3.2 RENOVATION/INSTALLATION OF ELEVATOR SYSTEM

A. General: Comply with manufacturer's instructions and recommendations for work required during installation, referenced codes, and specifications

B. Welded Construction: Provide welded connections for installation of elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance and replacement of worn parts. Comply with AWS standards for workmanship for qualifications of welding operators.

C. Coordination: Coordinate elevator work with other sections for proper time and sequence to avoid construction delays. The contractor shall provide fully operational elevator system as stipulated in the construction schedule. The contractor shall maintain full crews and continue work once elevator demolition begins until the elevator system is completed and operational and accepted by the Owner. The contractor shall provide the number of crews required to maintain the schedule and shall provide additional manpower and work such additional hours as are necessary to bring the project back on schedule.

D. Sound Isolation: Mount any new rotating or vibrating elevator equipment and components on vibration absorption mounts, designed to effectively prevent transmission of vibrations to structure, and thereby eliminate sources of structure borne noise from elevator system.

E. Guide Rails: The existing guide rails are being reused and it is the Contractor's responsibility to see they are adaptable to all new equipment, erected plumb, properly aligned, and anchored securely to the existing structure.

F. Hoisting: All required hoisting and movement of the elevator equipment shall be the responsibility of the contractor in this section.

G. Final Cleaning and Painting: Upon completion of all elevator work, provide total clean down of elevator equipment. All steel components in machine room and hoistway shall be provided with touch up painting to remove all scratches and blemishes incurred during the course of the work.

3.3 ELECTRIC WIRING

A. Conductors: Copper throughout with individual wires coded and all connections on identified studs or terminal blocks. Use no splices or similar connections on any wiring except at terminal blocks, control cabinets, junction boxes or conduits. Provide 10% spare conductors throughout, including traveling cables.

B. Conduit: Painted or galvanized steel or aluminum conduit and duct shall be used. Conduit size shall be ¾-inch minimum, except that ½-inch can be used for runs containing only 2 wires. Flexible conduit exceeding 18 inches in length shall not be used. Flexible heavy duty service cord, type SO, may be used between fixed car wiring and car door switches for safety edges.

3.4 FIELD QUALITY CONTROL

A. Acceptance Testing: Upon nominal completion of the elevator installation, and before permitting use of elevator (either temporary or permanent), perform acceptance tests as depicted in Rule 8.10 "Acceptance Inspections and Tests" of the Elevator Code. Also perform other tests, if any, as required by governing regulations.

1. Contractor is responsible for coordinating observance of final acceptance inspection with the Owner's representative and a representative of ATIS Elevator Consulting, as they have been retained by the Owner to represent the State of Missouri as the Licensed Elevator Inspector. Contractor is also responsible for coordinating any additional inspectors as required by local jurisdiction.
2. All fire alarm and emergency power testing shall occur outside of normal working hours for the building and be scheduled with the Owner.

B. Diagnostic Testing: The diagnostic testing device, or maintenance terminal, provided shall be demonstrated and tested during the final testing of the elevator installation. This diagnostic tool shall have the capability of troubleshooting and field programmability of all control variables providing interaction between the service man and the microprocessor controller including performance of all ongoing safety testing as required by the Elevator Code.

3.5 PROTECTION

A. At the time of substantial completion of elevator work (or portion thereof) provide suitable protective covering, barriers, devices, signs, or such other methods or procedures to protect elevator work from damage or deterioration. Maintain protective measures throughout remainder of construction period.

3.6 INSTRUCTION AND MAINTENANCE

A. A maximum period of four (4) hours shall be dedicated to instruct Owner 's personnel in proper use, operation and daily maintenance of elevators, including use of Interactive Monitoring and Security Access systems. Review emergency provisions, including emergency access and procedures to be followed at time of failure in operation and other building emergencies. Train Owner's personnel in normal procedures to be followed in checking for sources of operational failures or malfunctions. Provide instruction on the use and capabilities of the diagnostic testing device, or maintenance terminal. A complete manual of instruction shall be provided with the diagnostic equipment.

3.7 CYBERSECURITY REQUIREMENTS

A. Access Management: The contractor's Internal Access Management must comply with NIST 800-53 controls or ISO27001 standards, and the contractor must provide multi-factor authentication for their employee remote access to all internal and cloud-based systems.

1. The contractor MUST ensure personnel with access to state data (including any third-party personnel with access) pass standard background checks equal or better than those required by the State of Missouri for information technology employees. If required by the state to address an audit, the vendor must attest whether all applicable employees passed background checks performed in accordance with the contractor's standard background check process.
2. All contractor employees and subcontractor's employees must receive annual cyber security training.

B. Network Architecture: The contractor shall use safeguards designed to prevent the inappropriate use or disclosure of the state's proprietary or confidential information. The contractor must provide protection against cyber threats using advanced tools including, Advanced Firewall stacks, Web Application Firewalls, Intrusion Prevention appliances, advanced end-point protection agents, and advanced threat correlation and incident response systems.

1. The contractor's systems and applications must be mitigated against the Open Web Application Security Project (OWASP) top 10 vulnerabilities.
2. The contractor's solutions must meet vulnerability and patch management/mitigation standards.
3. The contractor must encrypt all State of Missouri sensitive information stored on servers both at rest and while in transit.
4. System log retention must meet State of Missouri regulatory requirements. (Requirements shall be provided by the state agency.)
5. The contractor must provide a solution for monitoring log data to meet State of Missouri regulatory requirements. (Requirements shall be provided by the state agency.)

C. Backup and Data Recovery: The contractor must provide a backup and data recovery solution to the State of Missouri for the technology service provided.

1. The contractor must provide a solution to conduct tests at least annually to ensure a successful restoration. Regular checking of backups and restore procedures must ensure a smooth recovery.

D. Maintenance and Support: If the solution is vendor managed, the agency is required to purchase maintenance and support to ensure security updates are maintained for the life of the solution.

3.8 ELEVATOR SCHEDULE

Renovate	Ten (10) electric traction passenger Elevator Nos. 1-4, 13 and 5-8, 14. Replace geared machines with gearless machines.
Capacity	Retain 3,500 lbs. Retain 4,500 pounds for Elevator No. 1
Speed	Retain 350 fpm.
Operational Control	New five (5) car group operation with computerized microprocessor logic control with additional features - Independent Service Fireman's Emergency Service Oper.

	Communications Verification Oper. Emergency Power Sequencing Oper. Car-to-Lobby Operation Door Hold Operation Elevator No. 1 Swing Car Elevator No. 1 Card Reader Operation
Machines	Remove existing geared machines. Provide new AC gearless drive machines, roped 1:1.
Motor Control	New VVVF AC motor drives.
Power Characteristics	Retain 480 volts, 3 phase, 60 Hertz
Governor Systems	Provide new governors, tail sheaves and governor ropes.
Stops & Openings	Eight (8) stops & openings all in the front of the hoistway at Floors ★1-8. Elevator no. 1 additionally serves eight (8) rear entrances at floors 1R-8R
Approximate Travel	91′-0″
Inside Car dimension	Retain existing.
Entrance Size	3′-6″ wide by 7′-0″ high. Elevator No. 1 rear entrance 4′-0″ wide by 7′-0″ high
Entrance Type	Center opening, single speed. Elevator No. 1 rear entrance side opening, two speed.
Hoistway Entrance	Retain entrance frames and sills. Provide all new operating assembly components including hangers, tracks, panels, gibs, interlocks, and closers. Retain door panels specified.
Door Operation	Provide new heavy duty, closed loop door operators. Provide new full infrared screen detector.
Guide Rails	Retain steel tees for cars and counterweights and realign as necessary. Clean rails of all old test marks.
Car Structures & Safeties	Retain existing car structures and safeties. Provide new spring-loaded, adjustable roller guides, car top rail, switch for top of car exits and toe guards.
Counterweights	Retain counterweights and provide new rollers for the counterweight roller guides. Add/delete weights for proper counterbalance.
Ropes	Provide all new hoist ropes.
Buffers	Retain car & counterweight oil buffers.
Car Enclosures	Provide new cabs and interior finishes as specified.
Signals -	

Car Control Stations	Provide new, dual car control station panels to be provided with integral speaker phones, fireman's emergency service phase II cabinets, and Elite Pi with voice synthesis. Finish to match cab front return.
Hall Buttons	Replace riser of hall push buttons at all floors with new flush mounted fixtures. Provide second riser for each group.
Inconspicuous Riser	A riser shall be added adjacent to the front entrances to Elevator No. 1 for use during simplex operation. Floor 1 hall buttons to contain Firemen's Emergency Service Operation components and Communication Verification components.
Hall Lanterns	Provide new at all floors.
Hoistway Access Key Switches	Provide new hoistway access key switch fixtures at the top and bottom terminal landing for each elevator.
High Rise Status Panel	Provide new elevator status panel in Floor 1 lobby with emergency power selection key switch.
60-Foot Master Telephone	Provide a master telephone to meet Code requirements. Locate the phone in the lobby status panel.
New Installation Service	Full maintenance service from thirty (30) days prior to the start of construction until 12 months after substantial completion of Project.

END OF SECTION 142100

SECTION 142400 - HYDRAULIC PASSENGER ELEVATOR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General Provisions of Contract, including general and supplementary conditions, special conditions and Division l Specification sections, apply to work of this section.

B. Provide all labor, materials, services, and equipment necessary to complete the renovation of the elevator as specified herein.

C. Anything not mentioned in these specifications or vice versa, as well as any work which is obviously necessary to complete the Project, within the limits established by the drawings, specifications and codes, although not shown on or described therein, shall be performed by the Contractor as part of their work.

1.2 DESCRIPTION OF WORK

A. This section includes the substantial renovation of three (3) direct plunger hydraulic passenger Elevator Nos. 9, 10 and 11 in the Truman State Office Building, 301 W High Street, Jefferson City , Missouri, as noted in the elevator schedule at the end of this section. The schedule indicates the elevator to be renovated, required performance, control, capacity, features, and finishes for the elevator.

B. Hydraulic elevator is defined to include a plunger & cylinder unit connected to the elevator platform which will raise and lower the elevator by using pumping units using oil as the medium complete with components, controls and devices as indicated as required for safely operating elevator at rated speed and capacity.

C. The renovation of the elevators shall be completed one (1) elevator at a time, to occur simultaneously with Elevator Nos. 1-8, 13-14 in the same project. There shall be no more than one (1) elevator out of service at any one time.

1. All tasks to be performed that will require more than one (1) elevator per group to be taken from service at a time shall be scheduled with the Owner and performed outside of the Owner’s normal working hours.
2. Prior to commencement of the work specified herein, the Contractor shall submit to the Owner a task-specific schedule for the elevator renovations. This schedule shall identify critical dates and dates for which owner-provided work is to be performed and completed so as to provide for uninterrupted progress of the work.

1.3 QUALITY ASSURANCE

A. Installer Qualification: The elevator manufacturer, or a licensee of the manufacturer, who has a record of successful experience with the renovation of similar elevators. The contractors shall have, as a minimum, the following qualifications and documentation verifying these qualifications shall be submitted prior to award:

1. Minimum of five (5) years successful experience in installing and servicing similar elevator renovations.

2. Installed at least ten (10) completed and accepted elevator systems of similar size, scope, logic control, and motion control required by this contract.
3. An existing in-house administrative and technical organization staffed with competent personnel who are experienced in the elevator related work required to install and service the elevator system as specified.

B. Elevator Code: Except for more stringent requirements as indicated or imposed by governing regulations (which must be complied with), comply with applicable requirements of the ASME A17.1-2016 Safety Code for Elevators and Escalators hereinafter referred to as the "Elevator Code" as required by the local Authority Having Jurisdiction (AHJ) and the 2018 International Building Code, hereinafter referred to as the "Building Code".

1. The phone component of the elevator systems shall comply with 2019 A17.1 means for two way text, two way voice and one way video. A variance shall be sought from the State of Missouri Elevator Safety Division, by the contractor in this section, for these devices to be installed.

C. NEC Code: Comply with the NEC Code and specifically with sections relating to electrical work for elevators.

D. Accessibility Standards: Comply with ANSI A117.1 - 2009 American National Standard for Accessible and Usable Buildings. Comply with the guidelines stipulated by the "Americans with Disability Act" (2010).

E. Performance Requirements: Provide an elevator that meets the following performance requirements:

1. Speed: +/- 5% of specified contract speed under a full load condition in either direction.
2. Stopping Accuracy: 1/4 inch under any loading condition.
3. Floor to Floor Performance Time: 17.0 seconds (based on a floor height of 13′-0″) from start of doors closing until doors are 3/4 open and car is level and stopped at the next successive floor under any loading condition or travel direction.
4. Door Close Time: 4.0 seconds
5. Door Open Time: 3.0 seconds
6. Door Open Dwell Time: 3.0 seconds car call / 5.0 seconds hall call. Dwell time shall be canceled upon activation of the door protection device or any car call button.
7. Nudging: 60 seconds (adjustable and capable of turning on or off)
8. Smooth acceleration and deceleration for comfort of ride.

1.4 SUBMITTALS

A. Refer to Division 1 for additional information regarding submittals, including submittal requirements, processing procedures, and limitations of review.

B. Pre-Construction Submittals: The following shall be submitted for review prior to manufacturing of equipment.

1. Product Data: Submit manufacturer's technical product data and instructions for each principal component or product. List and describe features of control system, performances, and operating characteristics. Submit brochures of all signal and operational fixtures, control and drive equipment, hoistway door equipment, door operator, and door protective device.

2. Shop Drawings: Shop drawings shall be prepared by skilled draftsmen and presented in a clear and thorough manner as follows:

    a. Job-specific Elevator Layout Drawings: Drawings shall include dimensional layout drawings for the elevator, showing plans, elevations, sections, and large scale details of hoistway and machine room indicating service at each landing, coordination with building structure, and relationships with other construction including, but not limited to, electrical and HVAC equipment. Indicate maximum dynamic and static loads imposed on building structure at points of support per the ASME A17.1 Safety Code for Elevators and Escalators. Indicate capacities, speeds, sizes, performances, operations, safety features, controls, finishes, and similar information on the layout drawings.
    b. Machine Room Layout Drawing: Submit job-specific, straight line dimensional drawings of elevator machine rooms, with locations where other trades equipment are can be provided.
    c. Fixture drawings: Submit job-specific, straight line dimensional drawings of all signal and operational fixtures.
    d. Car Enclosures: Submit job-specific plans, elevations, and details of car enclosures and finishes.
    e. Approval of shop drawings is for general arrangement only and does not include measurement, which is the contractor's responsibility, or approval of variations from the contract documents. The purpose of the shop drawing submittals by the contractor is to demonstrate to the owner the contractor understands the design concept and demonstrates an understanding of the equipment and materials to be furnished.

3. Samples: Submit samples of exposed finishes of car enclosures, hoistway entrances, and signal equipment per Division 1 requirements.
4. Maintenance Certification: The Contractor shall submit a written certification, signed by the Contractor and the manufacturer of the equipment, making a commitment to provide direct support to the Owner, or the Owner’s elevator maintenance service representative, including availability of parts (for inventory, not on an “exchange only” basis), diagnostic tools, and technical & engineering support. In addition, all parts and support shall be provided at a reasonable cost in line for which the original manufacturer would charge to its own customer base and response shall be in a timely manner. This commitment shall remain in effect for a minimum of twenty-five (25) years after substantial completion of the project.
5. Provide verification that all Information Technology systems and/or services provided to the State of Missouri must comply with National Institute of Standards and Technology (NIST) 800-53 or International Organization for Standardization (ISO) 27001 standards. The solution shall provide capabilities that support the state’s ability to remain in compliance with applicable federal laws and regulations related to the security and hosting services for the term of the contract.

    a. The contractor must internally comply with NIST 800-53 or ISO27001 standards. The contractor must document how they have internally adopted and comply with NIST 800-53 or ISO27001 by providing a list of titles of the cyber security policies currently in use to designated personnel in the State of Missouri, including proof of any certifications obtained by the contractor (i.e. SOC2, ISO27001/2).

C. Post Construction Submittals: Prior to completion and acceptance of the project, the following shall be submitted for review and acceptance.

1. Diagnostic Device: Upon completion of work provide diagnostic testing device, or maintenance terminal, suitable for all troubleshooting and testing procedures related to the specific type of

microprocessor control. This diagnostic testing device, or maintenance terminal, shall conform to the operating procedures under the testing section of these specifications. If onboard diagnostics are provided in the controller to meet this requirement, provide Adjustors Manual for proper interpretation of onboard diagnostics (see 1.3.C.2.b below).

2. Maintenance Manuals: Submit job-specific bound manuals for each elevator or group of elevators. Submit the required number in hard copy plus a minimum of one (1) electronic copy in .pdf format.

    a. Operating and maintenance instructions, lubricating schedule and instructions, parts listing, recommended parts inventory listing for motor and critical components, diagnostic device operations manual, emergency instructions and similar information. Include description of any manufacturer specific safety features that are beyond code requirements.
    b. The diagnostic device operations manual shall be complete with adjustment settings, sequence of operation, and other diagnostic technical data required for adjustments, tuning, maintenance, and operation of the elevators including performance of all required acceptance and periodic testing required by the Elevator Code. User's instruction manual shall include access codes required for accessing microprocessor equipment for adjusting or programming.
    c. Detailed "Maintenance Control Program" - specific to the elevator as required by Elevator Code. The MCP shall be in place to maintain the equipment in compliance with Elevator Code. The MCP shall specify examinations, tests, cleaning, lubrication, and adjustments to applicable components at regular intervals and shall comply with Section 8.6.1 of the Elevator Code. The MCP shall include "On-Site Documentation" and a method for "Maintenance Records" and "On-Site Maintenance Records" as described in Elevator Code. One (1) hard copy of the "Maintenance Control Program," identical to the MCP provided in the Maintenance Manual, shall be placed for use in the elevator control room.
    d. Wiring Diagrams: Complete electrical circuit diagrams for control and operational features as installed, showing location and wiring for power, signal and control systems. The diagrams shall differentiate clearly between manufacturer-installed wiring and field installed wiring.

3. On-Site Wiring Diagrams: Provide job-specific wiring diagrams located near the elevator controller in the elevator control room. Provide one (1) hard copy sized at 11″ x 17″ minimum, clear-laminated wiring diagrams.
4. Keys: Provide a total of six (6) sets of keys for each type of key fixture on the elevator equipment. Keys shall be tagged with permanent marking, identifying function and use.
5. Certificate Frame: Provide a certificate frame in the elevator machine room mounted in a conspicuous location. Frame shall be made of a quality metal with a window size to house the operating certificate from the State of Missouri.
6. Certificates and Permits: Provide Owner with copies of all inspection/acceptance certificates and operating permits as required by governing authorities to allow normal, unrestricted use of elevator. If any variances are required from the State of Missouri for the product installed, they shall be obtained by the Contractor. Provide a copy of any variances to the Owner upon completion of the project.

1.5 INITIAL MAINTENANCE SERVICE AND WARRANTY

A. Provide Initial Maintenance Service and Warranty per requirements described in Section 142100 - 1.5.

PART 2 - MATERIALS AND COMPONENTS

2.1 GENERAL

A. Provide manufacturer's base pre-engineered elevator system with modifications or added features that will comply with the elevator work requirements as specified herein or, at manufacturer's option, provide custom manufactured base elevator system that will comply with the requirements. Where components are not otherwise indicated, provide standard components, published by the manufacturer as included in standard pre-engineered elevator systems, and as required for a complete system.

2.2 ELEVATOR MACHINERY AND CONTROL EQUIPMENT

A. Elevator Nos. 9-10 Hydraulic Power Unit: The existing pumping unit shall be removed and replaced with a new pumping unit of an integral design and shall include an electric motor connected to a pump, a hydraulic control system, storage tank, necessary piping connections, and a controller, all compactly designed as a self-contained unit. The new pumping unit shall be located in the elevator machine room and the controller shall be mounted on the end of the machine or mounted on the wall of the machine room to meet NEC working clearance requirements. The hydraulic power unit shall be securely fastened to the machine room floor to prevent the tank from being overturned or displaced. Elevator contractor shall verify location and dimensions in general layout of machine room. Provide proper isolation pads under the feet of the pumping unit to substantially eliminate vibrations from the operating unit to the building structure.

1. The hydraulic control system shall be a compact design suitable for operation under the required pressures and it shall be mounted in the storage tank. The control valve will be a manifold type with up, down and check valve sections. A control section including solenoid valves will direct the main valve and control up and down starting, transition from full speed to leveling speed, up and down stops, pressure relief and manual lowering. Down speed and up and down leveling shall be controlled at the main valve sections. All of these functions shall be fully adjustable for maximum smoothness and to meet contract conditions. All control systems shall be pre-adjusted at the factory. A manual lowering feature shall be provided to permit lowering the elevator at slow speed in the event of power failure or for adjusting purposes.
2. The pump shall be a positive displacement screw type to give smooth operation and shall be especially designed and manufactured for elevator service.
3. The motor shall be of the alternating current, poly-phase squirrel cage induction, dry type with solid-state, reduced starting current and shall be of a design especially adapted to electro-hydraulic requirements.
4. The storage tank shall be constructed of steel and shall be provided with a removable cover and a means to gauge the proper level of the oil. The pump, motor and control valve shall be mounted on special reinforced isolation mounts below the tank. Provide a drip pan underneath the unit. All oil for the entire hydraulic system shall be new. An initial supply of oil sufficient for proper operation shall be provided.
5. Provide a muffler in the discharge oil line near the pump unit designed to dampen and absorb pulsation and noise in the flow of hydraulic fluid.
6. Provide a manual shut off valve in the supply line adjacent to the pump unit.
7. The oil supply line may be retained and modified to accept the new hydraulic power unit in the elevator machine room. Any new oil supply line piping shall be installed above ground and be of adequate size and thickness, properly supported, per code requirements.

B. Elevator No. 11 Hydraulic Power Unit: The existing pumping unit shall be retained and made to work in conjunction with the new control equipment. The existing oil shall be removed and new oil provided. The pumping unit shall be located in the elevator machine room and the controller mounted to meet NEC working clearance requirements. The hydraulic power unit shall be securely fastened to the machine room floor to prevent the tank from being overturned or displaced. Elevator contractor shall verify location and dimensions in general layout of machine room.

C. Cylinders & Plungers (Jack Units): The existing jack units shall be removed and replaced with new. The new jack unit shall be single-stage and the cylinder shall be constructed of steel pipe of sufficient thickness and suitable for the operating pressure per the Elevator Code. The top of the cylinder shall be equipped with a cylinder head with drip ring to collect any oil seepage as well as an internal guide ring and self-adjusting packing.

1. The plunger shall be constructed of selected steel tubing or pipe of proper diameter machined true and smooth with a fine polished finish. The plunger shall be provided with a stop ring electrically welded to it to prevent the plunger from leaving the cylinder. The plunger and cylinder shall be installed plumb and must operate freely with minimum friction. The plunger shall be securely mounted to the car frame and be isolated from the frame to eliminate any vibration from the jack unit to the car frame.
2. New pipe of adequate size and thickness shall be installed between the pumping unit and the cylinder head. Provide all new pipe mounts.
3. Well For Cylinder:

    a. The base bid shall assume the well hole does not substantially collapse with the removal of the old cylinder, all materials are able to be removed by an industrial vacuum truck, and that the hole is substantially plumb with enough space for the installation of the new cylinder with PVC protection.

        1) Remove all debris, standing water, and oil from the elevator pit.
        2) Demolition required area of pit floor and remove existing cylinder from well hole.
        3) Extract all loose materials and substantial oil spoils from well hole and project site.
        4) Water blast bottom of well hole to achieve any minor additional depth required for the additional PVC protective casing.
        5) Install new cylinder. Cylinder shall be additionally cased in capped, water-tight, PVC pipe, approximately 1 inch larger in diameter than cylinder. Construct a PVC flange to create a water-tight seal between the PVC casing and the cylinder flange in the pit. Provide a means of testing the bottom seal and a means of evacuating any material that may enter the containment. The access risers should be capped to prevent water from entering the cavity should flooding occur in the pit.
        6) Upon completion of the installation of the cylinder, the area between the steel casing (or hole structure) and the PVC casing shall be back filled with clean, washed sand. The void space created by the demolitioned area of the pit floor shall be filled with concrete up to the wall of the PVC casing.

D. Controller:

1. A microprocessor computer based control system shall be provided to perform all of the functions of safe elevator motion and elevator door control and shall be one of the following control systems or approved equal:

a. Motion Control Engineering – Motion 2000 (with onboard diagnostic keyboard and display)
b. Vertitron Midwest Inc. - VHC-102 (with onboard diagnostic keyboard and display)
c. Smartrise - Hydraulic Controller (with onboard diagnostic keyboard and display)
d. Elevator Controls - Pixel Hydraulic Controller (with onboard diagnostic keyboard and display)

2. The controller shall be designed with a split cabinet to separate high voltage from low voltage for efficiency and safety of future maintenance and troubleshooting of the unit.
3. The controller shall include all the hardware required to connect, transfer, and interrupt power and protect car operational and group supervisory control. A three-phase overload device shall be provided to protect the motor against overloading.
4. Identify each device, module and fuse (with ampere rating) by name, letter, or standard symbol, in an indelible and legible manner on the device or panel. Coordinate identification markings with identical markings on wiring diagrams. Use light emitting diodes (LED) for visual monitoring of individual modules. Components shall have interlocking circuits to assure fail-safe operation and to prevent unwarranted elevator movement should any component fail to function properly. Modules shall be of the type that plug into pre-wired mounting racks. Field wiring or alteration shall not be necessary in order to replace defective modules.
5. The elevator shall be provided with an automatic leveling device that will bring the car to a stop within ¼″ of the landing level regardless of load or direction of travel. Landing level will be maintained within the leveling zone irrespective of the hoistway doors being open or closed.
6. A protective circuit shall be provided which will stop the motor and the pump and return the car to its lowest landing in the event that the car while traveling up, does not reach its designated landing within a predetermined time interval. This circuit shall permit a normal exit from the car but prevent further operation of the elevator until the trouble has been corrected.
7. Solid state, reduced current starting shall be furnished which shall limit both the initial starting current and peak current drawn by the motor.
8. The control equipment and hydraulic power unit enclosures shall be mechanically fastened to the machine room floor.
9. Design the system so that it will start properly when power is restored in the event of a power failure. Provide system memory so that data is retained in the event of power failure or disturbance.
10. Provide manufacturer's standard pre-engineered microprocessor system, which shall control car movements as a simplex or group collective operation as required. Provide automatic dispatching of the car in response to hall calls with automatic response of system to changes in demand.
11. A car control station shall be furnished for the elevator and shall contain a bank of buttons numbered to correspond to the landing served. At each terminal landing a single push button fixture shall be provided containing the appropriate up or down push button and at each intermediate landing a button fixture shall be provided containing up and down push buttons.
12. When a call is registered by momentary pressure on a car or landing button, that button shall become illuminated and remain illuminated until the call is answered. Illuminated buttons serve as a visual indication that a call has been registered and that the car will stop at that landing.
13. For Elevator No. 11, operation shall be automatic by means of the car and landing buttons. Stops registered by the momentary actuating of the car and landing buttons shall be made in the order in which the landings are reached in each direction of travel after the buttons have been actuated. All stops shall be subject to the respective car or landing button being actuated sufficiently in advance of the arrival of the car at the landing to enable the stop to be made. The direction of travel for an idle car shall be established by the first car or landing button actuated.

a. "UP" landing calls shall be answered while the car is traveling in the up direction and "DOWN" landing calls shall be answered while the car is traveling in the down direction. The car shall reverse after the uppermost or lowermost car or landing call has been answered, and proceed to answer car calls and landing calls registered in the opposite direction of travel.
b. When the car, without registered calls arrives at a floor where both the "UP" and "DOWN" calls are registered, it shall initially respond to the hall call in the direction that the car was traveling. When no car call or hall call is registered for further travel in that direction, the car shall close its doors and immediately reopen them in response to the hall call in the opposite direction. The hall lantern shall indicate the changed direction when the doors reopen.

14. For Elevator Nos. 9-10, operation shall be automatic by means of the car and landing buttons. Response to hall calls shall be achieved by computing response time for each registered hall call. The car with the least response time for total system dispatching optimization shall have the call assigned to it. Response computations for each hall call shall be continuously monitored and hall call assignments changed if a more suitable car is found.
15. The selector system shall be designed so the elevator reaches full speed between all short floor heights. Leveling speed between short floor heights is not acceptable.
16. A diagnostic testing device, or maintenance terminal, suitable for all troubleshooting and testing procedures related to the specific type of microprocessor control, shall be installed on this project and provided at the final acceptance. This diagnostic testing device, or maintenance terminal, shall conform to the operating procedures under the testing section of these specifications.

    a. After successful testing of the diagnostic device, in conjunction with the microprocessor control, the testing device shall become the property of the Owner. The diagnostic testing device shall not become inoperative after a period of time requiring factory rehabilitation. The contractor shall provide written certification that repair and support of the diagnostic tool components is readily available to the Owner in the future.
    b. When repairs or replacement to the testing device become necessary prior to the final acceptance, the repairs, or replacement, shall be provided at no cost to the Owner.

17. Additional special operations shall be included with the elevator control system:

    a. Independent Service: A key switch shall be provided in the car operating station of the elevator which, when actuated, shall disconnect the elevator from the hall buttons and permit operation from the car buttons only. Close doors by constant pressure on desired destination floor button. Open doors automatically upon arrival at selected floor.
    b. Top of Car Inspection Operation: Provide an operating fixture on top of the car containing continuous pressure "Up" and "Down" buttons for operating the elevator, an emergency stop button, a light and duplex GFCI receptacle, and a toggle switch that will make the top of car operating device operative.
    c. Fireman's Emergency Service: Furnish emergency operation to return the elevator to the main fire access Floor 1 and return to the alternate Floor 4 (Elevator Nos. 9 & 10) or Floor 2 (Elevator No. 11) when emergency is at main fire access floor. Furnish "in car" control of the elevator during emergency operation by means of a key switch in the car.

        1) The appropriate signals from the fire alarm control system, as required to work in conjunction with the fireman’s phase I recall operation, shall be provided in the machine room by other sections. Coordinate exact signal requirements with fire alarm contractor to ensure proper operation and code compliance.

d. Emergency Communications System Failure Verification: For each elevator group, provide a means to verify operability of the telephone line, or other means of connection, serving the respective elevator group's emergency two-way communications system. This system shall verify telephone line operability on a daily basis and provide for a visual and audible alarm when the system determines that the telephone line is not functioning. The audible and visual alarm shall be located near the firemen's emergency service phase I key switch. The visual signal shall be an intermittent jewel illumination that shall not extinguish until the telephone line is functional. The audible signal shall be 10 dBA above ambient noise, but shall not exceed 80 dBA, as measured from the phase I recall key switch location. The audible alarm shall sound until authorized personnel silence it or until the telephone line is made functional. The means to silence the alarm shall be accessible only to authorized personnel. This system shall meet Elevator Code requirements.

e. Hoistway Access Key Switch Operation: Key operated switches shall be provided in the car and at the top and bottom landings for selecting hoistway access operation. When the inspection switch in the car is turned to the "ON" position, the car is put on inspection operation and can only be run by use of the switch at the terminal landings.

1) The car parks with the doors open and the closing circuit rendered inoperative. The inspector runs the car at low speed with the doors open by constant operation of the switch located in the elevator lobby.
2) The car can be run down from the top floor to gain access to the top of the car or up from the bottom floor to gain access to the elevator pit. The movement of the car initiated and maintained by the upper access switch shall be limited in the down direction to a travel not greater than the height of the car crosshead above the car platform, and limited in the up direction so that the maximum travel is the point where the bottom of the platform guard is even with the hoistway entrance header.
3) The car can be run up from the bottom landing to gain access to the pit. Travel is limited in the up direction by hoistway limit switches so that the maximum travel is the point where the bottom of the platform guard is even with the hoistway entrance header.

f. Door Hold Operation: For Elevator No. 11, provide a “Door Hold” button on the car control station panel on each elevator such that when the button is activated it shall illuminate and the door dwell time shall increase to 30 seconds for the movement of carts on and off the elevator. The timing devices shall be adjustable to increase or decrease the additional door dwell time from zero to one hundred twenty seconds. The increased door time shall be canceled upon initiation of any car button. After increased door dwell time has expired the doors shall close and the elevator shall return to normal operation.

g. Security Access Operation: Special security access operation shall be provided for Elevator No. 11 for floors 3 & 4. A key switch shall be provided in the car control station panel in proximity of the floors 3 & 4 call button for special security access operation to those floors. The key switch, when activated, shall provide access to initiate the floors 3 & 4 call button in the car. Fireman's emergency service operation shall override the key switch operation per elevator code requirements.

h. Controlled Access Operation - Card Reader: Car calls from car operating panel may be entered only in conjunction with the access control system which provides the elevator controller with signals to enable/disable car calls. A card reader, provided by others, shall be installed in the car station to provide authorized persons with ability to enter car calls for individual openings as determined by the access control system.

1) The contractor shall surface mount the card reader (as provided by other Sections) at the proper ADA/accessibility height on the face of the car control station panel. Wiring from the card reader shall be brought from the elevator car, through the traveling cable, and to the elevator machine room. Reader shall have a controller in the elevator machine room which shall be hard wired into the elevator control system under this section to individually enable/disable each car call button. Coordinate with other Sections and provide wiring between readers and controllers as directed by Access Control Installer.

i. Emergency Power Operation: When the normal power fails an emergency power source, as supplied under other sections, is applied to each elevator disconnect switch for the Elevator Nos. 9 & 10. A signal shall be provided by other sections from the emergency power transfer switch with wiring brought up to one elevator controller in the machine room to indicate to the elevator control system that emergency power is available for emergency use. Wiring between the passenger elevator machine room and service elevator machine room shall be provided by the contractor in this section. Conduit between the machine rooms will be provided by other sections.

1) When the elevators are on emergency power operation the elevators shall operate such that all car calls and hall calls for all elevators shall be made ineffective, and the cars are initially rendered inoperative.
2) One car at a time shall be automatically selected to return to the first floor. A selected car stopped between floors by the disruption of normal power will first run at low speed to the nearest floor and then return at high speed to the return floor. If the selected car does not start running within a predetermined time, the selection proceeds to the next car.
3) When the selected car arrives at the return floor the doors open. After the normal door open time, the doors close, the car is rendered in-operative, except for door reopening, and the selection proceeds to the next car. After all cars have returned to the first floor, one car is automatically selected to run on normal operation under emergency power. This car shall operate at full contract speed. The hall calls shall be made effective and the selected car responds to all hall calls and car calls as a normal operation.
4) An automatic and override selection key switch shall be provided at the lobby status panel to allow manual selection of Elevator Nos. 9 & 10 to run on normal operation. When the switch is turned to the automatic position, the automatic selection feature is made effective. Selection of a particular car to run on normal operation is done by turning the selection switch to the position that represents that car. The switch shall be made such that each position is interlocked from the other position and only one car is allowed to run at a time.
5) When normal power is restored all cars return to normal operation.

j. Elevator Emergency Power and Pre-transfer Operation: Elevator No. 11 is provided with emergency backup power and the elevator shall operate under emergency power. Upon the receipt of a signal that the elevator is operating under emergency power, the elevator controller shall illuminate an emergency power jewel at the main fire access landing. The elevator shall operate at full contract speed. Upon manually transferring power from emergency to normal, or vice versa during testing, the elevator control system will receive a pre-transfer signal. Upon receipt of the pre-transfer signal an elevator at a floor shall remain at that floor with the doors open and an elevator in motion shall proceed to the next available

floor and open its doors. After the transfer of power is complete normal operation shall be restored.

k. Elevator Monitoring System: Provide connections to Interactive Monitoring System as described in Section 142100 2.2.C.12.l.

2.3 CAR STRUCTURES

A. Platforms, Car Frames and Car Sills: For elevator Nos. 9 & 10, the existing platform and car frame shall be retained. The existing sills shall be removed and replaced with new aluminum sills. All components shall be thoroughly cleaned. For Elevator no. 11, a new car platform and frame shall be provided. The car platform shall be all steel construction and be independent from the car enclosure. Integral structures between the cab and car frame and/or platform are not acceptable. The Elevator No. 11 platform shall be equipped with extruded nickel silver sills. The entire platform shall rest on rubber pads, so designed to form an isolation cushion between the car and the platform. A suitable car frame fabricated from formed or structural steel members shall be provided with adequate bracing to support the platform and car enclosure.

B. Platform Guard: The existing platform toe guard under the entrances shall be replaced or modified to extend a minimum of 21 inches below the car sill before the bend. Upon completion, paint the guard with two (2) coats of a rust preventive paint, color to be black.

C. Slide Guides: For elevator nos. 9-10, the existing slide guide assemblies shall be retained and provided with new slide inserts. For elevator No. 11, provide new adjustable guide assemblies to guide the car on the rails. The guides shall be provided with replaceable inserts/wheels and shall be of a design to withstand the loads and capacity of the elevator. Adjust the guides with the rails for smooth quality of ride upon completion of the renovation.

D. Top of Car Handrail: A standard railing, consisting of a top rail, intermediate rail, posts, and toe-board, shall be provided on the top of each elevator car where required by code. The top rail shall have a smooth surface and the upper surface shall be located at a vertical height of 42″ from the top of the car. The intermediate rail shall be located approximately half-way between the top rail and the top of the car. Posts shall be located not more than 7′-10″ apart. The toe-board shall be securely fastened to the posts and extend from the top of the car to a height not less than 4″.

E. Balance: After all components are assembled on the car structure, the elevator car shall be statically balanced in alignment with the guide rails to equalize pressure on the guides for a smooth ride upon completion of the renovation.

F. Cleaning: Upon completion of all modifications on top of the car, clean the car structure and top of the new elevator car of all grease, lint, and dirt.

2.4 HOISTWAY COMPONENTS

A. Guide Rails: The present guide rails shall be retained. Rails shall be cleaned and realigned as required to assure smoothness of ride.

B. Hoistway Operating Devices: Normal terminal stopping devices shall be provided. When an emergency terminal speed-limiting device is furnished, the controller switches and circuitry shall be arranged in accordance with the requirements of the Elevator Code.

C. Pit Switch: A new emergency stop switch shall be provided located in the elevator pit within reach of the pit access door, adjacent to the pit ladder, and 18 inches above the sill.

D. Top of Car Operating Device: A new top of car operating device shall be provided for each car and made to work with the new control equipment. The device shall have the proper buttons, switches, and stop switch to operate the elevator on top of the car under inspection operation. The device shall be provided with a GFCI duplex receptacle and a guarded light providing 10 foot candles of illumination at any maintainable point on the car top.

1. If the stop switch on the top of car operating device is not within reach of the hoistway landing, a second stop switch shall be provided on the car top that is within reach of the hoistway landing.

E. Wiring: All hoistway and machine room wiring shall be installed new. The wiring and electrical interconnections shall comply with the governing codes. Insulated wiring shall have flame retardant and moisture-proof outer covering, and shall be run in conduit, tubing or electrical wireways. Assure all new wiring and conduits are located against a wall in the machine room or a minimum of 7’-0” above the machine room floor level.

F. Traveling Cable: A new traveling cable shall be provided and shall be flexible, of a round construction, with a flame and moisture resistant outer cover, and shall be suspended to relieve strain on individual conductors. Include the required number in addition to six (6) twisted pair spare sets of shielded communication wires and car lighting circuits from the machine room to the car connection points on the elevator.

1. Wire meshing, or similar means, shall be provided behind the traveling cable, between the elevator hoistways, to prevent the traveling cable from rubbing, chaffing against hoistway or car items, snagging, or swaying into the adjacent hoistway.
2. Traveling cable shall include two (2) coax cables.

G. Spring Buffers: The existing spring buffers and buffer channels shall be removed with the jack replacement and provided new in the elevator pit as a means for retarding the movement of the car at the bottom limits of travel.

H. Pit Ladder: For elevator nos. 9 and 11, remove the existing pit ladder and provide a new, Elevator Code-compliant, steel ladder for access to the pit. The new ladder shall be located on the interlock side of the entrance, be a minimum of 16 inches wide, provided with a 4-1/2 inches of toe kick to the pit wall, and have the handgrips extend 48 inches above the access landing. For elevator no. 10, the existing pit ladder may be retained.

2.5 DOOR OPERATING SYSTEM

A. Door Operator: Doors on the car and at the hoistway entrances shall be power operated by means of a new high speed, heavy duty, closed-loop, master door operator mounted on top of the car with all new associated operating linkages, door clutches, and gate switches. The motor shall have positive control over door movement for smooth operation. New infrared car door safety devices shall be used to cause instant reopening should an obstruction be detected during the closing cycle.

1. Door operation shall be automatic at each landing with door opening being initiated as the car arrives at the landing and closing taking place after expiration of a time interval. A car door electric contact shall prevent starting the elevator away from the landing unless the car door is in the closed

position. Door close shall be arranged to start within a time consistent with accessibility requirements.

2. The time interval for which the elevator doors remain open when a car stops at a landing shall be independently adjustable for response to car calls and response to hall calls.

B. Interlocks: A new approved positive interlock shall be provided for each hoistway entrance which shall be made to work in conjunction with the new door operators. The interlocks shall prevent operation of the elevator unless all doors for that elevator are closed and shall maintain the doors in their closed position while the elevator is away from the landing.

1. New hoistway door unlocking devices shall be provided at all hoistway landings to permit access to the top of the car and pit areas. The unlocking devices shall be actuated by a special key and access holes in hoistway doors shall be protected by a naturally finished, barrel type escutcheon plate.

C. Car Door Safety Devices: The existing door safety devices shall be removed and discarded. New infrared, door protection devices shall be installed and made to work in conjunction with the new control equipment. Operation for all devices to be as follows:

1. The doors shall be prevented from closing from their full open position if a person or object comes within the zone of detection. The detection zone shall move with the doors and if a person or object enters the zone as the doors are closing, the doors shall reverse and reopen prior to physical contact. The doors shall reclose after a minimal time interval. After a stop is made, the doors shall remain open for a time interval to permit passenger transfer, after which the doors shall close automatically. This interval shall be less for a car call stop than for a hall call stop or a coincident car/hall call stop.
2. If the doors are prevented from closing for a fixed time period an audible chime shall sound on the car. When the object is removed from the zone of detection the doors shall close at reduced power and speed to below 2 1/2 ft.-lbs. of kinetic energy. If an object enters the zone of detection while the doors are closing at reduced power and speed the doors shall stall and not reopen. Once the object is removed from the zone of detection the doors will continue to close at reduced power and speed. This operation will continue until the doors are totally closed. Normal operation shall resume at the next landing reached by the car.

D. Car Door Restrictors: New car door restrictors shall be provided. The door operating mechanism shall be arranged so that the car and hoistway doors cannot be opened by hand more than four inches from within the elevator car when the car is outside the unlocking zone. Design of door restricting mechanism shall permit opening of car doors from outside of the elevator car without the use of special tools. Only mechanical type door restrictors are permitted.

2.6 OPERATIONAL FIXTURES

A. Car Control Station: A new single car control station panel shall be provided on the front return panel of the elevator cars to replace the existing.

1. The car control station panel shall contain a bank of mechanical illuminated buttons and Braille marked to correspond to the landings served and contain an illuminated alarm bell, illuminated door hold as applicable, door open & close buttons, fireman's phase II service key & fixtures, key switches for lights, fan, and other controls required for specified car operation and control. Mount

the panel at height to comply with accessibility standards. Floor buttons shall be positioned in a single column. Braille plates shall not be the same shape as the floor call buttons.

2. The car control station panel for elevator shall incorporate the fireman's phase II key switch and associated fire operation fixtures inside a locked cabinet located at the upper portion of the panel. The fireman's keyswitch shall be of a tubular, 7 pin, style 137 construction and shall have a bitting code of 6143521. The key shall be coded "FEO-K1." The phase II key switch, instructions, call cancel button, fire jewel, door open and door close buttons, and stop switch shall all be located within this locked panel. The front of the cabinet shall be engraved with the label "FIREFIGHTERS' OPERATION". The cover to the cabinet shall be openable with the same key that is used to operate the phase II key switch. This cabinet shall meet Elevator Code requirements.
3. For Elevator Nos. 9 & 10, provide an "Elite PI+" as manufactured by C.E. Electronics (or another approved equal product). This fixture shall be mounted in the main car control station and shall be arranged with portrait orientation. The fixture shall provide for a digital representation of the floor the car is passing or stopped and provide for electronic voice annunciation to indicate to the passengers the floor the car is stopped and the direction of travel when the doors open (i.e. "Level 01, Going Up"). In addition to displaying car position, the fixture shall be a multi-functional unit designed to display both custom graphics and text, such as advertisements, tenant or building information and text-based messages. The C.E. Electronics Elite PI EX121-AP2 shall be the model utilized for pricing. The model may change based on the determined needs of the Owner. Provide programming software and all required equipment for updating and changing displays. The fixture will have the ability to incorporate live News Stations, Stock Market info, etc. via a subscription service.
4. For Elevator No. 11, a new digital car position indicator with direction arrows shall be provided in the top of the new car control station panel. The position of the car in the hoistway shall be shown by the illumination of the indication corresponding to the landing at which the car is stopped or passing. Provide an electronic, adjustable, floor bypass tone to indicate to passengers that car is stopping at a particular floor served.
5. The elevator number shall be permanently engraved on the upper portion of the car control station. The car capacity shall be permanently engraved on the lower portion of the car control station panel or engraved on an inset panel at this location. Lettering shall not be less than ½″ high and shall be black filled.
6. The car control station panel shall also contain emergency car lights and the emergency power unit employing a sealed rechargeable battery and static circuits, or a portion of the cab ceiling lights shall be made to work on a similar emergency power unit. The battery shall be 6-volt minimum, sealed, maintenance free, of either lead acid or gel cell construction, and designed to give a life expectancy of not less than 5 years. Illumination for the elevator car and power for alarm bell shall be provided in the event of power failure.
7. Car control station shall not contain plastic or polycarbonate components, labels or frames.
8. The car control station panel for Elevator No. 11 shall be provided with a security key switch to access Floors 3 & 4. The key switch shall be a two position key switch, spring return to the OFF position, and removable in the OFF position only.
9. Controlled Access Operation – Card Reader: The car operating panel shall also contain an applied card reader. The card reader shall be located at ADA/accessibility height requirements.
10. The car control station shall also contain an integral speakerphone located at ADA/accessibility height requirements. Provide operating switches with manufacturer's standard identification for required use or function. The activation button shall match the car operating panel button fixtures. The speaker shall be mounted behind the car operating panel with vandal resistant perforations drilled through the car operating panel.

a. The speakerphone shall be of the automatic dialing type and shall have the capability to automatically identify its location upon receipt of the call to the party answering the call.
b. Provide an activation button, with integral legend, and identification plate adjacent to the button. Illuminate button to indicate call registration. Provide means to indicate when call is answered. Provide engraved legend below indicator light explaining phone instruction. The speakerphone shall meet the requirements of ADA guidelines and shall operate in accordance with Elevator Code.
c. Necessary shielded wires shall be provided by the contractor from the speakerphone in the elevator car, through the traveling cables, and shall terminate in a junction box on the elevator controller in the elevator machine room. Connections to the building service system shall be provided by the Contractor.
d. On the same panel as the phone activation button, provide a display for messages from authorized personnel that acknowledge when two-way communication has been established and allow for further communication. Additionally, provide means for authorized personnel to obtain responses from entrapped passengers, including those who cannot verbally communicate or cannot hear.
e. Provide all required equipment, including any necessary software, in-car cameras, displays, computers, etc. required for authorized personnel receiving emergency calls from these elevators.
f. Authorized personnel receiving the call shall be provided with a means to display video of passengers at any location on the car floor.
g. The complete two-way communications system shall not be proprietary and shall not require any ongoing elevator maintenance agreement or elevator emergency call monitoring agreement from the elevator installer or any manufacturer. The building Owner shall have the option of having this system monitored by authorized personnel of their choosing.
h. The communications system shall provide for all operations necessary to comply with ASME A17.1 Rule 2.27.1.
i. The contractor in this section shall be responsible for phone, text and video monitoring during the maintenance and warranty period.
j. Exact requirements and connections shall be coordinated with State’s UC team.

B. Hall Push Button Station: The existing riser of hall button fixtures shall be replaced with new at all floors. At each terminal landing, single type button fixtures shall contain the appropriate "Up" or "Down" buttons, and at each intermediate landing dual button type fixtures shall be provided, containing appropriate "Up" and "Down" buttons. All fixtures shall be installed at proper height to comply with the accessibility standards. The hall button fixture faceplates shall be the flat, applied type that is flush mounted with the wall. The hall buttons shall operate such that when a call is registered by any momentary pressure on the landing button, the button shall become illuminated and remain illuminated until the call is answered. The fixture faceplates shall be large enough to cover access holes remaining from the old fixture so that there is no need for patching.

1. For Elevator No. 11, the face plate of the Floor 1 hall button shall additionally contain the fireman's phase I key switch. The fireman’s key switch shall be of a tubular, 7 pin, style 137 construction and shall have a bitting code of 6143521. The key shall be coded “FEO-K1.” The fireman's phase I instructions shall be permanently engraved on the face plate or on an inset plate mechanically fastened flush with the face of the hall button fixture.
2. For Elevator No. 11, the faceplate of the Floor 1 hall button shall additionally contain the audible and visual alarm for the elevator group’s “Emergency Communications System Failure Verification” in addition to the key switch for temporary silence of the alarm.

3. For Elevator No. 11, the hall button at the top and bottom landing shall contain the hoistway access key switch to activate Hoistway Access Operation.
4. For Elevator No. 11, the face plate of the Floor 1 hall button shall additionally contain the emergency power jewel.
5. The call buttons in the hall button fixture shall be centered at 42 inches above the finished floor. Assure there is space between the actual hall buttons and any other items on the fixture to avoid any confusion as to which button is the hall call button.

C. Hall Lanterns: For Elevator Nos. 9-10. above each entrance, provide new horizontally oriented hall lantern fixtures to replace the existing. The lantern shall incorporate the appropriate triangular direction arrows for the up and down directions. The operating function of the hall lantern shall incorporate the appropriate directional tones per accessibility standards. An adjustable, electronic, audible tone shall sound to announce the arrival of the elevator car. The tone shall sound once for the "UP" direction and twice for the "DOWN" direction 4 seconds prior to the arrival of the car.

1. Where possible, the existing hall lantern fixture cans at proper heights may be re-used. The Contractor shall be responsible for installing the new fixture cans when required to meet specification requirements. The faceplates of the new fixtures shall cover the new and old hall lantern access holes such that no refinishing of the front walls around the new fixtures will be required.

D. “In-Car” Hall Lantern: For Elevator No. 11, a new in-car hall lantern shall be located in the car entrance jamb location at the ADA/accessibility required height. The lantern shall be the applied type with a flush-mounted faceplate and shall be on the side of the entrance opposite the hall button location. The lantern shall incorporate the appropriate triangular direction arrows for the up and down directions. The operating function of the lantern shall incorporate the appropriate directional tones per accessibility standards. An adjustable, electronic, audible tone shall sound to announce the arrival of the elevator car. The tone shall sound once for the “UP” direction and twice for the “DOWN” direction upon opening of the car doors. The fixture faceplates shall be large enough to cover access holes remaining from the old fixture so that there is no need for patching.

E. Hall Position Indicator: For Elevator No. 11, at floor 1 above the hoistway entrance, the existing fixture shall be removed and replaced with a new fixture that includes a digital (segmented or dot matrix) position indicator in the center of the fixture that provides a numeric representation of the floor that the car is stopped or passing.

F. Hoistway Access Key Switches: For Elevator Nos. 9 & 10, a new, separate fixture shall be provided at the top and bottom landings for each car containing the hoistway access key switch. The key switch shall be a three position, Up-Off-Down, key switch with spring return to the Off position and removable in the Off position only. The centerline of the key switch shall be located between 48″ and 72″ above the finished lobby floor and within 12″ of the entrance frame.

G. Lobby Status Panel: For Elevator Nos. 9 & 10, a new elevator status panel shall be provided in the existing location. As the elevators will be visible from this panel, this fixture will act as the emergency services fixture for these elevators. The elevator status panel fixture shall incorporate digital position indicators and a car status light. The position indicators and car status lights shall be properly identified with engraved nomenclature, lettering to be black filled and a minimum of ¼″ high.

1. The fixture shall be of the flush mounted type. The contractor shall be responsible for all wiring to the elevator status panel and for mounting of the fixture. Conduit between the hoistways and the fire command station will be provided by others.
2. The fixture shall additionally contain an emergency power indicator and an automatic and override selection key switch. The switch shall be labelled "Auto, 9, 10" to allow manual selection of each car to run on normal operation. Key switch shall utilize "FEO-K1" key.
3. The lobby status panel shall also include an illuminated signal that indicates when each elevator is operational and when it is at the designated emergency return level with doors open. Provide illuminated signal that indicates when normal power supply has failed.
4. The faceplate of this fixture shall contain the fireman's phase I key switch, the fire hat illuminating jewel and phase I instructions permanently engraved on the faceplate. Lettering to be red filled. The fireman's key switch shall be of a tubular, 7 pin, style 137 construction and shall have a bitting code of 6143521. The key shall be coded "FEO-K1."
5. The faceplate of the Emergency Fixture shall additionally contain the audible and visual alarm for the elevator group's "Emergency Communications System Failure Verification" in addition to the key switch for temporary silence of the alarm.

H. Fixtures: For Elevator Nos. 9 & 10, the hall lanterns shall be of the standard digital type. For elevator no. 11, the position indicator shall be of the standard digital type. All other newly provided fixtures shall be from the lines listed below. All newly provided fixtures shall be constructed of stainless steel with a no. 4 satin grain finish. Vandal resistant screws shall be provided for mounting all signal and operational fixture face plates. Fixtures shall be as manufactured by the following or approved equal:

1. Elevator Nos. 9 & 10

    a. Otis - Luxury
    b. TKE - Traditional Sherman Classic with V7 Buttons
    c. Innovation – Universal
    d. PTL - Performer

2. Elevator No 11

    a. Otis - M3 Vandal Resistant
    b. TK Elevator - Vandal Resistant with V2 Buttons
    c. Innovation - Bruiser Line
    d. PTL - Centurion Series

2.7 CAR ENCLOSURES

A. For Elevator Nos. 9 & 10, the existing steel car enclosures shall be removed and replaced as follows:

1. The elevator cab shall be a steel shell cab with exterior sound deadening mastic. The car side and rear walls shall each consist of formed steel panels, bolted together to form a complete steel shell cab. Cab shell panels shall be a maximum of 24″ wide and made of a minimum of 16 gauge steel (or, at Contractor's option, provide 14 gauge steel with a maximum panel width of 36″). All vents in the cab walls shall be concealed. The clear inside height of the cab shell shall be the manufacturer's standard 8′-0″ cab.
2. The interior finishes and new ceilings shall be provided per Division 142700.
3. The front return panels shall incorporate an integral entrance column, shall be brushed stainless steel a minimum of 16 gauge, and shall extend from finished floor to underside of fascia. The front

return panels shall be arranged for mounting the car control station panels. A full width fascia of brushed stainless steel shall be furnished over the return panel and car entrance.

4. Each canopy shall be provided with two (2) coats of matte white paint on the car side.

    a. The existing top emergency exit panels shall be retained and provided with an electrical device that will prevent operation of the elevator cars if the exit cover is open more than 2 inches. Devices shall be designed in accordance with Elevator Code requirements.
    b. A new cab exhaust blower fan shall be provided and installed on each car top. Mount with rubber grommets and adjust for smooth, quiet operation. The fans shall be Morrison Model OE or approved equal.
    c. One light fixture shall be connected to the emergency power circuit and shall operate as the emergency power light for inside the cab upon power loss.

5. The car entrances shall be provided with new side-opening, single-speed car door panels with a brushed stainless steel facing on the car side suitably reinforced with applied hangers with track. The door shall be of hollow metal construction. Hangers shall be of the sheave type, two sheaves per door, rotating on a precision ball bearing. The roller shall be on an eccentric stud to provide adjustment. Car doors shall be provided with two phenolic gibs per car door panel.
6. The car door sill shall be retained and thoroughly cleaned. The car door sill shall accept the car flooring so the flooring is flush with the car door sill upon completion of the installation. The existing car flooring and shall be removed and replaced with new flooring, to be provided and installed by other trades. Exact flooring and subflooring thicknesses to be verified by contractor with flooring manufacturer. The Contractor in this section shall allow for the thickness and weight of the flooring, provide any necessary subflooring, and set the car entrance sills accordingly so as to avoid any tripping hazard.
7. The car enclosures shall comply with the ASME A17.1 Safety Code for Elevators and Escalators. All stainless steel shall be provided with #4 brushed finish.

B. For Elevator No. 11, the existing steel car enclosures shall be removed and replaced as follows:

1. The elevator cab shall be a steel shell cab. The elevator cab side and rear walls shall consist of formed rigidized stainless steel panels, bolted together to form a complete steel shell cab. Cab shell panels shall be a maximum of 24″ wide and made of a minimum of 16 gauge rigidized stainless steel (or, at Contractor’s option, provide 14 gauge rigidized stainless steel with a maximum panel width of 36″). Panels shall be provided with sound deadening exterior matting. Rigidized stainless steel shall have a 5WL pattern with a satin finish. The clear inside height of the cab shell shall be the manufacturer’s standard 8′-0″ cab.
2. The front return panel shall incorporate an integral entrance column, shall be brushed stainless steel a minimum of 16 gauge, and shall extend from finished floor to underside of fascia. The strike jamb shall also be stainless steel a minimum of 16 gauge. The front return panel shall be arranged for mounting the car control station panel. A full width fascia of brushed stainless steel shall be furnished over the return panel and car entrance.
3. The car top shall consist of a panel which shall be clad with sheet metal and contain a hinged top emergency exit panel 17" x 24", or code compliant equal. The car top material shall be a minimum of 12 gauge steel suitably reinforced with matte white painted finish.

    a. Provide an interlock on the top of car emergency exit that will prevent operation of the elevator car if the exit cover is open more than 2″. Interlock shall be designed in accordance with code requirements.

b. The ceiling shall be furnished with a concealed suspended frame supporting individual wood-core panels incorporating a brushed stainless steel finish on the exposed surfaces. Each panel shall contain a down light fixture with LED bulbs. A dimmer switch shall be provided on the car top to adjust the car lighting in the elevator car.
c. A two-speed fan shall be mounted in the car top above the ceiling. Mount with rubber grommets and adjust for smooth, quiet operation. Fan shall be Morrison Model OE or approved equal.

4. The car entrance shall be provided with a two-speed, side-opening car door with a brushed stainless steel facing on the car side suitably reinforced with applied hangers with track. The door shall be of hollow metal construction. Hangers shall be of the sheave type, two sheaves per door, rotating on a precision ball bearing. The roller shall be on an eccentric stud to provide adjustment. Car doors shall be provided with two phenolic gibs per car door panel.
5. The nickel silver car sill shall be installed such that the platform is recessed below the car door sill to accept the car flooring so the flooring is flush with the car door sill upon completion of the installation. The car flooring shall be stainless steel checker plate, with Mill 2B finish. .
6. A stainless steel handrail shall be furnished on the side and rear walls of the elevator cab and shall be mounted such that the top of the handrail is 34" above the finished floor. The handrail shall be a minimum of ⅜″ by 2″ square and the ends shall return back to the cab walls. Provide one continuous handrail on each wall. There shall be a minimum of four (4) supports on each side rail and three (3) supports ion the rear wall. Additionally, an ⅜″ by 8″ stainless steel bumper plate shall be installed on the side and rear walls of the elevator cab and mounted flush to the cab wall. The bumper plate shall be mounted at 10" from the finished floor to the top of the bumper. Handrail and bumper plate to be provided with a brushed, stainless-steel finish. Rails shall terminate within 6″ of cab walls.
7. The elevator cab shall be provided with protective stainless steel pad buttons permanently installed on the sides, rear, and front return panels. Pad buttons shall be bolted through to the back side of the cab wall. The contractor shall supply one (1) set of protective pads for the elevator upon substantial completion of the elevator work, pad color to be chosen from manufacturer's standards.
8. The car enclosures shall comply with the ASME A17.1 Safety Code for Elevators and Escalators. All stainless steel shall be provided with #4 brushed finish.

2.8 HOISTWAY ENTRANCES

Elevator Nos. 9 & 10 Entrance Summary

Total Number -	Six (6)
Type-	Retain Side Opening, Single Speed
Clear Opening	3′-0″ W by 7′-0″ H
Door Panels -	Provide New
Jambs & Sills -	Retain Side & Head jambs.
Door & Jamb Finish -	Provide New Stainless Steel Wrap.

Elevator No. 11 Entrance Summary

Total Number -	Four (4)
Type-	Retain Side Opening, Two Speed
Clear Opening	4′-0″ W by 7′-0″ H
Door Panels -	Provide New
Jambs & Sills -	Retain Side & Head jambs.
Door & Jamb Finish -	Retain existing.

A. The existing hoistway entrances shall be retained and modified as follows:

1. Frames: The existing frames shall be retained. At all bronze floors, new 18-gauge satin stainless steel wraps shall be installed and securely adhered/fastened in a professional manner to the existing frames. The new wraps shall extend all the way up past the transoms to make certain all bronze finish is covered. All painted steel or stainless steel entrances shall be retained and refinished by others.
2. Sills: The existing hoistway door sills shall be retained. The sills shall be thoroughly cleaned upon completion of the renovation.
3. Fascia Plates, Toe Guard & Dust Covers: The existing components may be retained. The contractor is responsible for checking the components and providing any additional required fastenings to assure they are totally secured to the hoistway structure. Any missing fascia or hanger covers shall be replaced with new. Upon completion, all fascia plates, hanger covers, toe guard, and dust cover shall be painted. The surfaces shall be wire brushed and thoroughly cleaned upon which time painted with one coat of a quality rust preventative type paint, color to be black.
4. Headers: The existing headers shall be retained. The plates shall be checked and any additional fasteners provided to assure they are secure to the hoistway entrances.
5. Hangers and Tracks: New hangers and tracks shall be provided for all entrances. Hangers shall be of the sheave type, two sheaves per door, rotating on a precision ball bearing shall be provided. The roller shall be on an eccentric stud to provide adjustment. Hangers shall be applied or integral on the top of the doors. Hanger fascia dust covers shall be provided over all hangers and shall be galvanized or painted steel. New steel tracks shall be provided and securely mounted to the entrance header.
6. Closers: The existing closers shall be replaced with new. All closers shall be adjusted to assure proper automatic closing of the doors when the car is away from the respective floor. Adjust all equipment for smooth operation.
7. Door Panels: For Elevator No. 11, the existing door panels shall be retained. For elevator Nos. 9-10, the existing door panels shall removed and provided with new. Provide steel hollow metal doors of the size and type to match existing, fabricated from steel sheet material with vertical internal channel reinforcements spaced at not more than 6″ on centers and welded to face sheets. Panels shall be provided with a stainless steel finish on the lobby side. For all doors, bottom of doors shall be provided with two (2) removable phenolic guides per door panel, which run in the sill slots with minimum clearance. The door panels shall be furnished with barrel type, naturally finished, escutcheon plates for the door unlocking devices at each landing.

    a. Hoistway doors shall be manufactured in accordance with the procedure established by Underwriters Laboratories and shall be so labeled. Four-inch decals indicating floor identification shall be applied on the hoistway side of the hoistway door panels.
    b. Steel sight guards shall be furnished on the leading edge of the doors to conceal the hoistway beyond the doors. Finish to match door panels.

8. Handicap Jamb Markings: The existing jamb Braille markings shall be removed and replaced with new. Provide stainless steel jamb marking plates with raised floor markings, a black background, and braille to identify each landing on both jambs of each hoistway entrance. Jamb marking plates shall be mechanically fastened to the entrance jambs utilizing stainless steel drive pins in the four corners of the plates.
9. Elevator Identification Signs: Provide new applied elevator identification signs with black raised number markings and a stainless steel background to identify the elevator on both jambs of the main and alternate fire recall floor hoistway entrances. Signs to be mounted directly below handicap jamb markings, vertically in line with handicap jamb markings, with ¼″ to ½″ inch space between signs.

10. Fire Evacuation Signs: Provide applied fire evacuation signs incorporating a pictograph as depicted in 2.27.9 of the Elevator Code and mount above each hall button in the elevator lobbies. For Elevator Nos. 9-10, signs to be made from stainless steel, brushed finish, and engraved.
11. All stainless steel shall be provided with #4 brushed finish unless stated otherwise.

PART 3 - EXECUTION

3.1 PREPARATIONS

A. Site Inspection: Prior to commencing elevator renovation inspect hoistway, hoistway openings, pit, and machine room as constructed. Contractor is responsible for all dimensions as field measured by the Contractor for proper installation and performance of elevator work.

1. Contractor shall be responsible for inspecting and determining extent of work to be performed at the site to complete the work. Contractor must consider all requirements for installation of new work, access, code requirements, and removal or demolition, which additional work shall be performed without cost to the Owner.

B. Demolition: The removal of all elevator equipment, which is not to be retained in the renovation, shall be completed by the contractor. The old elevator equipment removed becomes the property of the Contractor and it is their responsibility to remove this equipment from the project site. Include all work necessary to protect the public, residents, building employees, and building property during removal of demolished materials.

1. When barricades are required for protection of the hoistway they shall be provided by the Contractor. Do not start demolition of an area until all temporary protection and temporary partitions are in place as furnished by the contractor. Temporary screening between adjacent hoistways shall be provided during the renovation and shall be removed after completion of the elevator work.

C. Prior to renovation/installation of elevator systems, contractor shall supply information regarding the software required for use with controllers or connections to the State network. Please see the cybersecurity requirements.

3.2 INSTALLATION OF ELEVATOR SYSTEM

A. General: Comply with manufacturer's instructions and recommendations for work required during installation, referenced codes, and specifications.

B. Welded Construction: Provide welded connections for installation of elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance and replacement of worn parts. Comply with AWS standards for workmanship for qualifications of welding operators. Coordinate any welding or burning with the Owner’s Representative.

C. Coordination: Coordinate elevator work with other sections for proper time and sequence to avoid construction delays. The Contractor shall provide fully operational elevator system as stipulated in the construction schedule. The Contractor shall maintain full crews and continue work once elevator demolition begins until the elevator system is completed and operational and accepted by the Owner. The Contractor shall provide the number of crews required to maintain the schedule and shall provide

additional manpower and work such additional hours as are necessary to bring the project back on schedule.

D. Sound Isolation: Mount any new rotating vibrating elevator equipment and components on vibration absorption mounts, designed to effectively prevent transmission of vibrations to structure, and thereby eliminate sources of structure borne noise from elevator system.

E. Guide Rails: The existing guide rails are being reused and it is the Contractor's responsibility to see they are adaptable to Contractor's equipment, erected plumb, properly aligned, and anchored securely to the existing structure.

F. Hoisting: All required hoisting and movement of the elevator equipment shall be the responsibility of the Contractor in this section.

G. Final Cleaning & Painting: Upon completion of all elevator work, provide total clean down of elevator machine room, hoistway, and pit areas to remove all dirt and construction debris. All newly provided steel components in machine room and hoistway shall be provided with touch up painting to remove all scratches and blemishes incurred during construction.

3.3 ELECTRIC WIRING

A. Conductors: Copper throughout with individual wires coded and all connections on identified studs or terminal blocks. Use no splices or similar connections on any wiring except at terminal blocks, control cabinets, junction boxes or conduits. Provide 10% spare conductors throughout.

B. Conduit: Painted or galvanized steel or aluminum conduit and duct shall be used. Conduit size shall be ½″ minimum, except that ⅜″ can be used for runs containing only 2 wires. Flexible conduit exceeding 18″ in length shall not be used. Flexible heavy-duty service cord, type SO, may be used between fixed car wiring and car door switches for safety edges.

3.4 FIELD QUALITY CONTROL

A. Acceptance Testing: Upon nominal completion of the elevator work, and before permitting use of elevator (either temporary or permanent), perform acceptance tests as depicted in Rule 8.10.3, "Acceptance Inspection and Tests of Passenger & Freight Hydraulic Elevators", of the Elevator Code. Also perform other tests, if any, as required by governing regulations.

1. Contractor is responsible for coordinating observance of final acceptance inspection with the Owner’s representative and a representative of ATIS Elevator Consulting, as they have been retained by the Owner to represent the State of Missouri as the Licensed Elevator Inspector. Contractor is also responsible for coordinating any additional inspectors as required by local jurisdiction.
2. All fire alarm and emergency power testing shall occur outside of normal working hours for the building and be scheduled with the Owner.

B. Diagnostic Testing: The diagnostic testing device, or maintenance terminal, provided shall be demonstrated and tested during the final testing of the elevator installation. This diagnostic tool shall have the capability of troubleshooting and field programmability of all control variables providing interaction between the service man and the microprocessor controller including performance of all ongoing safety testing as required by the Elevator Code.

3.5 INSTRUCTION AND MAINTENANCE

A. A maximum period of four hours shall be dedicated to instruct Owner's personnel in proper use, operation and daily maintenance of elevators. Review emergency provisions, including emergency access and procedures to be followed at time of failure in operation and other building emergencies. Train Owner's personnel in normal procedures to be followed in checking for sources of operational failures or malfunctions.

B. At the time of substantial completion of elevator work (or portion thereof) provide suitable protective covering, barriers, devices, signs, or such other methods or procedures to protect elevator work from damage or deterioration. Maintain protective measures throughout remainder of construction period.

3.6 CYBERSECURITY REQUIREMENTS

A. Access Management: The contractor’s Internal Access Management must comply with NIST 800-53 controls or ISO27001 standards, and the contractor must provide multi-factor authentication for their employee remote access to all internal and cloud-based systems.

1. The contractor MUST ensure personnel with access to state data (including any third-party personnel with access) pass standard background checks equal or better than those required by the State of Missouri for information technology employees. If required by the state to address an audit, the vendor must attest whether all applicable employees passed background checks performed in accordance with the contractor’s standard background check process.
2. All contractor employees and subcontractor’s employees must receive annual cyber security training.

B. Network Architecture: The contractor shall use safeguards designed to prevent the inappropriate use or disclosure of the state’s proprietary or confidential information. The contractor must provide protection against cyber threats using advanced tools including, Advanced Firewall stacks, Web Application Firewalls, Intrusion Prevention appliances, advanced end-point protection agents, and advanced threat correlation and incident response systems.

1. The contractor’s systems and applications must be mitigated against the Open Web Application Security Project (OWASP) top 10 vulnerabilities.
2. The contractor’s solutions must meet vulnerability and patch management/mitigation standards.
3. The contractor must encrypt all State of Missouri sensitive information stored on servers both at rest and while in transit.
4. System log retention must meet State of Missouri regulatory requirements. (Requirements shall be provided by the state agency.)
5. The contractor must provide a solution for monitoring log data to meet State of Missouri regulatory requirements. (Requirements shall be provided by the state agency.)

C. Backup and Data Recovery: The contractor must provide a backup and data recovery solution to the State of Missouri for the technology service provided.

1. The contractor must provide a solution to conduct tests at least annually to ensure a successful restoration. Regular checking of backups and restore procedures must ensure a smooth recovery.

D. Maintenance and Support: If the solution is vendor managed, the agency is required to purchase maintenance and support to ensure security updates are maintained for the life of the solution.

3.7 ELEVATOR SCHEDULE ELEVATOR NOS. 9 & 10

Renovate	Two (2) direct plunger, hydraulic Elevator Nos. 9 & 10
Type of Machine	Provide new hydraulic pumping unit in the machine room. Replace the existing hydraulic jack unit drive.
Capacity & Speed	Retain 3,500 lbs. capacity at 150 fpm.
Operation	Provide new microprocessor controller with group collective operation with: Fireman's Emergency Service Independent Service Hoistway Access Operation Communication Verification Operation Elevator Monitoring Emergency Power Operation Controlled Access Card Reader
Approximate Travel	52′-0″
Number of Openings	Retain three (3) stops and openings at floors 1, 4, and 5.
Opening Size	Retain 3′-0″ wide by 7′-0″ high
Entrance Type	Retain side-opening, single-speed design.
Hoistway Entrances	Retain entrance frames and sills. Provide all new operating assembly components including hangers, tracks, panels, gibs, interlocks, and closers.
Door Operating Equipment	Provide a new heavy-duty, closed loop door operator with new clutch and door restrictor device. Provide a new infrared, non-contact door reversal device.
Guide Rails	Retain and clean existing rails and re-align as necessary.
Car Structure	Retain existing car platform and sling. Retain car door sills. Retain slide guide assemblies and furnish new slide inserts. Provide new top of car inspection station and top of car exit switch. Extend platform guard. Provide new top of car handrail system.
Buffers & Pit Equipment	Retain existing spring buffers and pit channels. Provide new pit stop switch ladder and stop switches. Provide new pit ladder for Elevator No. 9 and retain existing for Elevator No. 10.
Car Enclosure	Retain car enclosure and refurbish as specified.
Signal Fixtures	
Car Control Stations	Provide new car control station panels for each elevator, including integral speaker phone, position indicator, and fireman's emergency service phase II cabinet.
Hall Buttons	Provide new hall buttons at all floors.

Lobby Status Panel	At Floor 1 provide new fixture containing fireman's phase I key switch, fire hat illuminating jewel, engraved phase I instructions, Emergency Power illuminating jewel and selector switch, and Communications Verification functions (reset key switch, illuminating jewel and audible tone/speaker).
Hall Lanterns	Provide new horizontal hall lanterns at existing locations. Include triangular illuminating lenses and adjustable, electronic audible up and down tones (one tone for up, two tones for down) with stainless steel faceplates.
Hoistway Access Key Switches	Provide new hoistway access key switch fixtures at the top and bottom terminal landing for each elevator in the wall.
Warranty & Service	Full maintenance service from thirty (30) days prior to the start of construction until 12 months after substantial completion of Project.

3.8 ELEVATOR SCHEDULE ELEVATOR NO. 11

Renovate	One (1) direct plunger, hydraulic Elevator No. 11
Type of Machine	Retain hydraulic pumping unit in the machine room. Replace the existing hydraulic jack unit drive.
Capacity & Speed	Retain 4,000 lbs. capacity at 150 fpm.
Operation	Provide new microprocessor controller with simplex collective operation with: Fireman's Emergency Service Independent Service Hoistway Access Operation Communication Verification Operation Controlled Access Card Reader Security Access Door Hold Emergency Power Operation
Approximate Travel	39′-0″
Number of Openings	Retain four (4) stops and openings at floors 1-4.
Opening Size	Retain 4′-0″ wide by 7′-0″ high
Hoistway Entrances	Retain side-opening, two-speed design. Retain frames, door panels, and sills. Provide new tracks, hangers, hanger rollers, closers, unlocking devices and interlocks.
Door Operating Equipment	Provide a new heavy-duty, closed loop door operator with new clutch and door restrictor device. Provide a new infrared, non-contact door reversal device.

Guide Rails	Retain and clean existing rails and re-align as necessary.
Car Structure	Provide new car platform and sling. Provide new car door sill. Provide new guide assemblies. Provide new top of car inspection station and top of car exit switch.
Buffers & Pit Equipment	Retain existing spring buffers and pit channels. Provide new pit ladder.
Car Enclosure	Replace car enclosure in its entirety with new steel shell cab with stainless steel front return, header, and strike jamb.
Signal Fixtures	
Car Control Station	Provide new single car control station with integral car position indicator, speakerphone, and emergency light in the front return panel.
Hall Buttons	Provide new, flush mounted hall button fixtures. Floor 1 fixtures to additionally contain the Fireman's Phase I key switch, illuminated fire hat jewel, and engraved instructions, communications verification, and emergency power indicator. Terminal landings to also contain hoistway access key switches.
Hall Position Indicator	Provide new digital position indicator in the floor 1 lobby above the hoistway entrance.
In-car Hall Lantern	Provide new, In-car hall lantern with illuminating arrows and adjustable electronic direction tones.
Warranty & Service	Full maintenance service from thirty (30) days prior to the start of construction until 12 months after substantial completion of Project.

END OF SECTION 142400

SECTION 142700 - ELEVATOR CAB INTERIORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pre-engineered elevator interior finish system including the following:

1. Rear wall panels.
2. Side wall panels.
3. Handrails.
4. Corner/flat reveals.
5. Suspended ceiling.
6. Ceiling lighting.
7. Protective Pads.

1.2 RELATED SECTIONS

A. Section 09 60 00 - Flooring.

B. Section 14 20 00 - Elevators.

C. Section 26 05 00 - Common Work Results for Electrical.

D. Section 26 50 00 - Lighting.

1.3 REFERENCES

A. ASTM International (ASTM): ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

1.4 SUBMITTALS

A. Submit under provisions of Section 01 30 00 - Administrative Requirements.

B. Product Data: Provide manufacturer's data sheets on each product to be used.

C. Shop Drawings: Details of construction, including relationship with adjacent materials. Include installation and maintenance instructions.

D. Verification Samples: For each finish product specified, two samples, minimum size 2-1/2 inches (63 mm) by 1-1/2 inches (38 mm).

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Minimum 10 years' experience in manufacture of architectural surface materials and fabrication of elevator cab interiors.

B. Installer Qualifications: Minimum 3 years' experience in the installation of elevators.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to installation site in manufacturer's original packaging. Handle products in accordance with manufacturer's instructions. Store in dry, secure location, protected against direct sunlight and excessive heat. Protect finished surfaces.

1.7 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's limits.

1.8 WARRANTY

A. Warranty: Provide manufacturer's standard three-year warranty against defects and workmanship, from the date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design Manufacturer: SnapCab, which is headquartered at: 175 Titus Ave.; Warrington, PA 18976; Toll Free Tel: 888-766-7834; Email: sales@SnapCab.com; Web: www.SnapCab.com

B. FabACab, https://fabacab.com/

C. Kone, https://www.kone.us/

2.2 WALL PANELS AND SUSPENDED CEILING

A. Elevator Interior Wall Panel System, Interlocking Panel Type:

1. Description: Interlocking panel system comprised of removable wall panels with interlocking joints, 1/8 inch (3 mm) black shadow lines set into surface, toe kicks, top caps with sight and vent guards, panel binders at exposed panel edges near doors and corner/flat reveals.

    a. Passenger Elevator Panel Model: Modern.
    b. Freight Elevator Panel Model: Classic I

B. Elevator Interior Suspended Ceiling System:

1. Description: Suspended ceiling with adjustable mounting legs and removable panel for access to escape hatch.

    a. Passenger Elevator Ceiling Style: Aurora Ceiling
    b. Freight Elevator Ceiling Style: Modular Ceiling

2.3 MATERIALS

A. Wall Panel Core: Core Type will be determined based on manufacturing standards for face material selection:

1. Passenger Elevators: Wall Panel Core Type 2: 5/8 inch (15 mm) minimum thickness fire-rated resin particle board, Class B or better fire rated as per ASTM E 84. Panel backer sheet and adhesives as per manufacturer to achieve fire rating as tested.
2. Freight Elevator: Wall Panel Core Type 1: Compact, 3/8" (10 mm) minimum thickness fire rated high pressure laminate, non-porous, with integral decorative surface, Class B or better fire rated as per ASME E 84 and LEED compliant, as manufactured by Nevamar or approved equal. If used as a decorative surface, Color with a matte finish, as selected from manufacturer's standard product line.

B. Wall Panel Face:

1. Laminate Face: Standard finish, 0.039 inch (0.99 mm) minimum thickness Horizontal Grade Post forming Laminate conforming to NEMA standard HGF, with Class B or better fire rating when laminated to fire-rated particle board as per ASTM E 84

C. Toe Kick and Toe Kick Binder with Concealed Ventilation Gap for Interlocking Panels:

1. Passenger Elevator: Satin No. 4 finish 0.04 inch (1.01 mm) thick stainless steel toe kick with anodized mill finish aluminum binder with Satin No. 4 stainless steel cover.
2. Freight Elevator: Satin No. 4 finish 20 gauge stainless steel toe kick with anodized mill finish aluminum binder (standard).

D. Top Cap:

1. Elevators: Anodized mill finish aluminum top cap with integrated pad hook channel and 0.04 inch (1.01 mm) thick stainless steel flat insert. (standard).

E. Corner and Flat Reveals:

1. Elevators: Stainless steel, 20 gauge, No. 4 satin finish

F. Handrails: Pre-installed on wall panel to measure 32 inches (831 mm) above finished floor unless indicated otherwise.

1. Location: Back and side walls.
2. Passenger & Freight Elevator: Type: Flat bar with rounded returned ends, 3/8 inches (9.5 mm) thick.

    a. Width: 2 inches (50 mm).
    b. Material and Finish: Satin stainless steel with No. 4 finish.

G. Suspended Ceiling:

1. Passenger Elevator: Aurora Ceiling:

a. Type: Ceiling with concealed heavy-duty brushed 1.5 inch (38 mm) T aluminum frame, with adjustable mounting legs, with a removable panel for access to the escape hatch. Ceiling Class B or better fire
b. Facing: Stainless Steel with No. 4 satin finish.

2. Freight Elevator: Modular Ceiling:

a. Type: Ceiling with heavy-duty 1.5 inch (38 mm) T aluminum frame, with adjustable mounting legs and is divided into six sections, nine for larger cars, with a removable panel for access to the escape hatch. Ceiling Class B or better fire rated as per ASTM E 84 and LEED compliant.
b. Aluminum Frame Finish: Silver satin (standard).
c. Facing for Drop-in Panels: Stainless Steel.

H. Ceiling Lights:

1. Passenger Elevator: Perimeter Lighting: LED perimeter fixtures, mounted on perimeter of ceiling; 120 AC volt system.
2. Freight Elevator: LED Standard Fixtures Mounted on Suspended Ceiling: Standard LED downlights, low energy, low voltage, warm white (3000 Kelvin), 4 watt bulbs, 127 degree beam spread, up to 50,000 hours of life; integrated tamperproof metal trim ring. Pre-installed dimmer control included.

I. Bumpers: Pre-installed on wall panel to measure 12 inches (305 mm) above finished floor unless indicated otherwise.

1. Location: Back and side walls in Freight Elevators.
2. Type: Flat bar with returned ends, 3/8 inches (9.5 mm) thick.

a. Width: 4 inches (101 mm).
b. Material and Finish: Satin stainless steel with No. 4 finish.

J. Protective Pads: Vinyl protective pads for cab walls.

1. Type: Pads with pre-attached pad hooks that lock into integrated pad hook channel in the top cap, eliminating the need for pad buttons.
2. Quantity: Set of 1 for each elevator (13 total).

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare surfaces using the methods recommended by the manufacturer in printed installation instructions for achieving the best result for the substrate under the project conditions.

B. Protect elevator finishes, fixtures, and equipment from damage.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions. Install in proper relationship to adjacent materials.

1. Do not make structural changes to elevator cab.
2. Do not install work in a manner that interferes with the safe operation of the elevator.

3.3 CLEANING AND PROTECTION

A. Clean exposed surface in accordance with manufacturer's instructions.

B. Protect exposed surfaces from damage by subsequent construction.

END OF SECTION 142700

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SECTION 143100 – ESCALATORS

PART 1 - GENERAL

1.1 GENERAL NOTES

A. General Provisions of Contract, including general and supplementary conditions and Division l Specification sections, apply to work of this section.

B. Provide all labor, materials, services, and equipment necessary to complete the modifications to the escalators as specified herein.

C. Drawings and specifications are intended to show general arrangement, design and extent of work. As such they are not intended to be scaled for roughed in measurements or to serve as shop drawings.

D. Anything shown on drawings and not mentioned in these specifications or vice versa, as well as any work which is obviously necessary to complete the Project, within the limits established by the drawings, specifications, and codes, although not shown on or described therein, shall be performed by the Contractor as part of their work.

1.2 DESCRIPTION OF WORK

A. Extent of work in this Section is to provide a major alteration to six (6) electric Montgomery escalators in the Truman State Office Building, 301 W High Street, Jefferson City , Missouri, as noted in the escalator schedule. The schedule indicates escalators to be modified, required performance, control, capacities, features, and finishes for the escalators.

1. The escalator alterations shall consist of replacing all escalator components with the exception of the structural truss and floor plate frames. All existing mechanical, electrical and aesthetic components of the existing escalators shall be removed and replaced with brand new components as specified herein. Components equal to those removed, reconditioned or rebuilt original components shall not be acceptable for this installation. Only the original truss, drip pan, and access floor plate frames shall be retained.

B. Escalators are hereby defined to include a power driven, inclined, continuous stairway used for raising and lowering passengers.

C. Construction Sequence and Scheduling: Per the construction schedule outlined below, the Contractor shall perform the renovations on the escalators one (1) at a time. Renovated escalators shall be provided with a two (2) day break in period prior to removing the next escalator from service.

1. All tasks to be performed that will require more than one (1) escalator to be taken from service at a time shall be scheduled with the Owner and performed outside of the Owner’s normal working hours.
2. Prior to commencement of the work specified herein, the Contractor shall submit to the Owner a task-specific schedule for the escalator renovations. This schedule shall identify critical dates and dates for which owner-provided work is to be performed and completed so as to provide for uninterrupted progress of the work.

1.3 QUALITY ASSURANCE

A. Installer Qualification: The escalator manufacturer, or a licensee of the manufacturer, who has a record of successful experience with the renovation of similar escalators. The Contractor shall have, as a minimum, the following qualifications and documentation verifying these qualifications shall be submitted prior to award:

1. Minimum of five (5) years successful experience in installing and servicing similar escalator installations.
2. Installed at least one hundred (100) completed and accepted escalator systems of similar size, scope, logic control, and motion control required by this contract.
3. An existing in-house administrative and technical organization staffed with competent personnel who are experienced in the escalator related work required to install and service the escalator systems as specified. Service shall be provided by the installer and shall not be subcontracted. Installer shall have a local office established within one hundred fifty (150) miles of the project site.

B. Escalator Code: Except for more stringent requirements as indicated or imposed by governing regulations, alteration work shall comply with applicable requirements of the 2016 ASME A17.1 Safety Code for Elevators and Escalators (hereinafter referred to as the “Elevator Code”) and the 2018 IBC Building Code.

C. NFPA Code: Comply with applicable NFPA Codes and specifically with sections relating to electrical work and escalators.

D. Accessibility Standards: Comply with the Uniform Federal Accessibility Standards and the "Americans with Disability Act" of July 26, 1991.

E. Performance Requirements: Escalators shall provide smooth operation and operate within 2% of contract speed.

1.4 SUBMITTALS

A. Refer to Division 1 for additional information regarding submittals, including submittal requirements, processing procedures, and limitations of review.

B. Pre-Construction Submittals: The following shall be submitted for review prior to manufacturing of equipment.

1. Product Data: Submit manufacturer's product data, installation instructions, and maintenance recommendations for each material proposed for use.
2. Layout Drawings: Provide layout drawings of each escalator including maximum loads imposed on the building structure at all support points, dimensions of the existing escalator and electrical characteristics and connection requirements of new equipment.
3. Approval of shop drawings is for general arrangement only and does not include measurement, which is the contractor's responsibility, or approval of variations from the contract documents. The purpose of the shop drawing submittals by the contractor is to demonstrate to the owner the contractor understands the design concept and demonstrates an understanding of the equipment and materials to be furnished.

C. Post Construction Submittals: Prior to completion and acceptance of the project, the following shall be submitted for review and acceptance.

1. Maintenance Manuals: Submit job specific, bound manuals for escalators, with operating and maintenance instructions, lubricating schedule and instructions, parts listing, recommended parts inventory listing for motor and critical components, diagnostic device operations manual, emergency instructions and similar information.

    a. The diagnostic device operations manual shall be complete with adjustment settings, sequence of operation, and other diagnostic technical data required for adjustments, tuning, maintenance, and operation of escalators including performance of all required acceptance and periodic testing required by the 2016 ASME A17.1 Safety Code for Elevators and Escalators. Users instruction manual shall included access codes required for accessing microprocessor equipment for adjusting or programming.
    b. Provide one (1) copy of manual bound in standard three-ring, hard binder. Additionally, provide one (1) electronic copy in “PDF” format on flash drive. Identify each copy with escalator numbers and Owner's name.
    c. Detailed "Maintenance Control Program" - specific to the elevator as required by Elevator Code. The MCP shall be in place to maintain the equipment in compliance with Elevator Code. The MCP shall specify examinations, tests, cleaning, lubrication, and adjustments to applicable components at regular intervals and shall comply with Section 8.6.1 of the Elevator Code. The MCP shall include “On-Site Documentation” and a method for “Maintenance Records” and “On-Site Maintenance Records” as described in Elevator Code. One (1) hard copy of the “Maintenance Control Program,” identical to the MCP provided in the Maintenance Manual, shall be placed for use in the elevator control space.
    d. Wiring Diagrams: Complete electrical circuit diagrams for control and operational features as installed, showing location and wiring for power, signal and control systems. The diagrams shall differentiate clearly between manufacturer-installed wiring and field installed wiring.

2. On-Site Wiring Diagrams: Provide job-specific wiring diagrams located near the escalator controller in the escalator machine space. Provide one (1) hard copy sized at 11″ x 17″ minimum, clear-laminated wiring diagrams.
3. Keys: The Contractor shall provide the Owner with a total of six (6) sets of keys for each type of key switch fixture provided.
4. Serviceability of Equipment: The Contractor shall submit a written certification, signed by the Contractor and the manufacturer of the control equipment, making a commitment to provide direct support to the Owner, or the Owner’s escalator maintenance service representative, including availability of parts (for inventory, not on an “exchange only” basis), diagnostic tools, and technical & engineering support. In addition, all parts and support shall be provided at a reasonable cost in line for which the original manufacturer would charge to it’s own customer base and response shall be in a timely manner.
5. Certificates and Permits: Provide Owner with copies of all inspection/acceptance certificates and operating permits as required by governing authorities to allow normal, unrestricted use of escalators.

1.5 INITIAL MAINTENANCE AND WARRANTY

A. Maintenance Service: Furnish maintenance and callback service on the escalators from thirty (30) days prior to the start of the first escalator to be renovated until a period of twelve (12) months following date of substantial completion of all work on the Project. The maintenance and call back service shall include at a minimum, but not be limited to, the full maintenance requirements as follows:

1. Maintenance service shall be performed by skilled escalator personnel directly employed and supervised by the same company that furnished and installed the escalator equipment specified herein.
2. This service shall include:

    a. Semi monthly examination of each escalator unit as a minimum.
    b. Lubricating, adjusting, repairing and replacing of all parts as necessary to keep the equipment in a first class condition and proper working order.
    c. Furnish all lubricants and parts required.
    d. Equalizing tension of step chains when necessary.
    e. Assure smooth and consistent operation of escalator.
    f. Provide all periodic annual and maintenance testing in accordance with the Elevator Code.
    g. The contractor shall keep the escalator internal wellway, upper control area, and lower pit clean of all dirt and debris. All necessary cleaning supplies and equipment shall be furnished by the contractor.

3. The maintenance service shall not include the performance of any work required as a result of improper use, accidents or negligence, for which the contractor is not directly responsible.
4. All work shall be completed by trained employees of the elevator contractor and performed during normal working hours. Include 24 hour/day, 7-days/week emergency callback service. Owner is responsible for overtime cost of said callbacks. Exclude only repair/replacement due to misuse, abuse, accidents, or neglect caused by persons other than installer's personnel. Emergency callbacks shall be of highest priority.
5. The contractor shall maintain a log in the upper escalator machine space. The log shall list the date and time of routine examinations and all trouble calls. Each trouble call shall be fully described including the nature of the call, necessary corrections performed and or parts replaced.

B. General Warranty: The elevator warranty specified in this section shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

C. Warranty: Provide special project warranty, signed by Contractor, Installer, and Manufacturer, agreeing to replace, repair/restore defective materials and workmanship of escalator work during warranty period. "Defective" is hereby defined to include, but not by way of limitation, operation or control system failures, performances below required minimums, excessive wear, unusual deterioration or aging of materials or finishes, unsafe conditions, the need for excessive maintenance, abnormal noise or vibration, and similar unusual, unexpected and unsatisfactory conditions. The warranty period is twelve (12) months starting on date of substantial completion

of all work on the Project and shall be extended until "defects" as defined in this warranty are corrected.

PART 2 - MATERIALS AND COMPONENTS

2.1 GENERAL

A. Provide manufacturer's standard pre-engineered escalator systems that will comply with or fulfill the requirements of escalator schedule sheets or, at manufacturer's option, provide custom manufactured escalator systems that will fulfill requirements. Where components are not otherwise indicated, provide standard components, published by manufacturer as included in standard pre-engineered escalator systems, and as required for a complete system.

1. Direction of travel shall be considered as either direction, and unit shall be up and down reversible.

2.2 ESCALATOR MACHINERY AND CONTROL EQUIPMENT

A. Drive Machine: A totally enclosed, planetary, geared machine specially designed for this service shall be furnished. It shall include a drive motor and electro-magnetic brake. The machine shall be mounted in the upper end module to truss interface brackets and integrally attached to the track sub-assembly plates, and be connected by separate direct drive shafts to both the step drive sprocket and the handrail friction drive sheave. Handrail drive chains shall NOT be provided. The drive machine shall be designed to substantially match speeds of the step band and handrails. Lubrication of the gears and bearings shall be by synthetic based oil bath.

1. Bearings shall be rated for AFBMA L10 life under a fluctuating load. Bearings shall be rated for a minimum of 150,000 hours of service.
2. For the purpose of driving machine and power transmission calculations, the rated load shall comply with Code.

B. Motor: The escalators shall be equipped with a motors designed for escalator service. The motor shall be of TEFC design, ball bearing type, integrally and horizontally mounted to the drive machine. The motor protection class shall be equivalent to IP55 Insulation Group. The motor shall be flange mounted to the main drive gear case and torsionally connected to the gearbox. Driving motor and motor switchgear shall be designed to provide a smooth start, which shall prevent undue strain on drive components. The motor shall be of sufficient size to operate the escalator at a minimum of Code-rated load, ascending without exceeding the rated horsepower. Each escalator shall be provided with a permanent magnet ceramic brake, located on the high speed shaft which, when activated, shall stop the escalator as required by Code, upon activation of a stop button, safety device, or loss of power.

C. Permanent Magnet Ceramic Brake: A load compensating brake system shall be installed. The brake shall be capable of automatically stopping the escalator quickly but gradually, and shall hold the escalator stationary under full load whenever the power is interrupted. The brake shall be "fail safe" and electrically released. The system shall continually adjust brake torque to maintain a relatively constant deceleration independent of the load. The brake shall not cause the escalator to come to an abrupt stop. It shall be designed to meet ASME A17.1 2016 Code deceleration requirements without adjustment and shall operate in conjunction with a velocity feedback encoder on the new microprocessor controller.

D. Upper Reversing Station: The Upper Reversing Station and drive shall include a precision-machined step chain sprocket mounted on the machine output shaft and rotating on bearings.

E. Gear: Provide new gear for each escalator. The gears shall be adjusted per the original manufacturer's requirements. Replace the existing main drive chains for each escalator.

F. Step Band

1. Step Guidance: A step guidance system shall be provided to control the movement of the steps both horizontally and vertically. Each step shall be provided with horizontal guide pads, which shall guide the steps throughout their travel, in combination with a continuous guide profile installed in the area of the escalators open to passengers. A17.1 2016 Code Step/Skirt Performance Index requirements shall be met without the need for skirt deflector brushes.
2. Step Chain: The step band shall consist of consecutively running steps powered and spaced with a chain designed for long life and quiet operation. The step chain shall properly mesh with the main drive sprockets and lower reversing station castings. The chain shall be an engineering class roller chain, manufactured to close tolerances, from high quality material with heat-treated bushings, pins, and link plates.

    a. Lubrication-free chain: The escalators shall be designed using Lubrication-free chain. The chain shall be designed to reduce oil use and life cycle costs.
    b. Step chain and chain pins shall load rated in accordance with Code.

3. Steps: The steps shall be formed from one-piece die cast aluminum with closely spaced tread and riser cleats. Step rollers shall rotate on sealed ball bearings. The step shall be connected to the chain by a pin and bushing. Vertical curved step risers shall be furnished with vertical cleats arranged to pass between the cleats of the tread on the adjacent step to form an inter-meshing unit with minimum clearances.

    a. The number of level steps at each end of the escalator shall be two.
    b. Step demarcation inserts shall be provided on the sides and rear of each step. The inserts shall be fabricated from reinforced structural plastic, shall be easily replaced and shall be approximately 1.5 inches wide at the sides and approximately 1.5 inches wide at the rear. Inserts shall be attached to the step without the use of visible fasteners. The color of the demarcation inserts shall be in accordance with ASME A17.1 2016.
    c. Step assemblies shall be one (1) piece, die cast aluminum, or approved equal. Step treads shall have one eighth (1/8) of an inch wide cleats on three eighths (3/8) of an inch centers, not less than three eighths (3/8) of an inch in depth, and shall be designed to mesh with the combplates.
    d. Step ends shall be square in order to minimize step to skirt clearances. The entire step assembly shall be treated with not less than one (1) coat of zinc chromate primer and one (1) coat of aluminum enamel for corrosion resistance.
    e. Steps and their various attachments shall permit removal of steps without disturbing balustrades.
    f. The design shall permit the running of the drive without steps for convenience in cleaning and inspection.

g. Step rollers shall have polyurethane tires on hubs and sealed roller bearings and a minimum diameter of 3 inches. Step rollers shall not require any additional lubrication and must be rated for severe, heavy-duty service.
h. Steps shall be constructed so as to be driven by step linkages to step or step rollers. Step rollers shall rotate on sealed bearings.
i. Green step demarcation lights located below the step shall be located at both landings in an area not to exceed 16 in. from the combplate. There shall be a minimum of two fluorescent lamp fixtures at each landing. The lamps shall be activated whenever the escalator is in operation.

4. Tracks: New tracks shall be designed and fabricated to support and retain the steps and running gear at the rated load and at the highest speed specified. Tracks shall be assembled and secured together for easy removal and replacement of sections. The system shall be adjustable, with no welding of the track sections at the joints. Tracks shall be properly supported on stanchions to provide correct alignment and smooth transition to return stations. The rolling surface of the incline track shall be a minimum thickness of one eighth (1/8) of an inch. The transition track shall be a minimum thickness of three eighths (3/8) of an inch. The guiding surface of the wheels shall be galvanized steel profiles with smooth and even running surfaces. Joints shall be cut diagonally to the running direction. A second, continuous step guiding profile shall be provided above the step chain rollers.

G. Decks: All existing escalator decking shall be removed, and new escalator decking shall be provided in a #4 Stainless Steel finish. The new decking shall be fabricated in such a way so as to interface with the existing escalator cladding / wall finishes, or any required modifications required to match the new decking shall be included in the escalator contractors scope of work.

1. Newel Ends: The new newel ends shall support the handrail around the newel through the use of a new multi-roller bearing system to minimize drag and maximize handrail life.
2. Handrail Base: New handrail base shall be provided. New handrail guide channels shall also be installed.
3. Where applicable decking between escalators shall be designed to support a live load of one hundred and seventy-five (175) pounds per square foot, without surface deflection.
4. Install stainless steel deck between units and anti-slide devices, which shall consist of stainless steel objects fastened to the decks no closer than 4 inches from either handrail nor greater than 12 inches from either handrail. Each device shall be no less than 2 inches and shall contain no sharp corners or edges.

H. Controller: Provide a new microprocessor controller for each escalator. The new controller shall work in conjunction with the new and retained safety features, new annunciator cabinets, the new permanent magnet brake and the velocity encoder to ensure safe and proper escalator control. The controller shall be supplied by a portable cord so that it can be removed from the pit area, as required by 2016 ASME A17.1.

1. The escalator control equipment shall contain diagnostic capabilities as required for the ease of complete maintenance. The diagnostic system shall be an integral part of the controller and provide user-friendly interaction between the service person and the controls. All such systems shall be free of decaying circuits that must be periodically reprogrammed by the manufacturer.
2. The main control switchgear of an escalator shall contain at least the following devices: Lockable main switch thermal and magnetic motor protection starter for up and down

travel, hour counter, auxiliary contactors, phase failure device, phase sequence monitor, and ground fault monitor.

3. A diagnostic testing device, or maintenance terminal, suitable for all troubleshooting and testing procedures related to the specific type of microprocessor control, shall be installed on this project and provided for the control system at the final acceptance. This diagnostic testing device, or maintenance terminal, shall conform to the operating procedures under the testing section of these specifications.

    a. The diagnostic tool shall have the capability of being plugged into the main control cabinet, and in the newels at both the top and bottom terminals so the escalator can be diagnosed without removal of the floor plates.
    b. After successful testing of the diagnostic device, in conjunction with the microprocessor control, the testing device shall become the property of the Owner. The diagnostic testing device shall not become inoperative after a period of time requiring factory rehabilitation. The contractor shall provide written certification that repair and support of the diagnostic tool components is readily available to the Owner in the future.
    c. When repairs or replacement to the testing device become necessary prior to the final acceptance, the repairs, or replacement, shall be provided at no cost to the Owner.

4. All terminals shall have identification markings and all cables shall be provided with cable markers.
5. The controller shall be equipped with an AC induction motor reduced voltage starter; installed in line between the standard type contactor and the drive motor. The starter shall be solid state, capable of starting motors smoothly and gradually, reducing inrush current and mechanical shock upon start up. Adjustable settings for accelerating time and starting torque shall be provided. The starter shall also contain auxiliary contacts and a thermal overload relay for motor protection.
6. Electrical Economizer: Provide each escalator with a closed loop energy management device that will continually monitor the motor workload on the step band. This device shall automatically adjust the line current and voltage to the drive motor to allow it to always operate at its optimum efficiency regardless of elevator load.
7. The escalator control cabinet shall be provided with a fan to provide ventilation to the cabinet.
8. Elevator Monitoring System: Provide connections to Interactive Monitoring System as described in Section 142100 2.2.C.12.l.

I. Wiring: All wiring shall be replaced and installed new. The wiring and electrical interconnections shall comply with the governing codes. Insulated wiring shall have flame retardant and moisture-proof outer covering, and shall be run in conduit, tubing or electrical wireways.

J. Operating Devices: Provide new stop buttons and key-actuated starting switches for each escalator. A momentary pressure emergency stop button and key-actuated spring-return starting switch that shall start the escalator in either direction. Locate at upper and lower landing newels, at code-required locations. Stop buttons shall be housed under clear, high impact resistant, plastic cover, which shall be self closing by means of spring-loaded hinge at upper edge. Cover shall have clearly printed upon it, the words “emergency stop”, in one half (1/2) inch high letters. When

the cover is lifted an audible alarm shall sound at, or near, the top and bottom button locations until cover is returned to the closed position.

K. Handrail System: Escalator handrails shall be of the V-groove type and shall be properly constructed and reinforced. Handrails shall be endless with a smoothly vulcanized splice and shall operate with the moving steps. The handrails shall move on specially formed guides and traction sheaves. These sheaves shall be an integral part of the drive machine. Close fitting guards shall be provided by the handrail openings in the newel base. The handrail color shall be black. The handrail drive system shall be a direct drive type and shall not utilize a drive chain.

L. Truss: Retain the existing truss for each escalator. Provide a clean down of each truss to remove any surface rust, oil, grease, lint, dirt, and debris that has collected. Inspect and analyze the existing welds, rivets, and overall structure. At the upper and lower ends remove the track and support brackets, access cover support plates, selected truss cross members and handrail support return brackets. In the incline remove the top and return track, remove the handrail return brackets and modify the truss cross members as required for the installation of the new equipment. Paint truss with a low VOC type paint as specified in Section 09912.

M. Balustrade: Glass Balustrades shall be provided between the escalator decks and the handrails. The Balustrades shall be constructed of 1/2 inch tempered glass with joints perpendicular to the deck and shall be installed without mullions between the panels. In the balustrade ends, there shall be digital arrows indicating direction of travel.

N. Skirt Panels: Provide new skirt panels. The skirts shall be constructed from a heavy gauge material reinforced with steel channels. Skirts shall be fastened to the truss modules with hidden fastenings in the incline and transition areas. Skirt panels shall be installed without overlapping joints or requiring trim pieces to cover where two skirt panels meet. The skirt panels will be finished in Teflon coated 11-gauge stainless steel #4 satin finish.

1. Panel edges shall be sealed against moisture.
2. Panels shall be constructed, when practical, in equal lengths for interchangeability.
3. When framework to which panels are fastened is less than one quarter (1/4) of an inch thick, steel backup plates with a minimum one quarter (1/4) of an inch thickness shall be added which have tapped holes or clearance holes where necessary.

O. Comb Segments: Provide new sectional comb plates located at upper and lower landings, fabricated in sections to facilitate replacement without the use of special tools. Comb segments to be aluminum.

P. Front Plates: Stainless steel front plates shall be provided at upper and lower ends designed to include the handrail inlet device and key actuated direction starting switch. The handrail inlet device shall be a four piece door/gate assembly. The existing floor plate frames shall be retained, cleaned, and provide with any required modifications to accept the new floor plates.

Q. Control Station: At both the upper and lower landings, located near the handrail inlet, a station shall be provided which shall include a key actuated direction starting switch. The escalator will not restart automatically. It must be restarted with the key after it has shut down.

R. Upper and Lower Annunciator Cabinets: New annunciator printed circuit boards, provided in separate cabinets, shall be provided, and located at the upper and lower landings for each

escalator. These cabinets shall serve as individual interfaces for the electrical system, to which all of the safety devices will be wired into. Provide inspection switches on the exterior of each cabinet.

S. Floor Plates: The existing floor plate frames shall be retained in place. New, extruded aluminum floor plates shall be provided and be of such a design to meet Escalator Code.

T. Labeling Requirements: Every escalator shall be clearly marked with rated load and speed, braking torque and manufacturer serial number.

U. Protective Devices: Provide the following protective devices as required by Escalator Code and tie them into the escalator system at the new annunciator cabinets:

1. Missing Step Device: This device activates by detection of a missing step and shall cause the escalator to stop before the resulting gap emerges from the comb by removal of electrical power from the drive motor and applying the brake.
2. Handrail Speed Monitoring Device: This device is activated by a deviation between the handrail and step speed of more than 15 percent; upon detection, an alarm shall sound; the brake will be applied if deviation continues for more than two seconds.
3. Step Level Device: This device is activated by any downward displacement of riser end of step of 1/8 inch (3.2 mm) or greater; activation shall stop the escalator prior to the step entering the combplate by removal of electrical power from the drive motor and applying the brake.
4. Handrail Entry Device: This device is activated if an object becomes caught between the handrail and the handrail guard. The device will cause removal of electrical power from the drive motor and application of the brake.
5. Step Upthrust Device at Lower Landing: The device is activated if a step is displaced against the upthrust track at the lower curve in the passenger carrying line of the track system. The device will cause removal of electrical power from the drive motor and application of the brake.
6. Emergency Stop Buttons: Provide buttons to cut electrical power supply to the motor upon activation. Emergency stop buttons shall be located at each landing and in machinery spaces in accordance with Escalator Code.
7. Safety Signs: Provide pictorial sign at upper and lower landings in accordance with Escalator Code.
8. Friction Reversal Device: For an ascending escalator, the friction reversal device shall cause the electric power to be removed from the drive motor and the brake activated in case of reversal of travel while the escalator is operating. Device shall be employed to remove power if the escalator speed varies more than plus or minus twenty (+/- 20%) percent.
9. Left and Right Hand Broken Step Chain Contacts: The broken step chain devices will cause the electric power to the drive machine to be removed and the brake activated in the case that a step chain breaks or excessively sags.
10. Left and Right Hand Step and Skirt Safety Switch: These devices cause the electric power to the drive machine to be removed and the brake activated should an object become wedged between the step and skirt panel as the step approaches the upper or lower combplate.
11. Level Step Device: Device to stop escalator should escalator have misalignment of steps, or linkages. This device, one (1) at top and one (1) at bottom, shall monitor steps before entry into comb as well as on return side and shall be manually reset.

12. Comb-Step Impact Device: A comb-step impact device shall be provided at the upper and lower comb plates. Should an impact occur between the comb segments and the steps, the escalator shall come to a controlled stop.

PART 3 - EXECUTION

3.1 PREPARATIONS

A. Site Inspection: Prior to commencing escalator modifications, inspect wellways, openings, pits, and machinery areas as constructed. Contractor is responsible for all dimensions as field measured by the Contractor for proper installation and performance of escalator work.

1. Contractor shall be responsible for inspecting and determining extent of work to be performed at the site to complete the work. Contractor must take into account all requirements for installation of new work, access, code requirements, and removal or demolition, which additional work shall be performed without cost to the Owner.

B. Demolition: The removal of all escalator equipment, that is not to be retained in the renovation, shall be completed by the contractor. The old escalator equipment removed becomes the property of the Contractor and it is their responsibility to remove this equipment from the project site. Include all work necessary to protect the public, residents, building employees, and building property during removal of demolished materials.

1. Barricades required for protection of the wellways during the renovation shall be provided by the Contractor. Do not start demolition of an area until all temporary protection and temporary partitions are in place as furnished by the contractor.
2. During work on escalators, anytime there is the possibility of items falling from the respective escalator truss due to the particular work being performed (such as installation of outside skirting), the contractor shall provide all adequate protection / roping off of areas below, to protect the public.

3.2 MODIFICATIONS TO ESCALATOR SYSTEM

A. General: Comply with manufacturer's instructions and recommendations for work required during installation, referenced codes, and specifications.

B. Welded Construction: Provide welded connections for installation of escalator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship for qualifications of welding operators.

1. All welding shall require hot work permits from the facility and shall be performed outside of scheduled event hours.

C. Coordination: Coordinate escalator work with other sections for proper time and sequence to avoid construction delays. The Contractor shall provide modifications to achieve a fully operational escalator system as stipulated in the construction schedule. The Contractor shall maintain full crews and continue work once escalator demolition begins until the escalator system is completed and operational and accepted by the Owner. The Contractor shall provide the

number of crews required to maintain the schedule and shall provide additional manpower and work such additional hours as are necessary to bring the project back on schedule.

1. All construction activities that produce load noises (i.e. jack-hammering, saw-cutting, core drilling, etc.), or paint odors, that are deemed unacceptable by the Owner's Representative shall only be conducted outside of normal operating for the facilities as depicted on the construction phasing schedule drawing.
2. Contractor shall provide floor protection in barricaded areas consisting of plywood or masonite panels or approved equal. Contractor is additionally responsible for floor protection during removal and delivery of equipment to well ways. During transfer of heavy materials, provide temporary plywood or masonite panels to protect flooring.

D. Sound Isolation: Mount any new escalator equipment and components on vibration absorption mounts (when applicable), designed to effectively prevent transmission of vibrations to structure, and thereby eliminate sources of structure borne noise from escalator system.

E. Hoisting: All required hoisting and movement of the escalator equipment shall be the responsibility of the Contractor in this section.

F. Final Cleaning & Painting: Upon completion of all escalator work, provide total clean down of escalator machinery areas, wellways and pits, including equipment. All steel components in these areas shall be provided with touch up painting to remove all scratches and blemishes incurred during construction.

1. All painting shall be closely coordinated with the facility and shall be performed outside of scheduled event hours.

3.3 ELECTRIC WIRING

A. Conductors: Copper throughout with individual wires coded and all connections on identified studs or terminal blocks. Use no splices or similar connections on any wiring except at terminal blocks, control cabinets, junction boxes or conduits.

B. Conduit: Painted or galvanized steel or aluminum conduit and duct shall be used. Conduit size shall be 1/2" minimum, except that 3/8" can be used for runs containing only 2 wires. Flexible conduit exceeding 18" in length shall not be used.

3.4 FIELD QUALITY CONTROL

A. Acceptance Testing: Upon nominal completion of the escalator modifications, and before permitting use of elevator, perform acceptance tests as depicted in Rule 8.10.2.2, "Inspection and Test Requirements for New Installations", of the Escalator Code. Also perform other tests, if any, as required by governing regulations.

1. Advise Owner and Consultant of dates and time the acceptance tests and specification conformance review are to be completed as Consultant is required to make final check of each escalator operation to determine when the control systems and operating devices are functioning as specified and in compliance with code.

B. Diagnostic Testing: The diagnostic testing device, or maintenance terminal, provided shall be demonstrated and tested during the final testing of the elevator installation. This diagnostic tool shall have the capability of troubleshooting and field programmability of all control variables providing interaction between the service man and the microprocessor controller including performance of all ongoing safety testing as required by the Escalator Code.

3.5 PROTECTION

A. At the time of substantial completion of escalator work (or portion thereof) provide suitable protective covering, barriers, devices, signs, or such other methods or procedures to protect escalator work from damage or deterioration. Maintain protective measures throughout remainder of construction period.

3.6 INSTRUCTION AND MAINTENANCE

A. A maximum period of four (4) hours shall be dedicated to instruct Owner's personnel in proper use, operation and daily maintenance of escalators. Review emergency provisions and procedures to be followed at time of failure in operation and other building emergencies. Train Owner's personnel in normal procedures to be followed in checking for sources of operational failures or malfunctions. Provide instruction on the use and capabilities of the diagnostic testing device (if provided), or maintenance terminal. A complete manual of instruction shall be provided with the diagnostic equipment.

3.7 ESCALATOR SCHEDULE

A.	Quantity	Six (6) electric escalator nos. 1 through 6:
B.	Type of Escalator	Cleated step reversible type with 2 flat steps.
C.	Speed	100 feet per minute.
D.	Rise	Retain 13′-0″.
E.	Step Width	Retain 24 inches.
F.	Angle of Inclination	Retain 30 degrees.
G.	Balustrades	Provide new single radius newels and curved decking transitions. Install anti-slide devices between the escalators, installed 78 inches apart.
H.	Balustrade Finish	Provide new glass balustrades with joints perpendicular to the deck and no mullions between panels.
I.	Drive Machine & Motor	Provide new, planetary-geared drive machine and motor and provide new permanent magnet brake.
J.	Brake	Provide new, closed loop, load sensing permanent magnet ceramic brake on the new motor shaft.

K.	Controller & Wiring	Provide new microprocessor controller and wiring.
L.	Floor Plates	Provide new aluminum floor plates.
M.	Comb Plates	Provide new yellow combplates.
N.	Handrail System	Provide new, V-Groove type handrails with new drive sprockets, and idler sprockets.
O.	Skirts	Provide new stainless steel skirting with skirt deflection brush devices on each side of the stairway for each escalator.
P.	Step Chains	Provide new, lube free, step chains and step rollers.
Q.	Steps/Step Demarcation	Provide new one-piece die cast aluminum steps.
R.	Starting Switches	Provide new spring-loaded starting switches at the top and bottom landings with new spring-loaded switches with the properly labeled positions.
S.	Safety Features	Provide all new safety circuit switches to meet escalator code.
T.	Power Supply	Retain 480 volts, 3 phase, 60 hertz.
U.	Maintenance	Provide full maintenance service from thirty (30) days prior to start of work until a period of twelve (12) months after substantial completion of renovation work on all escalators.

END OF SECTION 143100

SECTION 210100 – BASIC FIRE PROTECTION REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Specification Sections, apply to this and the other sections of Division 21.

1.2 SUMMARY

A. This Section includes general administrative and procedural requirements for fire protection installations. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Division 01:

1. Submittals.
2. Material and Equipment Selection.
3. Coordination drawings.
4. Record documents.
5. Maintenance manuals.

1.3 REFERENCED STANDARDS

A. International Fire Code 2012 (IFC)

B. National Fire Protection Association Standards

1.4 REVIEW RESPONSIBILITIES

A. General: Submittals are not requested for all products covered in the specifications. Submit only the data requested under the submittals portion of each specification section or where indicated in a Submittal Log, if included within Division 01. Un-requested submittals will not be processed, reviewed or returned and the contractor will be notified that the submittal will not be reviewed by the engineer of record.

1. Non-requirement of submittals, when so noted, is not to be construed as an allowance for substitutions and does not relieve the contractor from full compliance with the plans and specifications.
2. Any deviation from specified items is considered a substitution. If the contractor desires to use other than specified items, then a formal request for substitution must be submitted prior to bid date (no exceptions), in accordance with the procedures and time limitations set forth in Division 01. Where not defined in Division 01, requests for substitutions shall be submitted no less than ten (10) working days prior to bid date. Review of substitution requests by the Engineer shall be done at the expense of the contractor. Charges for this substitution review shall be calculated based on the Engineer’s standard hourly rates, as defined in their contract with the Owner.

B. It is the responsibility of the Contractor to ensure that all submittals have been reviewed for total completeness and accuracy as to the requirements of the specifications and drawings before being submitted to the Engineer for review.

1. One comprehensive submittal shall be provided for each individual specification section. All required submittal information called for in each individual specification section shall be included in the submittal.
2. The Engineer of Record shall not be responsible for informing the contractor on items that have not been included and are necessary for a complete review of the required submittal information for a specification section.
3. The Engineer of Record shall have the option of returning any submittal, unmarked, if all required documentation called for in the specifications has not been provided in the submittal.
4. The Engineer of Record shall review each submittal no more than two (2) times and return to the contractor with the appropriate disposition.
5. If the Engineer of Record is required to review a submittal a second time, it shall be limited to review of the changed information, clearly highlighted by the submitter, and/or confirmation of documentation only and it shall be returned to the contractor with the appropriate disposition.
6. If the submittal is required to be reviewed a third time, it shall be done at the expense of the contractor. Charges for this additional submittal review shall be calculated based on the Engineer's standard hourly rates, as defined in their contract with the Owner.

C. Operation and Maintenance Manuals: All items required for insertion into each Operation and Maintenance (O&M) Manual are called out in the submittals portion of each specification section or in a Submittal Log, if included within Division 01. It is the responsibility of the Contractor to ensure that the O&M submittal has been reviewed and includes all the requirements of the specifications. The Engineer of Record shall review the submittal for the Operation and Maintenance Manual one (1) time and return to the contractor with the appropriate disposition.

1. If the submittal is required to be reviewed a second time, it shall be done at the expense of the contractor. Charges for this additional submittal review shall be calculated based on the Engineer's standard hourly rates, as defined in their contract with the Owner.
2. Submittals for the Operation and Maintenance Manual must be original documentation.
3. Photo copies of marked up Operations and Maintenance submittals are not acceptable.

D. Refer to Division 01 and each individual Division 21 Section for additional submittal requirements.

E. Prepare maintenance manuals in accordance with Division 01. In addition to the requirements specified in Division 01, include the following information for equipment items:

1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.

4. Servicing instructions and lubrication charts and schedules.
5. Facsimiles or photo copies are not allowed as submittals for operating and maintenance manuals. Submittals for operating and maintenance manuals must be on original manufacturer printed stock.

F. Prepare and submit Coordination Drawings as further described herein. The Engineer shall receive one copy of all coordination drawings supplied to the Owner as required in this specification. It is the responsibility of the Contractor to coordinate the work as outlined herein. Receipt by the Engineer of a copy of the coordination drawings is to verify conformance to the submittal requirements set forth in this specification section. It is not an admission by the Engineer as to the accuracy or completeness of the coordination proposed.

G. Coordination shall be drawn to a scale of ¼" = 1'0" or larger. Detail major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Show space requirements for installation and access. Indicate if sequence and coordination of installations are important to efficient flow of the Work. Include the following:

1. Planned piping layout, including valve and specialty locations and valve-stem movement. Include all piping including but not limited to Fire Protection piping, HVAC piping, and Plumbing piping. Include ceiling and wall-mounted access doors and panels required to provide access to valves and other operating devices.
2. Planned ductwork layout, including terminal units, dampers and specialty locations, with terminal unit and damper operator clearances. Include ceiling and wall-mounted access doors and panels required to provide access to dampers and other operating devices.
3. Clearances for installing and maintaining insulation.
4. Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly required for periodic maintenance.
5. Equipment and accessory service connections and support details.
6. Exterior wall and foundation penetrations.
7. Fire-rated wall and floor penetrations.
8. Sizes and location of required concrete pads and bases.
9. Scheduling, sequencing, movement, and positioning of large equipment into building during construction.
10. Floor plans, elevations, and details to indicate penetrations in floors, walls, ceilings and roofs, and their relationship to other penetrations and installations.
11. Ceiling plans showing coordination of mechanical, electrical, structural, ceiling suspension assembly, lighting, security, communications, fire alarm, plumbing, and fire protection work within allotted space.
12. Reflected ceiling plans to coordinate and integrate installation of air outlets and inlets, light fixtures, communication system components, sprinklers, access panels, special moldings, and other ceiling-mounted items.

Floor plans and sections of fan rooms and mechanical rooms; show layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.

H. Prepare record documents in accordance with the requirements in Division 01. In addition to the requirements specified in Division 01, indicate the following installed conditions:

1. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located. Indicate actual inverts and horizontal locations of all underground piping.
2. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
3. Approved substitutions, Contract Modifications, and actual equipment and materials installed.
4. Contract Modifications, actual equipment and materials installed.

I. Comply with each individual Division 21 Section for additional submittal requirements.

1.5 MATERIAL AND EQUIPMENT SELECTION

A. Product Options: The specification of each item of major mechanical equipment required for the project may include a list of manufacturers, with one “basis of design” manufacturer, type, and model identified by virtue of their listing in the equipment schedule on the Drawings. Where several manufacturers in addition to the “basis of design” manufacturer are listed in the specifications, it shall be understood that the words “or approved equal by” are implied to precede each of the other manufacturer’s names.

1. The manufacturers other than the “basis of design” may be furnished at the contractor’s option in lieu of the “basis of design” product, provided that the selected manufacturer’s product is equal in all material and functional respects. In addition to submittal requirements that may be specified in this section, submit a line-by-line written verification of the applicable specification section(s) identifying compliance with or variations from the specified features, materials, performance, capacities, weight, size, durability, energy consumption and efficiency, warranty, and visual impact (if exposed to view by other than maintenance persons). The burden of proof of manufacturer/product equality is on the contractor.
2. Where a product is not scheduled on the drawings and, therefore, where no “basis of design” is indicated, selection among all of the listed manufacturers and products is at the contractor’s option, subject to the requirements of the Contract Documents.
3. Products of manufacturers not listed in the Contract Documents are considered Substitutions and are not permitted, except as provided under the General and Supplementary Conditions and Division 01 Specifications. Full compliance with Division 01 section “Product Substitutions” is mandatory for acceptance of products or manufacturers not listed.

B. Listing of a manufacturer does not imply approval of that manufacturer’s standard product or products. Rather, listing of a manufacturer indicates only a general acceptance of that manufacturer’s name and reputation. Final approval is subject to full compliance with these Contract Documents.

C. Model numbers identified on the Drawings notwithstanding, all equipment must comply with the requirements of these Contract Documents. Do not assume that a manufacturer’s standard product is acceptable as is. For example, one or more custom modifications, custom colors or finishes, manufacturer’s options, and/or accessories may be required to meet the specified requirements.

D. Where drawings indicate sizes, profiles, connections, and dimensional requirements of material and equipment, these are based on the “basis of design” manufacturer, type and model indicated. In the event that equipment of power, dimensions, capacities, layout, connections, and/or ratings

differing from the "basis of design" are selected by the contractor and approved by the Owner's representative, any necessary adjustments are the contractor's responsibility. All connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, pipe and duct sizes, pipe and duct layout, and the like shall be adjusted by the contractor to suit the equipment provided. No additional costs will be approved for these changes. Should revisions to the design because of contractor's selection of manufacturer, type, or model other than the "basis of design" require additional review and/or redesign by an Architect or Engineer, the contractor shall reimburse the Owner for Owner's added professional fee expenses.

E. Where two or more materials are listed in the "Part 2 – Products" subsection of any Division 21 section, do not assume that the selection of materials is the contractor's option. Refer to "Part 3 – Execution" subsection of that same Division 21 section for an explanation of which specific material(s) shall be used for which specific application(s). For example, Part 2 may list several types and grades of piping, and Part 3 will describe which type and grade of pipe to use for a given application.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. Protect stored on-site or installed absorptive materials from moisture damage. Materials directly exposed to moisture via precipitation, water leaks, or condensation shall be removed from the jobsite and replaced.

END OF SECTION 210100

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SECTION 210500 - COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Mechanical sleeve seals.
3. Sleeves.
4. Escutcheons.
5. Grout.
6. Fire-suppression equipment and piping demolition.
7. Equipment installation requirements common to equipment sections.
8. Painting and finishing.
9. Concrete bases.
10. Supports and anchorages.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. CPVC: Chlorinated polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 CONTRACTOR'S SUBMITTAL REVIEW RESPONSIBILITIES

A. General: Submittals are not requested for all products covered in the specifications. Submit only the data requested under the submittals portion of each specification section or where indicated in a Submittal Log, if included within Division 01. Un-requested submittals will not be processed, reviewed or returned and the contractor will be notified that the submittal will not be reviewed by the engineer of record.
   1. Non-requirement of submittals, when so noted, is not to be construed as an allowance for substitutions and does not relieve the contractor from full compliance with the plans and specifications.
   2. Any deviation from specified items is considered a substitution. If the contractor desires to use other than specified items, then a formal request for substitution must be submitted prior to bid date (no exceptions), in accordance with the procedures and time limitations set forth in Division 01. Where not defined in Division 01, requests for substitutions shall be submitted no less than ten (10) working days prior to bid date. Review of substitution requests by the Engineer shall be done at the expense of the contractor. Charges for this substitution review shall be calculated based on the Engineer's standard hourly rates, as defined in their contract with the Owner.

B. It is the responsibility of the Contractor to ensure that all submittals have been reviewed for total completeness and accuracy as to the requirements of the specifications and drawings before being submitted to the Engineer for review.

   1. One comprehensive submittal shall be provided for each individual specification section. All required submittal information called for in each individual specification section shall be included in the submittal.
   2. The Engineer of Record shall not be responsible for informing the contractor on items that have not been included and are necessary for a complete review of the required submittal information for a specification section.
   3. The Engineer of Record shall have the option of returning any submittal, unmarked, if all required documentation called for in the specifications has not been provided in the submittal.
   4. The Engineer of Record shall review each submittal no more than two (2) times and return to the contractor with the appropriate disposition.
   5. If the Engineer of Record is required to review a submittal a second time, it shall be limited to review of the changed information, clearly highlighted by the submitter, and/or confirmation of documentation only and it shall be returned to the contractor with the appropriate disposition.
   6. If the submittal is required to be reviewed a third time, it shall be done at the expense of the contractor. Charges for this additional submittal review shall be calculated based on the Engineer's standard hourly rates, as defined in their contract with the Owner.

C. Operation and Maintenance Manuals: All items required for insertion into each Operation and Maintenance (O&M) Manual are called out in the submittals portion of each specification section or in a Submittal Log, if included within Division 01. It is the responsibility of the Contractor to ensure that the O&M submittal has been reviewed and includes all the requirements of the specifications. The Engineer of Record shall review the submittal for the Operation and Maintenance Manual one (1) time and return to The contractor with the appropriate disposition.

1. If the submittal is required to be reviewed a second time, it shall be done at the expense of the contractor. Charges for this additional submittal review shall be calculated based on the Engineer's standard hourly rates, as defined in their contract with the Owner.
2. Submittals for the Operation and Maintenance Manual must be original documentation.
3. Photo copies of marked up Operations and Maintenance submittals are not acceptable.

D. Coordination Drawings: Prepare and submit Coordination Drawings as further described herein and as indicated in the Special Conditions. The Engineer shall receive one copy of all coordination drawings supplied to the Owner as required in this specification. It is the responsibility of the Contractor to coordinate the work as outlined herein. Receipt by the Engineer of a copy of the coordination drawings is to verify conformance to the submittal requirements set forth in this specification section. It is not an admission by the Engineer as to the accuracy or completeness of the coordination proposed.

E. Refer to Division 01 and each individual Division 23 Section for additional submittal requirements.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Mechanical sleeve seals.
2. Escutcheons.

B. Welding certificates.

1.6 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Fire-Suppression Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.8 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for fire-suppression installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for fire-suppression items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 21 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 21 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

    a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

H. Solvent Cements for Joining CPVC Plastic Piping: ASTM F 493.

2.4 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Manufacturers:

    a. Advance Products & Systems, Inc.
    b. Calpico, Inc.
    c. Metraflex Co.
    d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Stainless steel. Include two for each sealing element.
4. Connecting Bolts and Nuts Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.

F. PVC Pipe: ASTM D 1785, Schedule 40.

G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.6 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Stamped-Steel Type: With **set screw** and chrome-plated finish.

2.7 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 FIRE-SUPPRESSION DEMOLITION

A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove fire-suppression systems, equipment, and components indicated to be removed.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.

5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 21 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. New Piping:

    a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
    c. Insulated Piping: One-piece, stamped-steel type with spring clips.
    d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.

e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
f. Bare Piping at Ceiling Penetrations in Finished Spaces: cast-brass type with polished chrome-plated finish.
g. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
h. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with set screw or spring clips.
i. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
j. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.
k. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

2. Existing Piping: Use the following:

a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
b. Insulated Piping: Split-plate, stamped-steel type with hinge and spring clips.
c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and spring clips.
e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
f. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and set screw.
g. Bare Piping in Unfinished Service Spaces: Split-casting, cast-brass type with polished chrome-plated finish.
h. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with hinge and set screw or spring clips.
i. Bare Piping in Equipment Rooms: Split-casting, cast-brass type.
j. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with set screw or spring clips.
k. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.

M. Sleeves are not required for core-drilled holes.

N. Permanent sleeves are not required for holes formed by removable PE sleeves.

O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.

1) Seal space outside of sleeve fittings with grout.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

R. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

S. Verify final equipment locations for roughing-in.

T. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 21 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

3.4 PAINTING

A. Painting of fire-suppression systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.5 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor fire-suppression materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.6 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor fire-suppression materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.7 GROUTING

A. Mix and install grout for fire-suppression equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 210500

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SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Pipes, fittings, and specialties.
2. Fire-protection valves.
3. Fire-department connections.
4. Sprinklers.
5. Alarm devices.
6. Manual control stations.
7. Control panels.
8. Pressure gages.

1.3 DEFINITIONS

A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175 psig maximum.

1.4 SYSTEM DESCRIPTIONS

A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

1.5 PERFORMANCE REQUIREMENTS

A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

B. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. Sprinkler system design shall be approved by authorities having jurisdiction.

1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
2. Sprinkler Occupancy Hazard Classifications:

a. Automobile Parking Areas: Ordinary Hazard, Group 1.
b. Building Service Areas: Ordinary Hazard, Group 1.

c. Churches: Light Hazard.
d. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
e. Dry Cleaners: Ordinary Hazard, Group 2.
f. General Storage Areas: Ordinary Hazard, Group 1.
g. Laundries: Ordinary Hazard, Group 1.
h. Libraries except Stack Areas: Light Hazard.
i. Library Stack Areas: Ordinary Hazard, Group 2.
j. Machine Shops: Ordinary Hazard, Group 2.
k. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.

3. Minimum Density for Automatic-Sprinkler Piping Design:

a. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
b. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.

4. Maximum Protection Area per Sprinkler: Per UL listing.
5. Maximum Protection Area per Sprinkler:

a. Office Spaces: 225 sq. ft..
b. Storage Areas: 130 sq. ft..
c. Mechanical Equipment Rooms: 130 sq. ft..
d. Electrical Equipment Rooms: 130 sq. ft..
e. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.

6. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:

a. Light-Hazard Occupancies: 100 gpm for 30 minutes.
b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.
c. Extra-Hazard Occupancies: 500 gpm for 90 to 120 minutes.

D. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7.

1.6 SUBMITTALS

A. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

B. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Qualification Data: For qualified Installer and professional engineer.

D. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

E. Welding certificates.

F. Fire-hydrant flow test report.

G. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

H. Field quality-control reports.

I. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13, "Installation of Sprinkler Systems."
2. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

1.8 PROJECT CONDITIONS

A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:

1. Notify Construction Manager and Owner no fewer than two days in advance of proposed interruption of sprinkler service.
2. Do not proceed with interruption of sprinkler service without Construction Manager's and Owner's written permission.

1.9 COORDINATION

A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

1.10 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

2.2 STEEL PIPE AND FITTINGS

A. Standard Weight, Schedule 40 Steel Pipe: ASTM A 53/A 53M, [Type S – seamless]. Pipe ends may be factory or field formed to match joining method.

B. Schedule 10, Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, Schedule 10 in NPS 5 and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10, plain end.

C. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.

D. Steel Couplings: ASTM A 865, threaded.

E. Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

F. Malleable- or Ductile-Iron Unions: UL 860.

G. Cast-Iron Flanges: ASME 16.1, Class 125.

H. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

I. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.

J. Grooved-Joint, Steel-Pipe Appurtenances:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Anvil International, Inc.
b. Corcoran Piping System Co.
c. National Fittings, Inc.
d. Shurjoint Piping Products.
e. Tyco Fire & Building Products LP.
f. Victaulic Company.

2. Pressure Rating: 175 psig minimum.
3. Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

K. Steel Pressure-Seal Fittings: UL 213, FM-approved, 175-psig pressure rating with steel housing, rubber O-rings, and pipe stop; for use with fitting manufacturers' pressure-seal tools.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Victaulic Company.

2.3 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:

1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
2. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

D. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

E. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F 493, solvent cement recommended by pipe and fitting manufacturer, and made for joining CPVC sprinkler pipe and fittings. Include cleaner or primer recommended by pipe and fitting manufacturer.

1. Use solvent cement that has a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Use adhesive primer that has a VOC content of 650 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. Plastic, Pipe-Flange Gasket, and Bolts and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.4 COVER SYSTEM FOR SPRINKLER PIPING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. DecoShield Systems, Inc.

B. Description: System of support brackets and covers made to protect sprinkler piping.

C. Brackets: Glass-reinforced nylon.

D. Covers: Extruded PVC sections of length, shape, and size required for size and routing of CPVC piping.

2.5 LISTED FIRE-PROTECTION VALVES

A. General Requirements:

1. Valves shall be UL listed or FM approved.
2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig.

B. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:

a. Anvil International, Inc.
b. Victaulic Company.

3. Standard: UL 1091 except with ball instead of disc.
4. Valves NPS 1-1/2 and Smaller: Bronze body with threaded ends.
5. Valves NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
6. Valves NPS 3: Ductile-iron body with grooved ends.

C. Check Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:

a. AFAC Inc.
b. American Cast Iron Pipe Company; Waterous Company Subsidiary.
c. Anvil International, Inc.
d. Clow Valve Company; a division of McWane, Inc.
e. Crane Co.; Crane Valve Group; Crane Valves.

f. Crane Co.; Crane Valve Group; Jenkins Valves.
g. Crane Co.; Crane Valve Group; Stockham Division.
h. Fire-End & Croker Corporation.
i. Fire Protection Products, Inc.
j. Fivalco Inc.
k. Globe Fire Sprinkler Corporation.
l. Groeniger & Company.
m. Kennedy Valve; a division of McWane, Inc.
n. Matco-Norca.
o. Metraflex, Inc.
p. Milwaukee Valve Company.
q. Mueller Co.; Water Products Division.
r. NIBCO INC.
s. Potter Roemer.
t. Reliable Automatic Sprinkler Co., Inc.
u. Shurjoint Piping Products.
v. Tyco Fire & Building Products LP.
w. United Brass Works, Inc.
x. Venus Fire Protection Ltd.
y. Victaulic Company.
z. Viking Corporation.
aa. Watts Water Technologies, Inc.

3. Standard: UL 312.
4. Pressure Rating: 250 psig minimum.
5. Type: Swing check.
6. Body Material: Cast iron.
7. End Connections: Flanged or grooved.

D. Indicating-Type Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:

a. Anvil International, Inc.
b. Fivalco Inc.
c. Global Safety Products, Inc.
d. Kennedy Valve; a division of McWane, Inc.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. Shurjoint Piping Products.
h. Tyco Fire & Building Products LP.
i. Victaulic Company.

3. Standard: UL 1091.
4. Pressure Rating: 175 psig minimum.

5. Valves NPS 2 and Smaller:

    a. Valve Type: Ball or butterfly.
    b. Body Material: Bronze.
    c. End Connections: Threaded.

6. Valves NPS 2-1/2 and Larger:

    a. Valve Type: Butterfly.
    b. Body Material: Cast or ductile iron.
    c. End Connections: Flanged, grooved, or wafer.

7. Valve Operation: Integral indicating device.

2.6 TRIM AND DRAIN VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating: 175 psig minimum.

B. Angle Valves:

1. Manufacturers: Subject to compliance with requirements:

    a. Fire Protection Products, Inc.
    b. United Brass Works, Inc.

C. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Affiliated Distributors.
    b. Anvil International, Inc.
    c. Barnett.
    d. Conbraco Industries, Inc.; Apollo Valves.
    e. Fire-End & Croker Corporation.
    f. Fire Protection Products, Inc.
    g. Flowserve.
    h. FNW.
    i. Jomar International, Ltd.
    j. Kennedy Valve; a division of McWane, Inc.
    k. Kitz Corporation.
    l. Legend Valve.
    m. Metso Automation USA Inc.
    n. Milwaukee Valve Company.
    o. NIBCO INC.
    p. Potter Roemer.

q. Red-White Valve Corporation.
r. Southern Manufacturing Group.
s. Stewart, M. A. and Sons Ltd.
t. Tyco Fire & Building Products LP.
u. Victaulic Company.
v. Watts Water Technologies, Inc.

D. Globe Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Fire Protection Products, Inc.
b. United Brass Works, Inc.

E. Plug Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Southern Manufacturing Group.

2.7 SPRINKLERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFAC Inc.
2. Globe Fire Sprinkler Corporation.
3. Reliable Automatic Sprinkler Co., Inc.
4. Tyco Fire & Building Products LP.
5. Venus Fire Protection Ltd.
6. Victaulic Company.
7. Viking Corporation.

B. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating for Residential Sprinklers: 175 psig maximum.
3. Pressure Rating for Automatic Sprinklers: 175 psig minimum.
4. Pressure Rating for High-Pressure Automatic Sprinklers: 250 psig minimum.

C. Automatic Sprinklers with Heat-Responsive Element:

1. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

D. Open Sprinklers with Heat-Responsive Element Removed: UL 199.

E. Sprinkler Finishes:

1. Chrome plated.
2. Bronze.
3. Painted.

F. Special Coatings:

1. Wax.
2. Lead.
3. Corrosion-resistant paint.

G. Sprinkler Guards:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Reliable Automatic Sprinkler Co., Inc.
b. Tyco Fire & Building Products LP.
c. Victaulic Company.
d. Viking Corporation.

2. Standard: UL 199.
3. Type: Wire cage with fastening device for attaching to sprinkler.

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.2 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.

C. Install seismic restraints on piping. Comply with requirements for seismic-restraint device materials and installation in NFPA 13.

D. Install a single air vent with a manual, automatic, or other approved connection near a high point of the system on each wet pipe system utilizing metallic pipe for air removal.

E. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

F. Install unions adjacent to each valve in pipes NPS 2 and smaller.

G. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

H. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

I. Install sprinkler piping with drains for complete system drainage.

J. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

K. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.

L. Install alarm devices in piping systems.

M. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.

N. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

O. Fill sprinkler system piping with water.

P. Install electric heating cables and pipe insulation on sprinkler piping in areas subject to freezing. Comply with requirements for heating cables in Division 21 "Heat Tracing for Fire-Suppression Piping" and for piping insulation in Division 21 Section "Fire-Suppression Systems Insulation."

Q. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 21 Section "Sleeves and Sleeve Seals for Fire-Suppression Piping."

R. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 21 Section "Sleeves and Sleeve Seals for Fire-Suppression Piping."

S. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 21 Section "Escutcheons for Fire-Suppression Piping."

3.3 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

I. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

J. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

K. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.

L. Copper-Tubing Grooved Joints: Roll rounded-edge groove in end of tube according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

M. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

N. Plastic-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

3.4 INSTALLATION OF COVER SYSTEM FOR SPRINKLER PIPING

A. Install cover system, brackets, and cover components for sprinkler piping according to manufacturer's "Installation Manual" and with NFPA 13 for supports.

3.5 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

3.6 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.

3.7 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
4. Energize circuits to electrical equipment and devices.
5. Start and run excess-pressure pumps.

6. Coordinate with fire-alarm tests. Operate as required.
7. Coordinate with fire-pump tests. Operate as required.
8. Verify that equipment hose threads are same as local fire-department equipment.

C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.9 CLEANING

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers with paint other than factory finish.

3.10 PIPING SCHEDULE

A. Sprinkler specialty fittings may be used, downstream of control vales, instead of specified fittings.

B. Standard-pressure, wet-pipe sprinkler system, NPS 2 and smaller, shall be one of the following:

1. Standard-weight Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. Standard-weight Schedule 40, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
3. Standard-weight Schedule 40, black-steel pipe with grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
4. Standard-weight Schedule 40, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
5. Standard-weight Schedule 40, black-steel pipe with plain ends; steel welding fittings; and welded joints.
6. Schedule 10, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
7. Schedule 10, black-steel pipe with plain ends; welding fittings; and welded joints.

C. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 to NPS 4, shall be one of the following:

1. Standard-weight Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. Standard-weight Schedule 40, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
3. Standard-weight Schedule 40, black-steel pipe with grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
4. Standard-weight Schedule 40, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
5. Standard-weight Schedule 40, black-steel pipe with plain ends; steel welding fittings; and welded joints.

6. Schedule 10, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
7. Schedule 10, black-steel pipe with plain ends; welding fittings; and welded joints.

D. Standard-pressure, wet-pipe sprinkler system, NPS 5 and larger, shall be one of the following:

1. Standard-weight Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. Standard-weight Schedule 40, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
3. Standard-weight Schedule 40, black-steel pipe with grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
4. Standard-weight Schedule 40, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
5. Standard-weight Schedule 40, black-steel pipe with plain ends; steel welding fittings; and welded joints.
6. Schedule 10, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
7. Schedule 10, black-steel pipe with plain ends; welding fittings; and welded joints.

3.11 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Pendent sprinklers
3. Wall Mounting: Sidewall sprinklers.

B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION 211313

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SECTION 220100 – BASIC PLUMBING REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Specification Sections, apply to this and the other sections of Division 22.

1.2 SUMMARY

A. This Section includes general administrative and procedural requirements for plumbing installations. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Division 01:

1. Submittals.
2. Material and Equipment Selection.
3. Coordination drawings.
4. Record documents.
5. Maintenance manuals.
6. Buy American Act Provision

1.3 REFERENCED STANDARDS

A. International Plumbing Code 2018 (IPC)

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers. Guideline 4-2008 *Preparation of Operating and Maintenance Documentation for Building Systems*. Atlanta, GA: ASHRAE, 2008.

C. ASHRAE Standard 90.1, Energy Efficiency Design of New Buildings Except Low-Rise Residential Buildings.

1.4 CONTRACTOR'S SUBMITTAL REVIEW RESPONSIBILITIES

A. General: Submittals are not requested for all products covered in the specifications. Submit only the data requested under the submittals portion of each specification section or where indicated in a Submittal Log, if included within Division 01. Un-requested submittals will not be processed, reviewed or returned and the contractor will be notified that the submittal will not be reviewed by the engineer of record.

1. Non-requirement of submittals, when so noted, is not to be construed as an allowance for substitutions and does not relieve the contractor from full compliance with the plans and specifications.
2. Any deviation from specified items is considered a substitution. If the contractor desires to use other than specified items, then a formal request for substitution must be submitted prior to bid date (no exceptions), in accordance with the procedures and time limitations set forth in Division 01. Where not defined in Division 01, requests for substitutions shall be submitted no less than ten (10) working days prior to bid date. Review of substitution requests by the Engineer shall be done at the expense of the contractor. Charges for this

substitution review shall be calculated based on the Engineer's standard hourly rates, as defined in their contract with the Owner.

B. It is the responsibility of the Contractor to ensure that all submittals have been reviewed for total completeness and accuracy as to the requirements of the specifications and drawings before being submitted to the Engineer for review.

1. One comprehensive submittal shall be provided for each individual specification section. All required submittal information called for in each individual specification section shall be included in the submittal.
2. The Engineer of Record shall not be responsible for informing the contractor on items that have not been included and are necessary for a complete review of the required submittal information for a specification section.
3. The Engineer of Record shall have the option of returning any submittal, unmarked, if all required documentation called for in the specifications has not been provided in the submittal.
4. The Engineer of Record shall review each submittal no more than two (2) times and return to the contractor with the appropriate disposition.
5. If the Engineer of Record is required to review a submittal a second time, it shall be limited to review of the changed information, clearly highlighted by the submitter, and/or confirmation of documentation only and it shall be returned to the contractor with the appropriate disposition.
6. If the submittal is required to be reviewed a third time, it shall be done at the expense of the contractor. Charges for this additional submittal review shall be calculated based on the Engineer's standard hourly rates, as defined in their contract with the Owner.

C. Operation and Maintenance Manuals: All items required for insertion into each Operation and Maintenance (O&M) Manual are called out in the submittals portion of each specification section or in a Submittal Log, if included within Division 01. It is the responsibility of the Contractor to ensure that the O&M submittal has been reviewed and includes all the requirements of the specifications. The Engineer of Record shall review the submittal for the Operation and Maintenance Manual one (1) time and return to the contractor with the appropriate disposition.

1. If the submittal is required to be reviewed a second time, it shall be done at the expense of the contractor. Charges for this additional submittal review shall be calculated based on the Engineer's standard hourly rates, as defined in their contract with the Owner.
2. Submittals for the Operation and Maintenance Manual must be original documentation.
3. Photo copies of marked up Operations and Maintenance submittals are not acceptable.

D. Refer to Division 01 and each individual Division 22 Section for additional submittal requirements.

E. Prepare maintenance manuals in accordance with Division 01. In addition to the requirements specified in Division 01, include the following information for equipment items:

1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.

2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
4. Servicing instructions and lubrication charts and schedules.
5. Facsimiles or photo copies are not allowed as submittals for operating and maintenance manuals. Submittals for operating and maintenance manuals must be on original manufacturer printed stock.

F. Prepare and submit Coordination Drawings as further described herein. The Engineer shall receive one copy of all coordination drawings supplied to the Owner as required in this specification. It is the responsibility of the Contractor to coordinate the work as outlined herein. Receipt by the Engineer of a copy of the coordination drawings is to verify conformance to the submittal requirements set forth in this specification section. It is not an admission by the Engineer as to the accuracy or completeness of the coordination proposed.

G. Coordination shall be drawn to a scale of ¼" = 1'0" or larger. Detail major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Show space requirements for installation and access. Indicate if sequence and coordination of installations are important to efficient flow of the Work. Include the following:

1. Planned piping layout, including valve and specialty locations and valve-stem movement. Include all piping including but not limited to Plumbing piping, HVAC piping, and fire protection piping. Include ceiling and wall-mounted access doors and panels required to provide access to valves and other operating devices.
2. Planned ductwork layout, including terminal units, dampers and specialty locations, with terminal unit and damper operator clearances. Include ceiling and wall-mounted access doors and panels required to provide access to dampers and other operating devices.
3. Clearances for installing and maintaining insulation.
4. Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly required for periodic maintenance.
5. Equipment and accessory service connections and support details.
6. Exterior wall and foundation penetrations.
7. Fire-rated wall and floor penetrations.
8. Sizes and location of required concrete pads and bases.
9. Scheduling, sequencing, movement, and positioning of large equipment into building during construction.
10. Floor plans, elevations, and details to indicate penetrations in floors, walls, ceilings and roofs, and their relationship to other penetrations and installations.
11. Ceiling plans showing coordination of mechanical, electrical, structural, ceiling suspension assembly, lighting, security, communications, fire alarm, plumbing, and fire protection work within allotted space.
12. Reflected ceiling plans to coordinate and integrate installation of air outlets and inlets, light fixtures, communication system components, sprinklers, access panels, special moldings, and other ceiling-mounted items.

Floor plans and sections of fan rooms and mechanical rooms; show layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.

H. Prepare record documents in accordance with the requirements in Division 01. In addition to the requirements specified in Division 01, indicate the following installed conditions:

1. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Indicate actual inverts and horizontal locations of all underground piping.
2. Valve location diagrams, complete with valve tag chart. Refer to Division 220500 Section "Basic Plumbing Materials and Methods."
3. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
4. Approved substitutions, Contract Modifications, and actual equipment and materials installed.
5. Contract Modifications, actual equipment and materials installed.
6. Invert elevation of underfloor sanitary and storm piping.

I. Comply with each individual Division 22 Section for additional submittal requirements.

J. Electronic Media and Files:

1. Electronic media files of the contract drawings in AutoCAD or PDF format and copies of the specifications in PDF format may be requested.
2. Complete and return a signed "Electronic File Transmittal" form provided by Introba upon request for electronic media,
3. Obtain approval from the appropriate Design Professional for use of their part of the documents if the information requested includes information prepared by other than Introba.
4. The electronic contract documents may be used for preparation of shop drawings and record drawings only. The information may not be used in whole or in part for any other project.
5. The drawings prepared by Introba for bidding purposes may not be used directly for raceway layout drawings or coordination drawings.
6. The use of these documents does not allow relief from the responsibility for coordination of work with other trades and verification of space available for the installation.
7. The information is provided to expedite the project with no guarantee by Introba as to the accuracy or correctness of the information provided. Introba accepts no responsibility or liability for the use of the provided information.

1.5 MATERIAL AND EQUIPMENT SELECTION

A. Product Options: The specification of each item of major mechanical equipment required for the project may include a list of manufacturers, with one "basis of design" manufacturer, type, and model identified by virtue of their listing in the equipment schedule on the Drawings. Where several manufacturers in addition to the "basis of design" manufacturer are listed in the specifications, it shall be understood that the words "or approved equal by" are implied to precede each of the other manufacturer's names.

1. The manufacturers other than the "basis of design" may be furnished at the contractor's option in lieu of the "basis of design" product, provided that the selected manufacturer's product is equal in all material and functional respects. In addition to submittal requirements that may be specified in this section, submit a line-by-line written verification of the applicable specification section(s) identifying compliance with or variations from the specified features, materials, performance, capacities, weight, size, durability, energy consumption and efficiency, warranty, and visual impact (if exposed to view by other than maintenance persons). The burden of proof of manufacturer/product equality is on the contractor.
2. Where a product is not scheduled on the drawings and, therefore, where no "basis of design" is indicated, selection among all of the listed manufacturers and products is at the contractor's option, subject to the requirements of the Contract Documents.
3. Products of manufacturers not listed in the Contract Documents are considered Substitutions and are not permitted, except as provided under the General and Supplementary Conditions and Division 01 Specifications. Full compliance with Division 01 section "Product Substitutions" is mandatory for acceptance of products or manufacturers not listed.

B. Listing of a manufacturer does not imply approval of that manufacturer's standard product or products. Rather, listing of a manufacturer indicates only a general acceptance of that manufacturer's name and reputation. Final approval is subject to full compliance with these Contract Documents.

C. Model numbers identified on the Drawings notwithstanding, all equipment must comply with the requirements of these Contract Documents. Do not assume that a manufacturer's standard product is acceptable as is. For example, one or more custom modifications, custom colors or finishes, manufacturer's options, and/or accessories may be required to meet the specified requirements.

D. Where drawings indicate sizes, profiles, connections, and dimensional requirements of material and equipment, these are based on the "basis of design" manufacturer, type and model indicated. In the event that equipment of power, dimensions, capacities, layout, connections, and/or ratings differing from the "basis of design" are selected by the contractor and approved by the Owner's representative, any necessary adjustments are the contractor's responsibility. All connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, pipe and duct sizes, pipe and duct layout, and the like shall be adjusted by the contractor to suit the equipment provided. No additional costs will be approved for these changes. Should revisions to the design because of contractor's selection of manufacturer, type, or model other than the "basis of design" require additional review and/or redesign by an Architect or Engineer, the contractor shall reimburse the Owner for Owner's added professional fee expenses.

E. Where two or more materials are listed in the "Part 2 – Products" subsection of any Division 22 section, do not assume that the selection of materials is the contractor's option. Refer to "Part 3 – Execution" subsection of that same Division 22 section for an explanation of which specific material(s) shall be used for which specific application(s). For example, Part 2 may list several types and grades of piping, and Part 3 will describe which type and grade of pipe to use for a given application.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. Protect stored on-site or installed absorptive materials from moisture damage. Materials directly exposed to moisture via precipitation, water leaks, or condensation shall be removed from the jobsite and replaced.

END OF SECTION 220100

SECTION 220500 – BASIC PLUMBING MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Section 220100 “Basic Plumbing Requirements” apply / applies to the work of this Section as if fully repeated herein.

1.2 SUMMARY

A. This Section includes the following basic plumbing materials and methods to complement other Division 22 Sections:

1. Materials and installation instructions common to plumbing systems.
2. Pipe joining materials and methods.
3. Dielectric fittings.
4. Flexible pipe connectors.
5. Plumbing sleeve seals.
6. Pipe sleeves.
7. Escutcheons.
8. Penetration firestopping of fire-resistance-rated assemblies and/or smoke barriers by plumbing piping or conduit.
9. Labeling and identifying plumbing systems and equipment.
10. Non-shrink grout for equipment installations.
11. Painting and finishing of plumbing work.
12. Coordination with Structural work.
13. Field-fabricated equipment supports.
14. Selective Demolition.
15. Cutting and patching.

B. Pipe and pipe fitting materials are specified in individual Division 22 piping system Sections.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following abbreviations are used throughout Division 22 Specification Sections:

1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. CPVC: Chlorinated polyvinyl chloride plastic.
3. CR: Chlorosulfonated polyethylene synthetic rubber.
4. EPDM: Ethylene propylene diene terpolymer rubber.
5. NBR: Acrylonitrile-butadiene rubber.
6. NP: Nylon plastic.
7. PE: Polyethylene plastic.
8. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

A. Product Data: For dielectric fittings, transition couplings, flexible pipe connectors, plumbing sleeve seals, escutcheons, and identification materials and devices.

B. For each type of penetration firestopping product, submit product data and include design designation of qualified testing and inspecting agency.

C. Shop Drawings: Detail fabrication and installation for supports and anchorage for plumbing materials and equipment.

D. Coordination Drawings: For access panel and door locations.

E. Samples: Of color, lettering style, and other graphic representation required for each identification material and device.

1.5 QUALITY ASSURANCE

A. Welding: Qualify welding processes and operators for structural steel according to AWS D1.1 “Structural Welding Code – Steel.”

B. Welding: Qualify welding processes and operators for piping according to ASME “Boiler and Pressure Vessel Code,” Section IX, “Welding and Brazing Qualifications.”

1. Comply with provisions of ASME B31 Series “Code for Pressure Piping.”
2. Certify that each welder has passed AWS qualification tests for the welding processes involved and that certification is current.
3. Contactor shall retain all welding certificates on file and produce them for review upon request by the Owner and/or Owner’s representative.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and prevent entrance of dirt, debris, and moisture.

B. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor or roof, if stored thereupon.

C. Protect flanges, fittings, and piping specialties from moisture and dirt.

D. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

E. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

1.7 SEQUENCING AND SCHEDULING

A. Coordinate plumbing equipment installation with other building components.

B. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for plumbing installations.

C. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed.

D. Sequence, coordinate, and integrate installations of plumbing materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning before closing in building.

E. Coordinate connection of plumbing systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.

F. Coordinate requirements for access panels and doors if plumbing items requiring access are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section “Access Doors and Panels.”

G. Coordinate installation of identifying devices after completing covering and painting, if devices are applied to surfaces. Install identifying devices before installing acoustical ceilings and similar concealment.

H. Coordinate connection of electrical services.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Transition Couplings:

a. Dresser Industries, Inc.
b. or approved equal.

2. Dielectric Fittings:

    a. Eclipse, Inc.; Rockford-Eclipse Div.
    b. Grinnell Corp.; Grinnell Supply Sales Co.
    c. Watts Industries, Inc.; Water Products Div.
    d. Zurn Industries, Inc.; Wilkins Div.

3. Flexible Pipe Connectors:

    a. Flexicraft Industries, Inc.
    b. Hyspan Precision Products, Inc.
    c. Mason Industries, Inc.
    d. The Metraflex Company
    e. Proco Products, Inc.

4. Plumbing Sleeve Seals:

    a. Advanced Products and Systems, Inc./Innerlynx
    b. The Metraflex Company
    c. Thunderline/Link-Seal.

5. Identifying Devices and Labels:

    a. Brady USA, Inc., Signmark Div.
    b. Brimar Industries, Inc.
    c. Kolbi Industries, Inc.
    d. Panduit Corp.
    e. Seton Name Plate Co.

2.2 PIPE AND PIPE FITTINGS

A. Refer to individual Division 22 piping Sections for pipe and fitting materials and joining methods.

2.3 JOINING MATERIALS

A. Refer to individual Division 22 piping Sections for joining materials.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

C. Pipe-Flange Joining Gaskets: ASME B16.21, EPDM, flat, asbestos-free, 1/8-inch (3.2-mm) thickness, unless noted otherwise.

1. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
2. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

D. Pipe-Flange Joining Bolts and Nuts: ASME B18.2.1 bolts with ASME B18.2.2 nuts, carbon steel, unless otherwise indicated.

1. Bolts and nuts shall be Type 304 or Type 316 stainless steel, if installed on stainless steel piping, and matching the grade of stainless-steel piping.

2. Bolts and nuts shall be Type 304 stainless steel if installed on uninsulated piping located outdoors.
3. Bolts and nuts shall be Type 316 stainless steel if installed on uninsulated direct-bury piping.

E. Solder Filler Metals: ASTM B32 lead-free alloys. Include water-flushable flux according to ASTM B813.

F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 DIELECTRIC FITTINGS

A. General: Assembly or fitting with insulating material isolating joined dissimilar metals, to prevent galvanic action and stop corrosion.

B. Description: Combination of copper alloy and ferrous, threaded, solder, plain, and weld-neck end types and matching piping system materials.

C. Insulating Material: Suitable for system fluid, pressure, and temperature.

D. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig (1725-kPa) minimum working pressure at 180ºF (82 C).

E. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.

F. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers. Provide separate companion flanges and steel bolts and nuts for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.

G. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225ºF (107 C).

H. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225ºF (107ºC).

2.5 MODULAR SLEEVE SEALS

A. Description: Modular design, with interlocking rubber links shaped to continuously fill annular space between pipe and sleeve. Include connecting bolts and pressure plates.

B. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

C. Pressure Plates: Stainless steel. Include two for each sealing element.

D. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

E. Minimum Temperature Rating: -40°F to +210°F (-40°C to +99°C).

2.6 PIPE SLEEVES

A. The following sleeve materials are for wall, floor, slab, and roof penetrations.

B. Steel Pipe: ASTM A53, Type E, Grade A, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated “wall pipe” equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

E. PE: Manufactured, reusable, tapered, cup shaped, smooth outer surface, with nailing flange for attaching to wooden forms.

F. Contractor’s Option: Pre-engineered, UL-listed fire-resistance rated and watertight cast-in-place floor sleeving systems meeting the following specifications will be acceptable in lieu of traditional floor sleeves with field-installed firestop, at contractor’s option.

1. Description: Cast-in-place, factory-assembled, one-piece watertight firestop device for use in concrete floors formed with wood and/or steel decking to protect penetrating objects from expansion and contraction of concrete, thermal and seismic movement, and the passage of air, smoke, fire, and hot gasses.
2. Manufacturer: Subject to compliance with requirements, provide Hydroflame™ sleeving system by Hubbard Enterprises / Holdrite; or approved equal.
3. Include an outer sleeve lined with an intumescent strip; and a radial extended flange attached to one end of the sleeve for fastening to concrete formwork; or wide outside wings attached to one end of the sleeve for fastening to metal deck concrete formwork and span deck corrugations.
4. Include a waterstop gasket and mid-body seal consisting of one to three concentric raised rings for embedment and sealing to the concrete slab. For applications involving a corrugated deck, also include a cone attached to the base for extending the device through the metal deck.
5. Product shall provide a two-hour fire-resistance rated assembly when tested according to ASTM E814 or ANSI/UL 1479.

2.7 ESCUTCHEONS

A. General: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Stamped-Steel Type: With spring clips and chrome-plated finish.

D. Split-Plate, Stamped-Steel Type: With concealed hinge, spring clips, and chrome-plated finish.

E. One-Piece, Floor-Plate Type: Cast-iron floor plate.

F. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.8 PIPING SYSTEMS

A. Penetration firestopping systems shall bear classification marking of UL or FM.

B. Penetrations in Fire-Resistance-Rated Assemblies: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).

1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.

C. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg (74.7 Pa).

1. L-Rating: Not exceeding 5.0 cfm/sq. ft. (0.025 cu. m/s per sq. m) of penetration opening at and no more than 50-cfm (0.024-cu. m/s) cumulative total for any 100 sq. ft. (9.3 sq. m) at both ambient and elevated temperatures.

D. Accessories: Provide components such as permanent forming/damming/backing materials, substrate primers, collars, and/or steel sleeves for each penetration firestopping system as necessary to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.

E. Mixing: For those products requiring mixing before application, comply with penetration firestopping system manufacturer’s written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

2.9 IDENTIFYING DEVICES AND LABELS

A. General: Manufacturer's standard products of categories and types required for each application as referenced in other Division 22 Sections. If more than one type is specified for application, selection is installer's option, but provide one selection for each product category.

B. Comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

C. Equipment Nameplates: Metal nameplate with operational data engraved or stamped; permanently fastened to equipment; furnished and factory-installed by original equipment manufacturer.

1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data.
2. Location: Accessible and visible location.

D. Pressure-Sensitive Pipe Markers: Manufacturer's standard preprinted, permanent adhesive, color-coded, pressure-sensitive vinyl, complying with ASME A13.1.

1. Nomenclature: Domestic Cold Water, Domestic Hot Water, Domestic Hot Water Return, Natural Gas, etc. as required per service. Match name to the name given on Drawings (full names, not abbreviations).
2. Color: Per ASME A13.1 Standard per service, unless noted otherwise.
3. Flow Direction: Indicate flow direction via arrows on each label.

E. Engraved Plastic-Laminate Signs: ASTM D709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated.

1. Fabricate in sizes required for message.
2. Engraved with engraver's standard letter style, of sizes and with wording to match equipment identification.
3. Punch for mechanical fastening.
4. Thickness: 1/16-inch (1.6 mm), for units up to 20 sq. in. (130 sq. cm) or 8 inches (200 mm) long; 1/8-inch (3.2 mm) for larger units.
5. Fasteners: Self-tapping stainless-steel screws or contact-type permanent adhesive.

F. Valve Tags: Photo-anodized barcode tags with ¼-inch (6-mm) letters and numbers. Include 5/32-inch (4-mm) hole for fastener.

1. Material: 0.032-inch (0.8-mm) thick anodized aluminum.
2. Color: Silver background with black characters.
3. Printed Nomenclature: Piping system abbreviation and sequenced number; e.g., HW-23 for domestic hot water supply valve #23; HWR-12 for domestic hot water return valve #12.
4. Barcode: Two-dimensional Data Matrix ECC 200 barcode symbology. Prior to manufacture, obtain valve tag information from owner's property manager for encoding into the barcode. Include valve number, piping system, system abbreviation, location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

G. Valve Tag Fasteners: Brass, wire-link chain or stainless-steel beaded chain.

H. Lettering and Graphics: Coordinate names, abbreviations, and other designations used in plumbing identification, with corresponding designations indicated. Use numbers, lettering, and wording indicated for proper identification and operation/maintenance of plumbing systems and equipment.

1. Multiple Systems: If multiple systems of same generic name are indicated, provide identification that indicates individual system number and service such as "Domestic Water Heater DWH1," "Hot Water Recirculation Pump HWRP1," or "Standpipe F12."

2.10 CONCRETE AND GROUT

A. Concrete: For all minor concrete work required for plumbing installations, such as concrete equipment bases and supports, refer to Division 03 Sections for specification of cast-in-place concrete and reinforcing materials, whose requirements apply to the work of Division 22 as if fully reproduced herein.

B. Concrete: For all minor concrete work required for plumbing installations, such as concrete equipment bases and supports, provide Quikrete® Commercial Grade FastSet™ Concrete #1004-51 prepackaged concrete mix, or approved equal. Mix, place, and cure in accordance with manufacturer's written instructions.

1. Reinforcing: ASTM A615 Grade 60 deformed bars and ASTM A185 welded wire fabric.

C. Non-shrink, Nonmetallic Grout: ASTM C1107, Grade B.

1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, non-staining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psig (34.5-MPa), 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

2.11 PAINTING AND FINISHING

A. For all painting and finishing work required for plumbing installations, as described in Part 3 of this Section and/or on the Drawings, refer to Division 09 Sections for specification of paint and finishing materials, whose requirements apply to the work of Division 22 as if fully reproduced herein.

B. Master Painters Institute, Inc. (MPI) Standards: Provide paint and paint products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."

A. Material Compatibility: Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

B. Colors: As directed by Owner's representative. Each pipe shall be painted a designated color according to service.

PART 3 - EXECUTION

3.1 GENERAL PLUMBING INSTALLATION REQUIREMENTS

A. Verify all dimensions by field measurements.

B. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.

C. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Architect.

D. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.

E. Install plumbing equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.

F. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

3.2 PIPE-PENETRATION INSTALLATION REQUIREMENTS

A. Install escutcheons for new piping penetrations of walls, ceilings, and floors according to the following:

1. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
2. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
3. Insulated Piping: One-piece, stamped-steel type with spring clips.
4. Uninsulated Piping in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
5. Uninsulated Piping in Unfinished Spaces: One-piece, cast-brass type.
6. Uninsulated Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

B. Install escutcheons for existing piping penetrations of new walls, ceilings, and floors. Match type, material, and finish as specified for new piping, except that split-casting or split-plate type will be accepted in lieu of one-piece.

C. Install sleeves for pipes passing through concrete and masonry walls, and concrete floor and roof slabs.

D. Cut sleeves to length for mounting flush with both surfaces. Exception: Extend sleeves installed in floors of mechanical/plumbing equipment areas or other wet areas 2 inches (50 mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

E. Fire-Resistance Rated, Cast-in-Place Sleeve Installation: Select sleeve size based on size and type of pipe and thickness of the floor. Position and secure sleeve to concrete form using nails or staples. Place concrete, and finish even with top of sleeve. Install in complete and strict accordance with manufacturer's UL-listed installation instructions.

F. Build sleeves into new walls and slabs as work progresses.

G. Install sleeves large enough to provide ¼-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

1. Steel Pipe Sleeves: For pipes smaller than 6-inch NPS (DN150).
2. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level. Refer to Division 07 Section "Flashing and Sheet Metal" for flashing.
3. Seal space outside of sleeve fittings with non-shrink, nonmetallic grout.

H. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using elastomeric joint sealants. Refer to Division 07 Section "Joint Sealants" for materials. Use Type S, Grade NS, Class 25, Use O, neutral-curing silicone sealant, unless otherwise indicated.

I. Aboveground, Exterior-Wall, Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeve for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) in diameter and larger.
3. Assemble and install mechanical sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber-sealing elements to expand and make watertight seal.

J. Underground, Exterior-Wall, Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Size sleeve for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals. Assemble and install mechanical sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber-sealing elements to expand and make watertight seal.

K. Sleeves are not required for core-drilled holes.

L. Permanent sleeves are not required for holes formed by PE removable sleeves.

M. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestopping materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

3.3 EQUIPMENT INSTALLATION REQUIREMENTS

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

B. Refer to equipment specifications in Division 22 and Division 26 for rough-in requirements.

C. Install equipment to provide maximum possible headroom, if mounting heights are not indicated.

D. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to Architect.

E. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

F. Positive attachment and anchorage of all equipment to the structure or floor is required. Do not rely on friction or gravity as a means of attachment.

G. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

H. Install equipment giving right of way to piping installed at required slope.

I. Install flexible pipe connectors at the following locations. Install on equipment side of shutoff valves.

1. Inlet and outlet of each pump.
2. Where indicated elsewhere in these specifications.
3. Where detailed on the Drawings.

J. Support for Suspended Equipment: As specified in Division 22 Section “Hangers and Supports.”

3.4 PENETRATION FIRESTOPPING INSTALLATION

A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, “Approval of Firestop Contractors,” or been evaluated by UL and found to comply with its “Qualified Firestop Contractor Program Requirements.”

B. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.

C. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.

D. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

E. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work. Proceed with installation only after unsatisfactory conditions have been corrected.

F. Surface Cleaning: Before installing penetration firestopping systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

G. Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

H. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

I. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.

J. Install fill materials by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

K. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.

L. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

3.5 LABELING AND IDENTIFYING

A. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow. Use plastic markers, with application systems. Install on insulation segment if required for hot, uninsulated piping.

B. Locate pipe markers as follows if piping is exposed in finished spaces, machine rooms, and accessible maintenance spaces, such as shafts, tunnels, plenums, and exterior non-concealed locations:

1. Near each valve and control device.
2. Near each branch, excluding short takeoffs for fixtures and terminal units. Mark each pipe at branch, if flow pattern is not obvious.
3. Near locations where pipes pass through walls, floors, ceilings, or enter non-accessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum of 50-foot (15-m) intervals along each run. Reduce intervals to 25 feet (7.5 m) in congested areas of piping and equipment.
7. On piping above removable acoustical ceilings, except omit intermediately spaced markers.

C. Install continuous plastic underground warning tapes during back filling of trenches for underground piping. Locate 6 to 8 inches (150 to 200 mm) below finished grade, directly over piping. Refer to Division 31 Section “Earth Moving” for warning-tape materials and devices and their installation.

D. Equipment: Install engraved plastic-laminate sign on or near each major item of plumbing equipment.

1. Lettering Size: Minimum ¼-inch- (6.4-mm-) high lettering for name of unit if viewing distance is less than 24 inches (610 mm), ½-inch- (12.7-mm-) high lettering for distances up to 72 inches (1800 mm), and proportionately larger lettering for greater distances. Provide secondary lettering two-thirds to three-fourths of size of principal lettering.
2. Text of Signs: Provide name of identified unit. Include text to distinguish between multiple units, inform user of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

E. Adjusting: Relocate identifying devices as necessary for unobstructed view in finished construction.

F. Install valve tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, plumbing fixture supply stops, faucets, and similar roughing-in connections of end-use fixtures and units.

3.6 PAINTING AND FINISHING

A. For all painting and finishing work required for plumbing installations, refer to Division 09 Sections for application requirements.

B. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45ºF. Maintain containers in clean condition, free of foreign materials and residue. Remove rags and waste from storage areas daily.

C. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50ºF and 95ºF. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5ºF above the dew point; or to damp or wet surfaces.

D. Examine substrates and conditions for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

E. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

F. Proceed with coating application only after unsatisfactory conditions have been corrected. Application of coating indicates acceptance of surfaces and conditions.

G. Comply with manufacturer's written instructions and recommendations in "Master Painters Institute (MPI) Manual" applicable to substrates indicated.

H. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints. Remove surface oxidation, loose mill scale, and shop primer, if any. Clean field welds, bolted connections, and abraded areas of shop paint.

I. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual." Use applicators and techniques suited for paint and substrate indicated. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

J. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

K. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

L. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

M. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

N. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

O. Painting Plumbing Work: Paint the following work where exposed to view in finished or unfinished spaces: Uninsulated steel piping, pipe hangers and supports, tanks that do not have factory-applied final finishes, all interior and exterior ferrous piping and appurtenances, including steel, galvanized steel, cast iron and ductile iron.

P. In addition, paint the following:

1. Equipment, and pipe insulation having ASJ or other paintable jacket material.

Q. Steel Substrates: Primer, alkyd, anti-corrosive, for metal, MPI #79; plus topcoat of latex, interior, semi-gloss, MPI #54.

R. Galvanized-Metal Substrates: Primer, galvanized, water based, MPI #134; plus topcoat of latex, interior, semi-gloss, MPI #54.

S. Aluminum (Not Anodized or Otherwise Coated) Substrates: Primer, quick dry, for aluminum, MPI #95; plus topcoat of latex, interior, semi-gloss, MPI #54.

T. ASJ Insulation-Covering Substrates: Including pipe and duct coverings. Primer sealer, latex, interior, MPI #50; plus topcoat of latex, interior, semi-gloss, MPI #54.

U. Primers specified above may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

3.7 COORDINATION WITH STRUCTURAL WORK

A. Concrete: Do not embed pipes, wires, tube, boxes, ducts or other cavity-creating elements in concrete work unless shown on or permitted by the structural drawings. Openings through concrete not shown on the structural drawings are subject to approval by the structural engineer of record. See coordination drawing requirements under Submittals.

B. Supported Slab: Do not suspend loads exceeding 500 pounds within any 100 square feet of contiguous area from concrete supported slab. Suspend such loads from structural steel only. Any "sub-framing" required is responsibility of Contractor or sub-contractor installing material requiring support.

1. Openings in concrete floor slabs not shown on structural drawings, such as openings required for stacks, pipes, ducts, plumbing vents, etc., shall be the responsibility of the trade requiring openings. Form block-outs in the slab, reinforcing deck, and cut openings after concrete has reached specified strength.
2. Where openings larger than 12-inches are required but not shown on structural drawings, secure written approval from Architect/Engineer prior to cutting deck.

3.8 ERECTION OF SUPPORTS AND ANCHORAGE

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

B. Field Welding: Comply with AWS D1.1, "Structural Welding Code – Steel."

3.9 SELECTIVE DEMOLITION

A. Disconnect, demolish, and remove plumbing work as indicated on the Drawings, and as required for installation of new work shown. Coordinate with Division 26 for disconnection of power to electrically-powered equipment prior to demolition.

B. Remove accessible work in its entirety. Repair cut surfaces to match adjacent surfaces. Abandon in place embedded or buried work, unless noted otherwise.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
3. Equipment to Be Removed: Disconnect and cap services and remove equipment.

C. Removal: Unless otherwise indicated, remove demolished pipe, and equipment from the Project site. Handle and dispose of in accordance with National, State, and Local regulations.

1. Relocation: Remove, store, clean, reinstall, reconnect, and make operational all work indicated for relocation.
2. Salvage: Remove and deliver to Owner all work indicated for salvage.

D. Refer to Division 01 Sections “Selective Demolition” and/or “Selective Structure Demolition” for additional requirements.

E. For selective demolition of any appliance or piece of equipment containing a CFC, HCFC, or HFC refrigerant: Prior to demolition, refrigerant shall be evacuated and captured in full compliance with the Clean Air Act; using only technicians with the proper refrigerant license as according to law, stored in approved containers, and shipped to a licensed refrigerant recycling facility all as required by the United States Environmental Protection Agency.

3.10 CUTTING AND PATCHING

A. General: Employ skilled workmen to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay. Perform cutting and patching in accordance with the following:

B. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.

C. Perform cutting, fitting, and patching of plumbing equipment and materials required to:

1. Uncover Work to provide for installation of ill-timed Work.
2. Remove and replace defective Work.
3. Remove and replace Work not conforming to requirements of the Contract Documents.
4. Install equipment and materials in existing structures.

D. Cut, remove and legally dispose of selected plumbing equipment, components, and materials as indicated, including but not limited to removal of plumbing piping, pumps, and other plumbing items made obsolete by the new Work.

E. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for plumbing installations. Perform cutting by skilled mechanics of trades involved.

F. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

G. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

H. Repair cut surfaces to match adjacent installations.

I. Repair any building insulation or building fireproofing materials, whether new or existing, that are removed or scraped away in order to make a plumbing installation, so as to maintain an equivalent insulation or fire rating as existed without said plumbing installation.

J. Refer to Division 01 Sections “Execution” and/or “Cutting and Patching” for additional requirements.

3.11 GROUTING

A. Install nonmetallic, non-shrink, grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Mix grout according to manufacturer’s written instructions. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Place grout, completely filling equipment bases. Avoid air entrapment during placing of grout. Place grout on concrete bases to provide smooth bearing surface for equipment. Place grout around anchors.

E. Cure placed grout according to manufacturer’s written instructions.

END OF SECTION 220500

SECTION 220529 – HANGERS AND SUPPORTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Section 220100 “Basic Plumbing Requirements,” and Section 220500 “Basic Plumbing Materials and Methods” all apply to the work of this Section as if fully repeated herein.

1.2 SUMMARY

A. This Section includes hangers and supports for mechanical system piping and equipment, including but not limited to the following:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Fastener systems.

B. Related Sections include the following:

1. Division 05 Sections for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports; and for materials for attaching hangers and supports to building structure.
2. Division 22 Section “Pipe Expansion Fittings” for pipe guides and anchors.
3. Division 22 Section “Plumbing Vibration Isolation” for vibration isolation devices.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

B. Terminology: As defined in MSS SP-90, “Guidelines on Terminology for Pipe Hangers and Supports.”

1.4 PERFORMANCE REQUIREMENTS

A. If contractor elects to apply channel support systems and/or heavy-duty steel trapezes to support multiple pipes, in lieu of individual supports, then contractor is responsible for design of same capable of supporting combined weight of supported systems, system contents, and test water.

1. Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Do not suspend pipe hangers and supports from roof deck. Suspend such loads from structural steel only, and provide structural steel sub-framing as required.

D. Do not suspend piping loads exceeding 500 pounds within any 100 square feet of contiguous area from supported concrete floor slabs. Suspend such loads from structural members only, and provide structural steel sub-framing as required.

E. Structural Performance: Hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1.5 SUBMITTALS

A. Product Data: For each type of pipe hanger, channel support system component, and thermal-hanger shield insert indicated. Include:

1. Metal pipe hangers and supports.
2. Thermal-hanger shield inserts.
3. Fastener systems.
4. Trapeze pipe hangers. Include Product Data for components.

B. Shop Drawings: Signed and sealed shop drawings by a qualified professional engineer are required for all custom pipe and equipment hangers and supports. Show fabrication and installation details and analysis data, and include calculations.

C. Welding certificates.

1.6 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, “Structural Welding Code – Steel.”

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code, Section IX, “Welding and Brazing Qualifications.”

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Manufactured Pipe Hangers:

a. Anvil International, Inc.
b. Cooper B-Line, Inc.
c. Carpenter & Patterson, Inc.
d. Erico International Corp.
e. PHD Manufacturing, Inc.
f. Tolco division of Cooper B-Line, Inc.

2. Thermal-Hanger Shield Inserts:

    a. Carpenter & Paterson, Inc.
    b. Erico International Corp.
    c. PHS Industries, Inc.
    d. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.

2.2 METAL PIPE HANGERS AND SUPPORTS

A. Application: Refer to “Hanger and Support Applications” Article in Part 3 for where to use specific hanger and support types.

B. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel unless noted otherwise.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.4 THERMAL-HANGER SHIELD INSERTS

A. Insulation-Insert Material for Piping Below Ambient Temperature: ASTM C552, Type II cellular glass with 100-psig (688-kPa) or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength and vapor barrier.

B. Insulation-Insert Material for Piping At or Above Ambient Temperature: Water-repellent treated, ASTM C533, Type I calcium silicate with 100-psig (688-kPa) ASTM C552, Type II cellular glass with 100-psig (688-kPa) or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength.

C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

E. Insert Length: Extend 2-inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.6 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.7 MISCELLANEOUS MATERIALS

A. Structural and Miscellaneous Steel: As specified in Division 22 Section “Basic Plumbing Materials and Methods.”

B. Grout: As specified in Division 22 Section “Basic Plumbing Materials and Methods.”

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT SCHEDULE OF APPLICATIONS

A. Comply with MSS SP-69 for pipe hanger and trapeze selections and applications that are not specified in this Section.

B. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

C. Use copper-plated pipe hangers and copper or stainless-steel attachments, or use nonmetallic coatings on attachments for electrolytic protection, where hangers are in direct contact with copper tubing.

D. Use padded hangers for piping that is subject to scratching.

E. Horizontal-Piping Hangers and Supports for the first three hangers/supports or the first 50-feet (whichever is greater) adjacent to Pumps: Use spring hangers and supports. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports shall include the following types:

1. Horizontal (MSS Type 54): Mounted horizontally.
2. Vertical (MSS Type 55): Mounted vertically.
3. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
4. Exception: Spring hangers are not required adjacent to inline pumps that are smaller than 5-horsepower. Use other types of hangers and supports as listed for service below.

F. Horizontal-Piping Hangers and Supports for individual pipe runs less than 20 feet long and all piping 2-inch diameter or smaller, regardless of length: Unless otherwise indicated, choose among the following types:

1. Adjustable Steel Clevis Hangers (MSS Type 1).
2. Yoke-Type Pipe Clamps (MSS Type 2): For pipes NPS 4 and larger.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3).

4. Steel Pipe Clamps (MSS Type 4).

G. Horizontal-Piping Hangers and Supports for individual uninsulated pipe runs of any size or length: Unless otherwise indicated, choose among the following types:

1. Adjustable Steel Clevis Hangers (MSS Type 1).
2. Yoke-Type Pipe Clamps (MSS Type 2): For pipes NPS 4 and larger.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3).
4. Steel Pipe Clamps (MSS Type 4).
5. Adjustable Steel Band Hangers (MSS Type 7): For pipes up to NPS 2 only.
6. Adjustable Swivel-Ring Band Hangers (MSS Type 10): For pipes up to NPS 2 only.
7. U-Bolts (MSS Type 24).

H. Vertical-Piping Hangers and Supports for individual pipe runs less than 20 feet long and all piping 2-inch diameter or smaller, regardless of length: Unless otherwise indicated, choose among the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8).
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): Where longer ends are required.

I. Vertical-Piping Hangers and Supports for individual uninsulated pipe runs of any size or length: Unless otherwise indicated, choose among the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8).
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): Where longer ends are required.

J. Hanger-Rod Attachments: Unless otherwise indicated, choose among the following types:

1. Steel Turnbuckles (MSS Type 13).
2. Steel Clevises (MSS Type 14).
3. Malleable-Iron Sockets (MSS Type 16).
4. Steel Weldless Eye Nuts (MSS Type 17).

K. Building Attachments: Unless otherwise indicated, choose among the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to concrete ceiling.
2. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
3. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams.
4. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
5. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

6. Side-Beam Brackets (MSS Type 34): For sides of steel beams.
7. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

3.2 HANGER AND SUPPORT MAXIMUM SPACING AND MINIMUM ROD SIZE

A. Install hangers and supports with the following maximum spacing and minimum rod sizes.

B. Drawn-Temper Copper Piping for any liquid-service piping systems:

1. NPS ½ (DN 15): Maximum span, 4 feet (1.2 m); minimum rod size, 3/8-inch (10 mm).
2. NPS ¾ (DN 20): Maximum span, 5 feet (1.5 m); minimum rod size, 3/8-inch (10 mm).
3. NPS 1 (DN 25): Maximum span, 6 feet (1.8 m); minimum rod size, 3/8-inch (10 mm).
4. NPS 1¼ (DN 32): Maximum span, 6 feet (1.8 m); minimum rod size, 3/8-inch (10 mm).
5. NPS 1½ (DN 40): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8-inch (10 mm).
6. NPS 2 (DN 50): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8-inch (10 mm).
7. NPS 2½ (DN 65): Maximum span, 9 feet (2.7 m); minimum rod size, 1/2-inch (13 mm).
8. NPS 3 (DN 80): Maximum span, 10 feet (3 m); minimum rod size, 1/2-inch (13 mm).
9. NPS 4 (DN 100): Maximum span, 12 feet (3.7 m); minimum rod size, 5/8-inch (16 mm).

C. Cast Iron and/or Ductile Iron Piping: Install hangers at the same maximum spacing and with the same minimum rod sizes as for Steel Piping for hydronic system service, except that maximum spacing shall not exceed 12 feet and smallest rod size allowed is ½-inch.

1. Vertical piping: Shall be supported at each stack base and at each floor. Free standing vertical pipe should be adequately staked or braced during construction to maintain alignment.
2. Horizontal piping: Shall be supported within 18-inches of the coupling joint at maximum 10 foot intervals for 10 foot pipe lengths and at maximum 5 foot intervals for 5 foot pipe lengths. Support or hangers should be properly placed to maintain alignment and grade with provision made to prevent shear. Large diameter pipe should be braced at changes of direction to prevent horizontal movement.

D. Rod diameters may be reduced one size for double-rod hangers, with 3/8-inch (10 mm) minimum rods.

E. Hanger and support spacing for piping and tubing not listed above shall be according to MSS SP-69 and piping manufacturer's written instructions.

3.3 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A36/A36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

D. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

E. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

F. Install lateral bracing with pipe hangers and supports to prevent swaying.

G. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

H. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

I. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2½ (DN 65) and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

J. Repair any building insulation or building fireproofing materials, whether new or existing, that are removed or scraped away in order to attach hangers and supports, so as to maintain an equivalent insulation or fire rating as existed without said hanger or support attachment.

K. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4-inches (100 mm) thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer’s operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer’s written instructions.

3.4 PROTECTION OF INSULATED PIPING:

A. Attach clamps and spacers to piping.

1. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
2. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.

B. Do not exceed pipe stress limits according to ASME B31.9.

C. Piping Operating above Ambient Air Temperature: Clevis- and clamp-type supports shall project through insulation, with pipe support making direct contact with pipe and with insulation applied in a manner that encapsulates the clevis or clamp. For piping on roller-type

supports, install MSS SP-58, Type 39 protection saddles, and fill interior voids with insulation that matches adjoining insulation.

1. Contractor's Option: In lieu of the above paragraph, contractor has the option of complying with the same specifications as for "Piping Operating below Ambient Air Temperature" in the following paragraphs.

D. Piping Operating below Ambient Air Temperature: Clevis- and clamp-type supports shall be sized for the outside diameter of the insulation including jacket. Install MSS SP-58, Type 40 protective metal shields. Shields shall span an arc of 180 degrees.

1. Pipe Sizes NPS 4 and larger: Include thermal-hanger shield inserts. Insert shall be same thickness as adjoining pipe insulation and length shall be at least as long as the protective shield. Include steel weight-distribution plate if pipe is installed on rollers.
2. Metal Shield Dimensions for Pipe: Not less than the following:

   a. NPS ¼ to NPS 3½: 12-inches long and 0.048-inch thick.
   b. NPS 4: 12-inches long and 0.06-inch thick.
   c. NPS 5 and NPS 6: 18-inches long and 0.06-inch thick.
   d. NPS 8 to NPS 12 (DN 200 to DN 350): 24-inches (610 mm) long and 0.075-inch (1.91 mm) thick.

3.5 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.6 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and/or equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.7 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1½-inches (40 mm).

3.8 PAINTING

A. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

B. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05 mm).

C. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.

END OF SECTION 220529

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SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Section 220100 “Basic Plumbing Requirements,” and Section 220500 “Basic Plumbing Materials and Methods” all apply to the work of this Section as if fully repeated herein.

1.2 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.
2. Specialty pipe fittings.
3. Encasement for underground metal piping.

B. Related Requirements:

1. Section 221329 "Sanitary Sewerage Pumps" for effluent and sewage pumps.
2. Section 226600 "Chemical-Waste Systems for Laboratory and Healthcare Facilities" for chemical-waste and vent piping systems.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data for Credit IEQ 4.1: For solvent cements and adhesives, and primers, documentation including printed statement of VOC content.

1.4 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.

B. Field quality-control reports.

1.5 FIELD CONDITIONS

A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Construction Manager and Owner no fewer than two weeks in advance of proposed interruption of sanitary waste service.
2. Do not proceed with interruption of sanitary waste service without Owner's written permission.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water (30 kPa).
2. Waste, Force-Main Piping: 100 psig (690 kPa).

B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.2 PIPING MATERIALS

A. All cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) ® and listed by NSF International.

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

B. Pipe and Fittings shall be “Made In The U.S.A”.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Extra Heavy class(es).

B. Gaskets: ASTM C 564, rubber.

C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

B. Tensile Strength: 21,000 psig minimum.

C. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute ® and listed by NSF International.

D. Each length of pipe and each fitting shall be plainly marked with size, country of origin, and name of manufacturer, or manufacturer’s registered trademark by which the manufacturer can be readily identified after installation.

2.4 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 and CISPI 301.

B. Tensile Strength: 21,000 psig minimum.

C. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute ® and listed by NSF International.

D. Each length of pipe and each fitting shall be plainly marked with size, country of origin, and name of manufacturer, or manufacturer's registered trademark by which the manufacturer can be readily identified after installation.

E. Mid-Duty, Hubless-Piping Couplings:

1. Standards: ASTM C 1540, FM 1680 Class1.
2. Description: 304 stainless-steel shield, bands and 305 stainless steel tightening devices, and ASTM C 564, neoprene sleeve.

a. Manufacturers:
1) Husky HD 2000
2) Clamp all-80
3) Mission Heavyweight

F. Heavy-Duty, Hubless-Piping Couplings:

1. Standards: ASTM C 1540, heavy duty, FM 1680 Class1.
2. Description: Shield Assemblies shall consist of stainless-steel bi-directional corrugated shield (min. 28 gauge) with stainless-steel bands and 305 stainless steel tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
3. 1 ½" to 6" utilize four band; 8" to 15" utilize six band.

a. Manufacturers:

1) Husky SD 4000
2) Clamp-All Corp-125

1.02 HIGH PERFORMANCE COATED HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service class.

B. Gaskets: ASTM C 564, rubber.

C. Caulking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

D. Tensile Strength: 21,000 psig minimum.

E. All cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI), and listed by NSF International.

F. Each length of pipe and each fitting shall be plainly marked with size, country of origin, and name of manufacturer, or manufacturer's registered trademark by which the manufacturer can be readily identified after installation.

G. The inside of each pipe shall be reamed prior to coating to decrease the coefficient of friction.

H. Pipe Coating: Chemically deposited zinc-phosphate pretreatment layer followed by an electrically deposited, high performance cathodic epoxy coating, and finally an electrically deposited, high performance anodic epoxy top coat. Coating thickness shall be 5 mils or greater on both the OD and ID.

I. Fitting Coating: Chemically deposited zinc-phosphate pretreatment layer followed by an electrically deposited, high performance cathodic epoxy coating, and finally an epoxy acrylic powder top coat. Coating thickness shall be 5 mils or greater on both the OD and ID.

J. Coating Performance: Pipe and Fitting Coatings must pass the following performance specifications per EN 877:
a. 350 hours of salt spray testing
b. Resistance to wastewater for 30 days at 73º F
c. Chemical resistance from pH 2 to pH 12 for 30 days at 73º F
d. Resistance to hot water for 24 hours at 203º F

2.5 COPPER TUBE AND FITTINGS

A. Copper Type DWV Tube: ASTM B 306, drainage tube, drawn temper.

B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

C. Hard Copper Tube: ASTM B 88, Type L and Type M (ASTM B 88M, Type B and Type C), water tube, drawn temper.

D. Soft Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B), water tube, annealed temper.

E. Copper Pressure Fittings:

1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

F. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.

1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

G. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.6 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
2. Pressure Transition Couplings:

a. Acceptable manufacturers; Jomar Industries, Mega-Coupling and Dresser.
b. Standard: AWWA C219.
c. Description: Metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
d. Center-Sleeve Material: Manufacturer's standard.
e. Gasket Material: Natural or synthetic rubber.
f. Metal Component Finish: Corrosion-resistant coating or material.

B. Dielectric Fittings:

1. See Section 220500 “Basic Plumbing Materials and Methods”.

2.7 ENCASEMENT FOR UNDERGROUND METAL PIPING

A. Standard: ASTM A 674 or AWWA C105/A 21.5.

B. Material: high-density, cross-laminated polyethylene film of 0.004-inch (0.10-mm) minimum thickness.

C. Form: Sheet or tube.

D. Color: Black or natural.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.

1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
2. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 200800 “Seismic Protection”. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.

1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
2. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.

    a. Straight tees, elbows, and crosses may be used on vent lines.

3. Do not change direction of flow more than 90 degrees.
4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.

    a. Reducing size of waste piping in direction of flow is prohibited.

K. Lay buried building waste piping beginning at low point of each system.

1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
3. Maintain swab in piping and pull past each joint as completed.

L. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:

1. Building Sanitary Waste: 2 percent downward in direction of flow for piping NPS 3 (DN 80) and smaller; 1 percent downward in direction of flow for piping NPS 4 (DN 100) and larger.
2. Horizontal Sanitary Waste Piping: 2 percent downward in direction of flow.
3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

M. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.

N. Install steel piping according to applicable plumbing code.

O. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."

P. Install engineered soil and waste and vent piping systems as follows:

1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
2. Hubless, Single-Stack Drainage System: Comply with ASME B16.45 and hubless, single-stack aerator fitting manufacturer's written installation instructions.
3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.
4. Install encasement on piping according to ASTM A 674 or AWWA C105/A 21.5.

Q. Plumbing Specialties:

1. Install backwater valves in sanitary waster gravity-flow piping.

a. Comply with requirements for backwater valves specified in Section 221319 "Sanitary Waste Piping Specialties."

2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.

a. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping.
b. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."

3. Install drains in sanitary waste gravity-flow piping.

a. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."

R. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

S. Install sleeves for piping penetrations of walls, ceilings, and floors.

1. Comply with requirements for sleeves specified in Section 220500 “Basic Plumbing Material and Methods."

T. Install sleeve seals for piping penetrations of concrete walls and slabs.

1. Comply with requirements for sleeve seals specified in Section 220500 “Basic Plumbing Material and Methods."

1. Install escutcheons for piping penetrations of walls, ceilings, and floors.
1. Comply with requirements for escutcheons specified in Section 220500 “Basic Plumbing Material and Methods."

3.3 JOINT CONSTRUCTION

A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum calked joints.

C. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

D. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.

E. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.

3.4 SPECIALTY PIPE FITTING INSTALLATION

A. Dielectric Fittings:

1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
2. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric unions.
3. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100) Use dielectric flanges.

3.5 VALVE INSTALLATION

A. Comply with requirements in Section 220523 "Valves", for general-duty valve installation requirements.

B. Shutoff Valves:

1. Install shutoff valve on each sewage pump discharge.
2. Install gate or full-port ball valve for piping NPS 3 and smaller.

C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.

D. Backwater Valves: Install backwater valves in piping subject to backflow.

1. Horizontal Piping: Horizontal backwater valves. Use normally closed type unless otherwise indicated.
2. Floor Drains: Drain outlet backwater valves unless drain has integral backwater valve.
3. Install backwater valves in accessible locations.

4. Comply with requirements for backwater valve specified in Section 221319 "Sanitary Waste Piping Specialties."

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices specified in Section 200800 “Seismic Protection”.

B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment." Section 200800 “Seismic Protection."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
3. Vertical Piping: MSS Type 8 or Type 42, clamps.
4. Install individual, straight, horizontal piping runs:

    a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet (30 m) if Indicated: MSS Type 49, spring cushion rolls.

5. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
6. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support horizontal piping and tubing within 12 inches (300 mm) of each fitting , valve, and coupling.

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.

F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
2. NPS 3 (DN 80): 60 inches (1500 mm) with 1/2-inch (13-mm) rod.

G. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).

H. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 (DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
2. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.

I. Install supports for vertical copper tubing every 10 feet (3 m).

J. Support piping and tubing not listed above according to MSS SP-58 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect waste and vent piping to the following:

1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
5. Install horizontal backwater valves in pit with pit cover flush with floor.
6. Comply with requirements for backwater valves, cleanouts, and drains specified in Section 221319 "Sanitary Waste Piping Specialties."
7. Equipment: Connect waste piping as indicated.

    a. Provide shutoff valve if indicated and union for each connection.
    b. Use flanges instead of unions for connections NPS 2-1/2 (DN 65) and larger.

D. Connect force-main piping to the following:

1. Sanitary Sewer: To exterior force main.
2. Sewage Pump: To sewage pump discharge.

E. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

F. Make connections according to the following unless otherwise indicated:

1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.8 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping.

B. Comply with requirements for identification specified in Section 220500 "Basic Plumbing Materials and Methods".

3.9 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections, and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary waste and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.

    a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.

    a. Expose work that was covered or concealed before it was tested.

3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.

    a. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa).
    b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
    c. Inspect joints for leaks.

4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.

    a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg (250 Pa).
    b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
    c. Air pressure must remain constant without introducing additional air throughout period of inspection.
    d. Inspect plumbing fixture connections for gas and water leaks.

5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

6. Prepare reports for tests and required corrective action.

E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved.

a. Expose work that was covered or concealed before it was tested.

2. Cap and subject piping to static-water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials.

a. Isolate test source and allow to stand for four hours.
b. Leaks and loss in test pressure constitute defects that must be repaired.

3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
4. Prepare reports for tests and required corrective action.

3.10 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

D. Repair damage to adjacent materials caused by waste and vent piping installation.

3.11 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground, soil and waste piping NPS 4 (DN 100) and smaller shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings and hubless, heavy-duty hubless-piping couplings; and coupled joints.
3. Copper Type DWV tube, copper drainage fittings, and soldered joints.
4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

C. Aboveground, soil and waste piping NPS 5 (DN 125) and larger shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings and hubless; heavy-duty hubless-piping couplings; and coupled joints.
3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

D. Underground, soil, waste, and vent piping NPS 4 (DN 100) and smaller shall be any of the following:

1. Extra Heavy or Service class, cast-iron soil piping; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; heavy-duty cast-iron hubless-piping couplings; and coupled joints.
3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

E. Aboveground sanitary-sewage force mains NPS 1-1/2 and NPS 2 (DN 40 and DN 50) shall be any of the following:

1. Hard copper tube, Type L (Type B); copper pressure fittings; and soldered joints.

END OF SECTION 221316

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SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Section 220100 “Basic Plumbing Requirements,” and Section 220500 “Basic Plumbing Materials and Methods” all apply to the work of this Section as if fully repeated herein.

1.2 SUMMARY

A. Section Includes:

1. Backwater valves.
2. Cleanouts.
3. Through-penetration firestop assemblies.
4. Miscellaneous sanitary drainage piping specialties.
5. Floor drains.

B. Related Requirements:

1.3 DEFINITIONS

A. FRP: Fiberglass-reinforced plastic.

B. HDPE: High-density polyethylene.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rated capacities, operating characteristics, and accessories for the following:

1. FOG disposal systems.

B. Shop Drawings:

1. Show fabrication and installation details for frost-resistant vent terminals.

1.5 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For FOG disposal systems, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For sanitary waste piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTIONS

A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14 for plastic sanitary waste piping specialty components.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing, and marked for intended location and application.

2.2 BACKWATER VALVES

A. Drain-Outlet Backwater Valves

1. Approved manufacturers are J. R. Smith, Josam, and Zurn.
1. Size: Same as floor drain outlet.
2. Body: Cast iron or bronze made for vertical installation in bottom outlet of floor drain.
3. Check Valve: Removable ball float.
4. Inlet: Threaded.
5. Outlet: Threaded or spigot.

2.3 CLEANOUTS

A. Cast-Iron Exposed Cleanouts:

1. Approved manufacturers are J. R. Smith, Josam, and Zurn.
1. Standard: ASME A112.36.2M.
2. Size: Same as connected drainage piping
3. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
4. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

2.4 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.

a. NPS 2 (DN 50): 4-inch- (100-mm-) minimum water seal.
b. NPS 2-1/2 (DN 65) and Larger: 5-inch- (125-mm-) minimum water seal.

B. Floor-Drain, Trap-Seal Primer Fittings:

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
2. Size: Same as floor drain outlet with NPS 1/2 (DN 15) side inlet.

C. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

D. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch (25 mm) above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

2.5 DRAIN ASSEMBLIES

A. Sanitary drains shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14 for plastic sanitary piping specialty components.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Equipment Mounting:

1. Comply with requirements for vibration-isolation devices specified in Section 220548 "Vibration Controls for Plumbing Piping and Equipment."

B. Install backwater valves in building drain piping.

1. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.

C. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4 (DN 100). Use NPS 4 (DN 100) for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet (15 m) for piping NPS 4 (DN 100) and smaller and 100 feet (30 m) for larger piping.
4. Locate at base of each vertical soil and waste stack.

D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

F. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof. Comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."

G. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof. Comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."

H. Install deep-seal traps on floor drains and other waste outlets, if indicated.

I. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.

1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
2. Size: Same as floor drain inlet.

J. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

K. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.

L. Install fire-rated wood-blocking reinforcement for wall-mounting-type specialties.

M. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

N. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage.
3. Set with grates depressed according to the following drainage area radii:

a. Radius, 30 Inches (750 mm) or Less: Equivalent to 1 percent slope, but not less than 1/4-inch (6.35-mm) total depression.
b. Radius, 30 to 60 Inches (750 to 1500 mm): Equivalent to 1 percent slope.
c. Radius, 60 Inches (1500 mm) or Larger: Equivalent to 1 percent slope, but not greater than 1-inch (25-mm) total depression.

4. Install floor-drain flashing collar or flange, so no leakage occurs between drain and adjoining flooring.

    a. Maintain integrity of waterproof membranes where penetrated.

5. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

O. Install trench drains at low points of surface areas to be drained.

1. Set grates of drains flush with finished surface, unless otherwise indicated.

P. Comply with ASME A112.3.1 for installation of stainless-steel channel drainage systems.

1. Install on support devices, so that top will be flush with adjacent surface.

Q. Install FRP channel drainage system components on support devices, so that top will be flush with adjacent surface.

R. Install plastic channel drainage system components on support devices, so that top will be flush with adjacent surface.

3.2 CONNECTIONS

A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

E. Comply with requirements in Section 221319 "Sanitary Waste Piping Specialties" for backwater valves, air admittance devices and miscellaneous sanitary drainage piping specialties.

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required.

B. Set flashing on floors and roofs in solid coating of bituminous cement.

C. Secure flashing into sleeve and specialty clamping ring or device.

3.4 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign:

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.

1. Nameplates and signs are specified in Section 220500 Basic Plumbing Materials and Methods."

3.5 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319

SECTION 221429 - SUMP PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Section 220100 “Basic Plumbing Requirements,” and Section 220500 “Basic Plumbing Materials and Methods” all apply to the work of this Section as if fully repeated herein.

1.2 SUMMARY

A. Section Includes:

1. Submersible sump pumps.
2. Wet-pit-volute sump pumps.
3. Sump-pump basins and basin covers.

B. Related Section:

1. Section 221329 "Sanitary Sewerage Pumps" for effluent and sewage pumps.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Wiring Diagrams: For power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pumps and controls, to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.

C. Comply with pump manufacturer's written rigging instructions for handling.

PART 2 - PRODUCTS

2.1 SUBMERSIBLE SUMP PUMPS

A. Submersible, Fixed-Position, Double-Seal Sump Pumps:

1. Acceptable manufacturers: Weil, Zoeller and Liberty.
2. Description: Factory-assembled and -tested sump-pump unit.
3. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal sump pump as defined in ANSI HI 1.1-1.2 and HI 1.3.
4. Pump Casing: Cast iron, with strainer inlet, legs that elevate pump to permit flow into impeller, and vertical discharge for piping connection.
5. Impeller: Statically and dynamically balanced, Refer to manufacturer product data.
6. Pump and Motor Shaft: Stainless steel, with factory-sealed, grease-lubricated ball bearings.
7. Seals: Mechanical.
8. Moisture-Sensing Probe: Internal moisture sensor and moisture alarm.
9. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.

    a. Motor Housing Fluid: Oil.

10. Controls:

    a. Enclosure: NEMA 250, Type 4X; wall-mounted.
    b. Switch Type: Mechanical-float type, in NEMA 250, Type 6 enclosures with mounting rod and electric cables.
    c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
    d. High-Water Alarm: Rod-mounted, NEMA 250, Type 6 enclosure with mechanical-float, mercury-float, or pressure switch matching control and electric bell; 120-V ac, with transformer and contacts for remote alarm bell.

11. Control-Interface Features:

    a. Remote Alarm Contacts: For remote alarm interface.
    b. Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:

        1) On-off status of pump.
        2) Alarm status.

2.2 SUMP PUMP CAPACITIES AND CHARACTERISTICS

A. See schedule on drawings.

2.3 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

B. Motors for submersible pumps shall be hermetically sealed.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation and filling are not applicable.

3.2 EXAMINATION

A. Examine roughing-in for plumbing piping to verify actual locations of storm drainage piping connections before sump pump installation.

3.3 INSTALLATION

A. Pump Installation Standards: Comply with ANSI HI 1.4 for installation of sump pumps.

3.4 CONNECTIONS

A. Comply with requirements for piping specified in Section 221413 "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Pumps and controls will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.7 ADJUSTING

A. Adjust pumps to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust control set points.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps.

END OF SECTION 221429

SECTION 230500 – BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following basic mechanical materials and methods to complement other Division 23 Sections:

1. Materials and installation instructions common to mechanical systems.
2. Pipe joining materials and methods.
3. Modular sleeve seals.
4. Pipe sleeves.
5. Escutcheons.
6. Penetration firestopping of fire-resistance-rated assemblies and/or smoke barriers by mechanical piping, conduit, or ductwork
7. Labeling and identifying mechanical systems and equipment.
8. Painting and finishing of mechanical work.
9. Coordination with Structural work.
10. Field-fabricated equipment supports.
11. Selective Demolition.
12. Cutting and patching.

1.2 RELATED DOCUMENTS

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

B. Pipe and pipe fitting materials are specified in individual Division 23 piping system Sections.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following abbreviations are used throughout Division 23 Specification Sections:

1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. CPVC: Chlorinated polyvinyl chloride plastic.
3. CR: Chlorosulfonated polyethylene synthetic rubber.
4. EPDM: Ethylene propylene diene terpolymer rubber.
5. NBR: Acrylonitrile-butadiene rubber.
6. NP: Nylon plastic.
7. PE: Polyethylene plastic.
8. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

A. Product Data: For dielectric flanges or nipples, transition couplings, flexible pipe connectors, modular sleeve seals, and identification materials and devices.

B. For each type of penetration firestopping product, submit product data and include design designation of qualified testing and inspecting agency.

C. Shop Drawings: Detail fabrication and installation for supports and anchorage for mechanical materials and equipment.

D. Coordination Drawings: For access panel and door locations.

E. Samples: Of color, lettering style, and other graphic representation required for each identification material and device.

1.5 QUALITY ASSURANCE

A. Welding: Qualify welding processes and operators for structural steel according to AWS D1.1 “Structural Welding Code – Steel.”

B. Welding: Qualify welding processes and operators for piping according to ASME “Boiler and Pressure Vessel Code,” Section IX, “Welding and Brazing Qualifications.”

1. Comply with provisions of ASME B31 Series “Code for Pressure Piping.”
2. Certify that each welder has passed AWS qualification tests for the welding processes involved and that certification is current.
3. Contactor shall retain all welding certificates on file and produce them for review upon request by the Owner and/or Owner’s representative.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and prevent entrance of dirt, debris, and moisture. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor or roof, if stored thereupon. Protect flanges, fittings, and piping specialties from moisture and dirt.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

C. Protect ductwork interiors from the elements and foreign materials throughout construction. Deliver ducts with shop-applied impervious protective covering over all open ends. Maintain protective end coverings through shipping, storage, and handling to prevent entrance of dirt, debris, and moisture. Elevate stored ducts above grade. As ductwork is installed, remove protective end covering as each successive segment is connected, but with protective end covering maintained over open ends remaining exposed.

D. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

1.7 SEQUENCING AND SCHEDULING

A. Coordinate mechanical equipment installation with other building components.

B. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.

C. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed.

D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning before closing in building.

E. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.

F. Coordinate requirements for access panels and doors if mechanical items requiring access are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section “Access Doors and Panels.”

G. Coordinate installation of identifying devices after completing covering and painting, if devices are applied to surfaces. Install identifying devices before installing acoustical ceilings and similar concealment.

H. Coordinate connection of electrical services.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Transition Couplings:

a. Dresser Industries, Inc.
b. or approved equal.

2. Modular Sleeve Seals:

    a. Calpico, Inc.
    b. Flexicraft Industries, Inc. “PipeSeal”
    c. GPT div. of EnPro Industries, Inc “Link-Seal”
    d. The Metraflex Company

3. Identifying Devices and Labels:

    a. Brady USA, Inc., Signmark Div.
    b. Brimar Industries, Inc.
    c. Kolbi Industries, Inc.
    d. Panduit Corp.
    e. Seton Name Plate Co.

2.2 PIPE AND PIPE FITTINGS

A. Refer to individual Division 23 piping Sections for pipe and fitting materials and joining methods.

2.3 JOINING MATERIALS

A. Refer to individual Division 23 piping Sections for special joining materials not listed below.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

C. Pipe-Flange Joining Gaskets: ASME B16.21, EPDM, flat, asbestos-free, 1/8-inch (3.2-mm) thickness, unless noted otherwise.

1. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
2. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

D. Pipe-Flange Joining Bolts and Nuts: ASME B18.2.1 bolts with ASME B18.2.2 nuts, carbon steel, unless otherwise indicated.

1. Bolts and nuts shall be Type 304 or Type 316 stainless steel, if installed on stainless steel piping, and matching the grade of stainless steel piping.
2. Bolts and nuts shall be Type 304 stainless steel if installed on uninsulated piping located outdoors.
3. Bolts and nuts shall be Type 316 stainless steel if installed on uninsulated direct-bury piping.

E. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

1. Bolts and nuts shall be Type 304 stainless steel if installed on uninsulated piping located outdoors.
2. Bolts and nuts shall be Type 316 stainless steel if installed on uninsulated direct-bury piping.

F. Solder Filler Metals: ASTM B32 lead-free alloys. Include water-flushable flux according to ASTM B813.

G. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

H. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

I. Solvent Cements: Manufacturer's standard solvent cements for the following:

1. ABS Piping: ASTM D2235.
2. CPVC Piping: ASTM F493.
3. PVC Piping: ASTM D2564. Include primer according to ASTM F656.
4. PVC to ABS Piping Transition: ASTM D3138.

J. Plastic Pipe Seals: ASTM F477, elastomeric gasket.

2.4 FLEXIBLE PIPE CONNECTORS

A. General: Fabricated from materials suitable for system fluid and that will provide equipment-pipe connections.

B. Flexible Pipe Connectors for Copper Piping: Corrugated bronze inner tubing covered with interwoven bronze wire braid. Include copper-tube ends, brazed to hose.

C. Flexible Pipe Connectors for Steel Piping: Corrugated stainless-steel inner tubing covered with interwoven stainless-steel wire braid.

D. Performance Rating Requirements:

1. Misalignment: Rated for ¾-inch (20-mm) permanent lateral offset.
2. Length: As needed to allow offset rating above, but not less than 9-inches (230 mm).
3. Design Working Pressure: 150 psig (1035 kPa) at 300°F (149°C).

E. Schedule of End Connections:

1. 2-Inch NPS (DN50) and Smaller, Copper Pipe: Copper tube end connections suitable for soldering to adjacent piping; except that brazed end connections are required for refrigerant service.
2. 2-Inch NPS (DN50) and Smaller, Steel Pipe: Threaded-end carbon steel nipples welded to hose; except that stainless-steel ends are required for natural gas service or where mated to stainless steel piping.
3. 2½-Inch NPS (DN65) and Larger: Carbon-steel flanged end connections welded to hose and drilled to meet ANSI Class 150; except that stainless-steel flanged end connections are required for natural gas service or where mated to stainless steel piping.

F. Flexible pipe connectors specified herein are for use at the piping connection to a piece of mechanical equipment, including but not limited to pumps. These are not acceptable for use

where “expansion joints” or “pipe expansion fittings” are called out. Refer to Division 23 Section “Pipe Expansion Fittings” for pipe expansion joints or pipe expansion fittings.

2.5 MODULAR SLEEVE SEALS

A. Description: Modular design, with interlocking rubber links shaped to continuously fill annular space between pipe and sleeve. Include connecting bolts and pressure plates.

B. Sealing Elements: Interlocking links of EPDM or Nitrile rubber, shaped to fit surface of pipe. Include number and size of links required for size of pipe. Modular seal elements shall have a tensile strength of not less than 1200 psi per ASTM D412 test method.

C. Pressure Plates: Select among reinforced nylon polymer, steel zinc dichromate, or stainless steel. Include two for each sealing element.

D. Connecting Bolts and Nuts: Type 304 or 316 stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

E. Minimum Temperature Rating: -40°F to +210°F (-40°C to +99°C).

2.6 PIPE SLEEVES

A. The following sleeve materials are for wall, floor, slab, and roof penetrations.

B. Steel Pipe: ASTM A53, Type E, Grade A, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated “wall pipe” equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

E. PE: Manufactured, reusable, tapered, cup shaped, smooth outer surface, with nailing flange for attaching to wooden forms.

F. Contractor’s Option: Pre-engineered, UL-listed fire-resistance rated and watertight cast-in-place floor sleeving systems meeting the following specifications will be acceptable in lieu of traditional floor sleeves with field-installed firestop, at contractor’s option.

1. Description: Cast-in-place, factory-assembled, one-piece watertight firestop device for use in concrete floors formed with wood and/or steel decking to protect penetrating objects from expansion and contraction of concrete, thermal and seismic movement, and the passage of air, smoke, fire, and hot gasses.
2. Manufacturer: Subject to compliance with requirements, provide Hydroflame™ sleeving system by Hubbard Enterprises / Holdrite; or approved equal.
3. Include an outer sleeve lined with an intumescent strip; and a radial extended flange attached to one end of the sleeve for fastening to concrete formwork; or wide outside

wings attached to one end of the sleeve for fastening to metal deck concrete formwork and span deck corrugations.

4. Include a waterstop gasket and mid-body seal consisting of one to three concentric raised rings for embedment and sealing to the concrete slab. For applications involving a corrugated deck, also include a cone attached to the base for extending the device through the metal deck.
5. Product shall provide a two-hour fire-resistance rated assembly when tested according to ASTM E814 or ANSI/UL 1479.

2.7 PENETRATION FIRESTOPPING SYSTEMS

A. Penetration firestopping systems shall bear classification marking of UL or FM.

B. Penetrations in Fire-Resistance-Rated Assemblies: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).

1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.

C. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg (74.7 Pa).

1. L-Rating: Not exceeding 5.0 cfm/sq. ft. (0.025 cu. m/s per sq. m) of penetration opening at and no more than 50-cfm (0.024-cu. m/s) cumulative total for any 100 sq. ft. (9.3 sq. m) at both ambient and elevated temperatures.

D. Accessories: Provide components such as permanent forming/damming/backing materials, substrate primers, collars, and/or steel sleeves for each penetration firestopping system as necessary to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.

E. Mixing: For those products requiring mixing before application, comply with penetration firestopping system manufacturer’s written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

2.8 IDENTIFYING DEVICES AND LABELS

A. General: Manufacturer’s standard products of categories and types required for each application as referenced in other Division 23 Sections. If more than one type is specified for application, selection is installer’s option, but provide one selection for each product category.

B. Comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

C. Equipment Nameplates: Metal nameplate with operational data engraved or stamped; permanently fastened to equipment; furnished and factory-installed by original equipment manufacturer.

1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data.
2. Location: Accessible and visible location.

D. Engraved Plastic-Laminate Signs: ASTM D709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated.

1. Fabricate in sizes required for message.
2. Engraved with engraver's standard letter style, of sizes and with wording to match equipment identification.
3. Punch for mechanical fastening.
4. Thickness: 1/16-inch (1.6 mm), for units up to 20 sq. in. (130 sq. cm) or 8 inches (200 mm) long; 1/8-inch (3.2 mm) for larger units.
5. Fasteners: Self-tapping stainless-steel screws or contact-type permanent adhesive.

E. Valve Tags: Photo-anodized barcode tags with ¼-inch (6-mm) letters and numbers. Include 5/32-inch (4-mm) hole for fastener.

1. Material: 0.032-inch (0.8-mm) thick anodized aluminum.
2. Color: Silver background with black characters.
3. Printed Nomenclature: Piping system abbreviation and sequenced number; e.g., CWS-23 for chilled water supply valve #23; HWR-12 for hot water return valve #12.
4. Barcode: Two-dimensional Data Matrix ECC 200 barcode symbology. QR Code is also acceptable. Prior to manufacture, obtain valve tag information from owner's property manager for encoding into the barcode. Include valve number, piping system, system abbreviation, location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

F. Valve Tag Fasteners: Brass, wire-link chain or stainless steel beaded chain.

G. Lettering and Graphics: Coordinate names, abbreviations, and other designations used in mechanical identification, with corresponding designations indicated. Use numbers, lettering, and wording indicated for proper identification and operation/maintenance of mechanical systems and equipment.

1. Multiple Systems: If multiple systems of same generic name are indicated, provide identification that indicates individual system number and service such as "Boiler No. 3," "Air Supply No. 1H," or "Standpipe F12."

H. Chiller Room Warning Sign: Each entrance to a refrigerating machinery room shall be provided with a legible permanent sign, securely attached and easily accessible, reading "Machinery

Room – Authorized Personnel Only." A second sign shall further state "Audible and Visual Refrigerant Alarm Sounding Indicates Refrigerant Detection – Entry is Forbidden Except by Those Personnel Trained in Emergency Procedures."

2.9 PAINTING AND FINISHING

A. For all painting and finishing work required for mechanical installations, as described in Part 3 of this Section and/or on the Drawings, refer to Division 09 Sections for specification of paint and finishing materials, whose requirements apply to the work of Division 23 as if fully reproduced herein.

B. Master Painters Institute, Inc. (MPI) Standards: Provide paint and paint products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."

A. Material Compatibility: Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

B. Colors: As directed by Owner's representative. Each pipe [or duct] shall be painted a designated color according to service.

C. Furnish 5 percent extra paint, but not less than 1 gallon of each material and color applied, from the same product run, that match products installed and that are packaged for storage and identified with labels describing contents.

D. Mechanical Room Floor Paint: Sherwin Williams ArmorSeal 8100 (D70W8161) water-based epoxy in Satin finish and Shark Grip additive for slip resistance.

PART 3 - EXECUTION

3.1 GENERAL MECHANICAL INSTALLATION REQUIREMENTS

A. Verify all dimensions by field measurements.

B. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.

C. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Architect.

D. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.

E. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.

F. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

3.2 PIPING SYSTEM INSTALLATION REQUIREMENTS

A. General: Install piping as described below, unless piping Sections specify otherwise. Individual Division 23 piping Sections specify unique piping installation requirements.

B. General Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated, unless deviations to layout are approved on Coordination Drawings.

C. Install components with pressure rating equal to or greater than system operating pressure.

D. Install piping at indicated slope, and free of sags and bends.

E. Install piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal. Install piping to allow application of insulation plus 1-inch (25-mm) clearance around insulation.

F. Locate groups of pipes parallel to each other, arranged and spaced to permit valve servicing.

G. Install fittings for changes in direction and branch connections. Install couplings according to manufacturer's written instructions.

H. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.

I. Electrical Equipment Spaces: Route piping to avoid passing through transformer vaults and electrical equipment spaces and enclosures.

J. Piping Support: As specified in Division 23 Section "Hangers and Supports."

3.3 PIPING JOINING REQUIREMENTS

A. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping specification Sections.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipefittings and valves as follows:

1. Note internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
2. Apply appropriate tape or thread compound to external pipe threads, unless dry seal threading is specified.
3. Align threads at point of assembly.
4. Tighten joint with wrench. Apply wrench to valve end into which pipe is being threaded.
5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, "Recommended Practices and Procedures for Welding Low Carbon Steel Pipe," using qualified processes and welding operators according to "Quality Assurance" Article.

1. Apply one coat of self-priming, rust-inhibitor paint around the entire circumference of each welded pipe joint; regardless of whether or not the piping is specified to be painted. Paint may be brush-applied, roller-applied, or spray-applied at contractor's option.

H. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join pipe and fittings according to the following:

1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
2. ABS Piping: ASTM D2235 and ASTM D2661.
3. CPVC Piping: ASTM D2846 and ASTM F493.
4. PVC Pressure Piping: ASTM D2672.
5. PVC Non-pressure Piping: ASTM D2855.
6. PVC to ABS Non-pressure Transition Fittings: Procedure and solvent cement according to ASTM D3138.

J. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D2657 procedures and manufacturer's written instructions.

1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

K. Piping Connections: Make connections according to the following, unless otherwise indicated.

1. Install unions, in piping 2-inch NPS (DN50) and smaller at final connection to each piece of equipment with 2-inch NPS (DN50) or smaller threaded pipe connection.
2. Install flanges, in piping 2½-inch NPS (DN65) and larger, adjacent to flanged valves and at final connection to each piece of equipment with flanged pipe connection.
3. Install dielectric flanges to connect piping materials of dissimilar metals.
4. Valve Caps: Any valve that represents a termination or the end of a run (e.g., blowdown or drain valve, hose-end valve, etc.) shall be fitted with a permanent but removable cap, plug, or blind flange matching the valve construction, to minimize risk in the event the valve is accidentally opened under pressure.

3.4 PIPE-PENETRATION INSTALLATION REQUIREMENTS

A. Except as noted otherwise, install escutcheons for both insulated and bare piping in the following cases:

1. New piping of penetrations of newly-constructed walls, ceilings, and floors.
2. New piping penetrations of existing walls, ceilings, and floors.
3. Existing piping which penetrates newly-constructed walls, ceilings, and floors.

B. Escutcheons are not required in the following cases. Note that some form of closure of the annular or overcut opening (for reasons of acoustics, fire/smoke, sight, etc.) may still be required by other provisions of these documents.

1. Existing piping which penetrates existing walls, ceilings, and floors.
2. Wall penetrations in an unfinished cavity above a finished ceiling.
3. Penetrations of a wall or partition dividing one unfinished space from another unfinished space, such as service spaces, storage rooms, and equipment rooms.

C. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening. Use one-piece type for new piping and split-plate type for existing piping as specified in Part 2 of this section.

D. Install floor plates for piping penetrations of unfinished floors in service spaces and equipment rooms. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening. Use one-piece floor-plate type for new piping and split-casting floor-plate type for existing piping as specified in Part 2 of this section.

E. Install sleeves for pipes passing through concrete and masonry walls, and concrete floor and roof slabs.

F. Cut sleeves to length for mounting flush with both surfaces. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

G. Fire-Resistance Rated, Cast-in-Place Sleeve Installation: Select sleeve size based on size and type of pipe and thickness of the floor. Position and secure sleeve to concrete form using nails

or staples. Place concrete and finish even with top of sleeve. Install in complete and strict accordance with manufacturer's UL-listed installation instructions.

H. Build sleeves into new walls and slabs as work progresses.

I. Install sleeves large enough to provide ¼-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

1. Steel Pipe Sleeves: For pipes smaller than 6-inch NPS (DN150).
2. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level. Refer to Division 07 Section "Flashing and Sheet Metal" for flashing.
3. Seal space outside of sleeve fittings with non-shrink, non-metallic grout.

J. Aboveground, Exterior-Wall, Pipe Penetrations: Seal penetrations using sleeves and modular sleeve seals. Size sleeve for 1-inch (25-mm) annular clear space between pipe and sleeve for installing modular sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) in diameter and larger.
3. Assemble and install modular sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber-sealing elements to expand and make watertight seal.

K. Sleeves are not required for core-drilled holes.

L. Permanent sleeves are not required for holes formed by PE removable sleeves.

M. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestopping materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

3.5 EQUIPMENT INSTALLATION REQUIREMENTS

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected. Refer to equipment specifications in Division 23 and Division 26 for rough-in requirements.

B. Install equipment to provide maximum possible headroom, if mounting heights are not indicated.

C. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to Architect.

D. Positive attachment and anchorage of all equipment to the structure or floor is required. Do not rely on friction or gravity as a means of attachment.

E. Install flexible pipe connectors at the following locations. Install on equipment side of shutoff valves.

1. Inlet and outlet of each pump.
2. Inlet and outlet of each chiller.
3. Inlet and outlet of each cooling tower.
4. At each connection to a packaged computer-room air-conditioning unit.
5. Where indicated elsewhere in these specifications.
6. Where detailed on the Drawings.

F. Support for Suspended Equipment: As specified in Division 23 Section “Hangers and Supports.”

3.6 PENETRATION FIRESTOPPING INSTALLATION

A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, “Approval of Firestop Contractors,” or been evaluated by UL and found to comply with its “Qualified Firestop Contractor Program Requirements.”

B. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.

C. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.

D. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

E. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work. Proceed with installation only after unsatisfactory conditions have been corrected.

F. Surface Cleaning: Before installing penetration firestopping systems, clean out openings immediately to comply with manufacturer’s written instructions and with the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

G. Prime substrates where recommended in writing by manufacturer using that manufacturer’s recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

H. General: Install penetration firestopping systems to comply with manufacturer’s written installation instructions and published drawings for products and applications. Install and cure penetration firestopping materials per manufacturer’s written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

I. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.

J. Install fill materials by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

K. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.

L. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

3.7 LABELING AND IDENTIFYING

A. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow. Use plastic markers, with application systems.

1. Install on insulation segment if required for hot, uninsulated piping.
2. Install directional arrows around the pipe on both ends of pipe identification label, overlapping label slightly to help secure label to pipe.
3. If directional arrows are not applicable, install adhesive tape matching pipe or insulation color on both ends to help secure pipe identification label.

B. Locate pipe markers as follows if piping is exposed in finished spaces, machine rooms, and accessible maintenance spaces, such as shafts, tunnels, plenums, and exterior non-concealed locations:

1. Near each valve and control device.
2. Near each branch, excluding short takeoffs for fixtures and terminal units. Mark each pipe at branch, if flow pattern is not obvious.
3. Near locations where pipes pass through walls, floors, ceilings, or enter non-accessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum of 50-foot (15-m) intervals along each run. Reduce intervals to 25 feet (7.5 m) in congested areas of piping and equipment.

7. On piping above removable acoustical ceilings, except omit intermediately spaced markers.

C. Install continuous plastic underground warning tapes during back filling of trenches for underground piping. Locate 6 to 8 inches (150 to 200 mm) below finished grade, directly over piping. Refer to Division 31 Section “Earth Moving” for warning-tape materials and devices and their installation.

D. Equipment: Install engraved plastic-laminate sign on or near each major item of mechanical equipment.

1. Lettering Size: Minimum ¼-inch- (6.4-mm-) high lettering for name of unit if viewing distance is less than 24 inches (610 mm), ½-inch- (12.7-mm-) high lettering for distances up to 72 inches (1800 mm), and proportionately larger lettering for greater distances. Provide secondary lettering two-thirds to three-fourths of size of principal lettering.
2. Text of Signs: Provide name of identified unit. Include text to distinguish between multiple units, inform user of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

E. Duct Systems: Identify air supply, return, exhaust, intake, and relief ducts with duct markers showing duct system service and direction of flow. In each space, if ducts are exposed or concealed by removable ceiling system, locate signs near points where ducts enter into space and at maximum intervals of 50 feet (15 m).

F. Adjusting: Relocate identifying devices as necessary for unobstructed view in finished construction.

G. Install valve tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, plumbing fixture supply stops, faucets, and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units.

3.8 PAINTING AND FINISHING

A. For all painting and finishing work required for mechanical installations, refer to Division 09 Sections for application requirements.

B. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45ºF. Maintain containers in clean condition, free of foreign materials and residue. Remove rags and waste from storage areas daily.

C. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50ºF and 95ºF. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5ºF above the dew point; or to damp or wet surfaces.

D. Examine substrates and conditions for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

E. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

F. Proceed with coating application only after unsatisfactory conditions have been corrected. Application of coating indicates acceptance of surfaces and conditions.

G. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates indicated.

H. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints. Remove surface oxidation, loose mill scale, and shop primer, if any. Clean field welds, bolted connections, and abraded areas of shop paint.

I. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual." Use applicators and techniques suited for paint and substrate indicated. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

J. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

K. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

L. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

M. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

N. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

O. Painting HVAC Work: Paint the following work where exposed to view in finished or unfinished spaces: Uninsulated steel piping, pipe hangers and supports, tanks that do not have factory-applied final finishes, all interior and exterior ferrous piping and appurtenances, including steel, galvanized steel, cast iron and ductile iron.

P. In addition, paint the following:

1. Duct, equipment, and pipe insulation having ASJ or other paintable jacket material.
2. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

Q. Steel Substrates: Primer, alkyd, anti-corrosive, for metal, MPI #79; plus topcoat of latex, interior, semi-gloss, MPI #54.

R. Galvanized-Metal Substrates: Primer, galvanized, water based, MPI #134; plus topcoat of latex, interior, semi-gloss, MPI #54.

S. Aluminum (Not Anodized or Otherwise Coated) Substrates: Primer, quick dry, for aluminum, MPI #95; plus topcoat of latex, interior, semi-gloss, MPI #54.

T. ASJ Insulation-Covering Substrates: Including pipe and duct coverings. Primer sealer, latex, interior, MPI #50; plus topcoat of latex, interior, semi-gloss, MPI #54.

U. Primers specified above may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

3.9 COORDINATION WITH STRUCTURAL WORK

A. Concrete: Do not embed pipes, wires, tube, boxes, ducts or other cavity-creating elements in concrete work unless shown on or permitted by the structural drawings. Openings through concrete not shown on the structural drawings are subject to approval by the structural engineer of record. See coordination drawing requirements under Submittals.

B. Roof Deck: Do not place loads on, or hang any loads whatsoever from roof deck, unless shown on structural drawings, including, but not limited to, hangers for pipes, ducts, equipment, etc. Trade contractor installing such loads shall provide sub-framing connected to steel frame.

1. Do not exceed capacity of roof deck as a working platform. Submit all proposed construction loads to deck supplier for approval.
2. Openings in roof deck not shown on structural drawings, such as openings required for stacks, pipes, ducts, plumbing vents, etc., shall be cut and reinforced by trade requiring opening.

C. Supported Slab: Do not suspend loads exceeding 500 pounds within any 100 square feet of contiguous area from concrete supported slab. Suspend such loads from structural steel only. Any “sub-framing” required is responsibility of Contractor or sub-contractor installing material requiring support.

1. Openings in concrete floor slabs not shown on structural drawings, such as openings required for stacks, pipes, ducts, plumbing vents, etc., shall be the responsibility of the trade requiring openings. Form blockouts in the slab, reinforcing deck, and cut openings after concrete has reached specified strength.
2. Where openings larger than 12-inches are required but not shown on structural drawings, secure written approval from Architect/Engineer prior to cutting deck.

3.10 ERECTION OF SUPPORTS AND ANCHORAGE

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

B. Field Welding: Comply with AWS D1.1, “Structural Welding Code – Steel.”

3.11 SELECTIVE DEMOLITION

A. Disconnect, demolish, and remove mechanical work as indicated on the Drawings, and as required for installation of new work shown. Coordinate with Division 26 for disconnection of power to electrically-powered equipment prior to demolition.

B. Remove accessible work in its entirety. Repair cut surfaces to match adjacent surfaces. Abandon in place embedded or buried work, unless noted otherwise.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material. Do not abandon dead-end legs on an active system; instead cap the abandoned leg at the active main.
3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material. Do not abandon dead-end legs on an active system; instead cap the abandoned leg at the active main.
5. Equipment to Be Removed: Disconnect and cap services and remove equipment.

C. Removal: Unless otherwise indicated, remove demolished pipe, duct and equipment from the Project site. Handle and dispose of in accordance with National, State, and Local regulations.

1. Relocation: Remove, store, clean, reinstall, reconnect, and make operational all work indicated for relocation.
2. Salvage: Remove and deliver to Owner all work indicated for salvage.

D. Refer to Division 01 Sections “Selective Demolition” and/or “Selective Structure Demolition” for additional requirements.

E. For selective demolition of any appliance or piece of equipment containing a CFC, HCFC, or HFC refrigerant: Prior to demolition, refrigerant shall be evacuated and captured in full compliance with the Clean Air Act; using only technicians with the proper refrigerant license as according to law, stored in approved containers, and shipped to a licensed refrigerant recycling facility all as required by the United States Environmental Protection Agency.

3.12 CUTTING AND PATCHING

A. General: Employ skilled workmen to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay. Perform cutting and patching in accordance with the following:

B. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.

C. Perform cutting, fitting, and patching of mechanical equipment and materials required to:

1. Uncover Work to provide for installation of ill-timed Work.
2. Remove and replace defective Work.
3. Remove and replace Work not conforming to requirements of the Contract Documents.
4. Install equipment and materials in existing structures.

D. Cut, remove and legally dispose of selected mechanical equipment, components, and materials as indicated, including but not limited to removal of mechanical piping, pumps, and other mechanical items made obsolete by the new Work.

E. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of trades involved.

F. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

G. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

H. Repair cut surfaces to match adjacent installations.

I. Repair any building insulation or building fireproofing materials, whether new or existing, that are removed or scraped away in order to make a mechanical installation, so as to maintain an equivalent insulation or fire rating as existed without said mechanical installation.

3.13 GROUTING

A. Install nonmetallic, non-shrink, grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Mix grout according to manufacturer’s written instructions. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Place grout, completely filling equipment bases. Avoid air entrapment during placing of grout. Place grout on concrete bases to provide smooth bearing surface for equipment. Place grout around anchors.

E. Cure placed grout according to manufacturer’s written instructions.

END OF SECTION 230500

SECTION 230513 – MOTORS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes basic requirements for factory-installed motors associated with mechanical equipment specified elsewhere in Division 23.

B. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.2 RELATED DOCUMENTS

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

B. Section 230500 "Basic Mechanical Materials and Methods" all apply to the work of this Section as if fully repeated herein.

C. Related Sections include all other Division 23 Sections for application of motors and reference to specific motor requirements for motor-driven equipment.

1.3 DEFINITIONS

A. Factory-Installed Motor: A motor installed by motorized-equipment manufacturer as a component of equipment.

B. Field-Installed Motor: A motor installed at Project site and not factory installed as an integral component of motorized equipment.

C. ECM: Electrically-commutated motor.

D. ODP: Open drip-proof.

E. TEAO: Totally-enclosed, air-over.

F. TEFC: Totally-enclosed, fan-cooled.

1.4 SUBMITTALS

A. Product Data: Submit motor product data with each associated equipment submittal. Show nameplate data and ratings; characteristics; mounting arrangements; size and location of winding termination lugs, conduit entry, and grounding lug; and coatings.

B. Product Data for Field-Installed Motors: For each type and size of motor, provide nameplate data and ratings; shipping, installed, and operating weights; enclosure type and mounting

arrangements; size, type, and location of winding terminations; conduit entry and ground lug locations; and information on coatings or finishes.

C. Shop Drawings for Field-Installed Motors: Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Include the following:

1. Each installed unit's type and details.
2. Nameplate legends.
3. Diagrams of power, signal, and control wiring. Provide schematic wiring diagram for each type of motor and for each control scheme.

D. Coordination Drawings: Floor plans showing dimensioned layout, required working clearances, and required area above and around field-installed motors. Show motor layout, mechanical power transfer link, driven load, and relationship between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.

E. Qualification Data: For testing agency.

F. Source quality-control test reports.

G. Field quality-control test reports.

H. Operation and Maintenance Data: For field-installed motors to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. UL Listing: Motors specified in this Section must be listed and labeled by Underwriters Laboratories and bear the UL logo.

C. All motors designated for "severe duty" shall comply with IEEE 841-2001, *Standard for Petroleum and Chemical Industry-Severe Duty Totally Enclosed Fan-Cooled (TEFC) Squirrel-Cage Induction Motors-Up to and Including 370 KW (500 HP)*.

1.6 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices and features that comply with the following:

1. Compatible with magnetic controllers, multi-speed controllers, and/or reduced-voltage controllers where applicable.
2. Designed and labeled for use with variable frequency controllers where applicable and suitable for use throughout speed range without overheating.
3. Matched to torque and horsepower requirements of the load.
4. Matched to ratings and characteristics of supply circuit and required control sequence.

B. Coordinate motor support with requirements for driven load; access for maintenance and motor replacement; installation of accessories, belts, belt guards; and adjustment of sliding rails for belt tensioning.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide motors by one of the following:

1. Baldor Electric Co.
2. Century Electric Co.
3. General Electric Co.
4. MagneTek
5. Marathon Electric Mfg. Co.
6. Reliance Electric Co.
7. Siemens Energy & Automation, Inc.

2.2 BASIC MOTOR REQUIREMENTS

A. Basic requirements apply to all types of mechanical equipment motors, unless otherwise indicated.

1. Motors ½ HP and Larger: Polyphase.
2. Motors Smaller than ½ HP: Single phase.
3. Frequency Rating: 60 Hz.

B. Voltage Rating: NEMA standard voltage selected to operate on nominal voltage of circuit to which motor is connected.

C. Service Factor: According to NEMA MG 1, unless otherwise indicated, but at least 1.15 polyphase motors and 1.35 for single-phase motors.

D. Duty: Continuous duty at ambient temperature of 104°F (40°C) and at altitude of 3300 feet (1000 meters) above sea level.

E. Capacity and Torque Characteristics: Rated for continuous duty and sufficient to start, accelerate, and operate connected loads at designated speeds, in indicated environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

F. Enclosure: ODP, unless otherwise indicated.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design E, medium induction motor, unless otherwise indicated.

1. Stator: Copper windings, unless otherwise indicated.
2. Rotor: Random-wound, squirrel cage, unless otherwise indicated.

3. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
4. Temperature Rise: Match insulation rating, unless otherwise indicated.
5. Insulation: Class F, unless otherwise indicated.

B. Code Letter Designation: Motors 15 HP and larger shall be NEMA starting Code F or Code G. Motors under 15 HP shall have manufacturer's standard starting characteristics.

C. Enclosure: Cast iron for motors 7½ HP and larger; rolled steel for motors smaller than 7½ HP; with enamel finish.

D. Efficiency: Motor efficiencies for motors one horsepower and greater shall in no case shall be less efficient than "Premium Efficiency" as defined in NEMA MG 1-2014 *Motors and Generators*. Motors shall be tested and labeled in accordance with NEMA MG 1-2014 Standard. Motor nameplate labeling shall include both the minimum and nominal efficiency.

E. Motors Used with Reduced-Inrush Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

F. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Designed with critical vibration frequencies outside operating range of controller output.

2. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
3. Temperature Rise: Matched to rating for Class B insulation.
4. Insulation: Class F or H.
5. Motor shall be inverter-duty or inverter-ready and shall not require the use of external cooling fans.

G. Shaft Grounding Ring: On any and all motors to be controlled by a Variable Frequency Motor Controller, include an engineered ring consisting of two or more rows of circumferential conductive microfibers to redirect shaft current and provide a low-impedance path from shaft to frame, bypassing the motor bearings. Factory-install on the motor shaft by sliding the ring over either end, and lock it in place with mechanically-fastened mounting brackets. Motors over 100 nameplate horsepower shall be provided with an insulated bearing on the non-drive end and a shaft grounding ring on the drive end of the motor. Product shall be "Aegis SGR" by Electro Static Technology or approved equal.

H. Multispeed Motors: Variable torque.

1. For motors with 2:1 speed ratio, consequent pole, single winding.
2. For motors with other than 2:1 speed ratio, separate winding for each speed.

I. Source Quality Control: Perform the following routine tests according to NEMA MG 1:

1. Measurement of winding resistance.

2. No-load readings of current and speed at rated voltage and frequency.
3. Locked rotor current at rated frequency.
4. High-potential test.
5. Alignment.

J. Source Quality Control for Field-Installed Motors: Perform the following tests on each motor according to NEMA MG 1:

1. Measure winding resistance.
2. Read no-load current and speed at rated voltage and frequency.
3. Measure locked rotor current at rated frequency.
4. Perform high-potential test.

2.4 SINGLE-PHASE MOTORS

A. Type: As indicated or selected by manufacturer from one of the following, to suit starting torque and other requirements of specific motor application.

1. Permanent-split capacitor.
2. Split-phase start, capacitor run.
3. Capacitor start, capacitor run.

B. Shaded-Pole Motors: Do not use, unless motors are smaller than 1/20 hp.

C. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

D. Thermal Protection: Where indicated or required, internal protection shall automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal protection device shall automatically reset when motor temperature returns to normal range, unless otherwise indicated.

E. Bearings: Ball-bearing type for belt-connected motors and other motors with high radial forces on motor shaft. Sealed, pre-lubricated sleeve bearings for other single-phase motors.

F. Source Quality Control for Field-Installed Motors: Perform the following tests on each motor according to NEMA MG 1:

1. Measure winding resistance.
2. Read no-load current and speed at rated voltage and frequency.
3. Measure locked rotor current at rated frequency.
4. Perform high-potential test.

2.5 ELECTRICALLY-COMMUTATED MOTORS

A. General: Electrically-Commutated Motors are required wherever indicated in other Division 23 Specifications and/or notations on the Drawings.

B. Motor: Motor shall be ECM, variable-speed, DC type, brushless motor designed for fan applications with heavy duty permanently lubricated ball bearings and electric commutation. It

shall contain internal circuitry that converts single phase power into a DC signal. Motor shall be designed for direct-drive applications.

C. Speed Control: The ECM shall be speed-controllable down to 10% of full speed via exterior-mounted field-adjustable potentiometer dial or DDC control signal input.

D. Efficiency: Minimum 70% at all speeds.

E. Voltage: Single-phase 115-V, 208-V, or 277-V as indicated.

F. Rotor: Synchronous; permanent magnet type; built-in soft start.

G. Thermal Protection: Where indicated or required, internal protection shall automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal protection device shall automatically reset when motor temperature returns to normal range, unless otherwise indicated.

PART 3 - EXECUTION

3.1 INSTALLATION, ALL MOTORS

A. Use adjustable motor mounting bases for belt-driven motors. Align motors, bases, shafts, pulleys, and belts. Tension belts according to manufacturer’s written instructions. Verify bearing lubrication.

B. Run each motor with its controller. Demonstrate correct rotation, alignment, and speed at motor design load. Test interlocks and control and safety features for proper operation. Verify that current and voltage for each phase comply with nameplate rating and NEMA MG 1 tolerances.

C. Correct malfunctioning motors on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new motors and retest.

3.2 EXAMINATION, FIELD-INSTALLED MOTORS

A. Examine areas to receive field-installed motors for compliance with requirements, installation tolerances, and other conditions affecting performance.

B. Examine roughing-in for conduit systems to verify actual locations of conduit connections before motor installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 FIELD-INSTALLED MOTOR INSTALLATION

A. Anchor each motor assembly to base, adjustable rails, or other support, arranged and sized according to manufacturer’s written instructions. Attach by bolting. Level and align with load transfer link.

B. Install motors on concrete bases complying with Division 03.

3.4 FIELD QUALITY CONTROL FOR FIELD-INSTALLED MOTORS

A. Prepare for acceptance tests.

1. Align motors, bases, shafts, pulleys, and belts. Tension belts according to manufacturer's written instructions.
2. Verify bearing lubrication.
3. Run each motor with its controller. Demonstrate correct rotation, alignment, and speed at motor design load.
4. Test interlocks and control and safety features for proper operation.
5. Verify that current and voltage for each phase comply with nameplate rating and NEMA MG 1 tolerances.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

C. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:

1. Perform electrical tests and visual and mechanical inspections including optional tests and inspections stated in NETA ATS on field-installed motors. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.5 FIELD-INSTALLED MOTOR DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain field-installed motors. Refer to Division 01.

END OF SECTION 230513

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SECTION 230529 – HANGERS AND SUPPORTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes hangers and supports for mechanical system piping and equipment, including but not limited to the following:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Equipment stands.
8. Equipment supports.

1.2 RELATED DOCUMENTS

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

B. Section 230500 “Basic Mechanical Materials and Methods” all apply to the work of this Section as if fully repeated herein.

C. The following Sections contain requirements that relate to this Section:

1. Division 05 Sections for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports; and for materials for attaching hangers and supports to building structure.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

B. Terminology: As defined in MSS SP-90 *Guidelines on Terminology for Pipe Hangers and Supports*.

1.4 PERFORMANCE REQUIREMENTS

A. If contractor elects to apply channel support systems and/or heavy-duty steel trapezes to support multiple pipes, in lieu of individual supports, then contractor is responsible for design of same capable of supporting combined weight of supported systems, system contents, and test water. Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Do not suspend pipe hangers and supports from roof deck. Suspend such loads from structural steel only, and provide structural steel sub-framing as required.

D. Do not suspend piping loads exceeding 500 pounds within any 100 square feet of contiguous area from supported concrete floor slabs. Suspend such loads from structural members only, and provide structural steel sub-framing as required.

E. Structural Performance: Hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1.5 SUBMITTALS

A. Product Data: For each type of pipe hanger, channel support system component, and thermal-hanger shield insert indicated. Include:

1. Metal pipe hangers and supports.
2. Thermal-hanger shield inserts.
3. Fastener systems.
4. Pipe stands.

B. Shop Drawings: Shop drawings signed and sealed by a qualified professional engineer are required for the following custom pipe and equipment hangers and supports. Show fabrication and installation details and analysis data, and include calculations. Include Product Data for components.

1. All equipment stands and supports for equipment weighing 500 lbs (227 kg) or more.
2. Trapeze pipe hangers supporting an individual pipe larger than 12-inch (DN 300), two pipes larger than 8-inch (DN 200), three or four pipes larger than 6-inch (DN150), or any trapeze supporting five or more pipes of any size.
3. Metal framing systems supporting an individual pipe larger than 12-inch (DN 300), two pipes larger than 8-inch (DN 200), three or four pipes larger than 6-inch (DN150), or any trapeze supporting five or more pipes of any size.
4. All custom pipe supports for steam systems operating above 15 psig (105 kPa).
5. All custom pipe supports for hydronic systems operating above 160 psig (105 kPa) or 250°F (121°C).
6. Risers over 10 stories or 100 feet (30 m).

C. Welding certificates.

1.6 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M *Structural Welding Code – Steel*.

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code, Section IX, “Welding and Brazing Qualifications.”

C. ANSI/MSS Standard SP-58-2018 *Pipe Hangers and Supports – Materials, Design, Manufacture, Selection, Application, and Installation* including Amendment 1 Issued October 17, 2019, is hereby incorporated by reference. This Standard establishes:

1. Minimum requirements for materials, allowable stresses, product design, testing, and load ratings for pipe hanger and support assemblies for standard and unique pipe hangers and supports.
2. Inspection criteria for the manufacture and installation of pipe hangers and supports.
3. Required procedures for packing, marking, shipping, receiving, and storage of pipe hangers and supports.
4. Minimum requirements for pipe hanger and support assembly drawings.
5. Field practices for installation, adjustment, testing, and inspection of pipe hangers and supports.
6. Terminology and identification of pipe hangers and supports, along with recommended contractual relationship structures.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Manufactured Pipe Hangers:

    a. Anvil International, Inc.
    b. Cooper B-Line, Inc.
    c. Carpenter & Patterson, Inc.
    d. Erico International Corp.
    e. PHD Manufacturing, Inc.
    f. Tolco division of Cooper B-Line, Inc.

2. Metal Framing Systems:

    a. Anvil International, Inc.
    b. Cooper B-Line, Inc.
    c. Erico / Michigan Hanger Co.
    d. Thomas & Betts Corporation.
    e. Tolco division of Cooper B-Line, Inc.
    f. Unistrut Corporation; Tyco International, Ltd.

3. Thermal-Hanger Shield Inserts:

    a. Carpenter & Paterson, Inc.
    b. Erico International Corp.
    c. PHS Industries, Inc.
    d. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.

4. Powder-Actuated Fastener Systems:

    a. Hilti, Inc.
    b. ITW Ramset/Red Head.
    c. Simpson Manufacturing Co.; Strong-Tie Anchor Systems Div.

5. Roof-Mounted Pipe Stands:

    a. “Caddy Pyramid” by Erico International Corp.
    b. Mapa Products.
    c. Miro Industries, Inc.

2.2 METAL PIPE HANGERS AND SUPPORTS

A. Application: Refer to “Hanger and Support Applications” Article in Part 3 for where to use specific hanger and support types, including special padding or coatings where required.

B. Carbon-Steel Pipe Hangers and Supports: MSS SP-58, Types 1 through 58, factory-fabricated components with pre-galvanized or hot dipped galvanized coatings. Include continuous-thread hanger rods, nuts, and washer made of carbon steel unless noted otherwise.

C. Stainless-Steel Pipe Hangers and Supports: MSS SP-58, Types 1 through 58, factory-fabricated components. Include continuous-thread hanger rods, nuts, and washer made of stainless steel unless noted otherwise.

D. Copper Pipe Hangers: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components. Include continuous-thread hanger rods, nuts, and washer made of stainless steel unless noted otherwise.

1. Riser Clamp: Riser clamps for insulated copper piping installed in a vertical configuration shall be a pre-engineered support meeting ANSI/MSS SP-58 Type 8; with carbon steel clamp and a thermoplastic polyolefin insert to support the weight of the riser pipe with insulation. Design shall provide insulation crush-resistance, maintain vapor barrier for below-ambient pipe services, and protect insulation ends from compression and tears. Capacity shall be not less than 320 pounds [145 kg] of vertical load. Comply with 25/50 Flame Spread/Smoke Development Index according to UL 2043 *Fire Test for Heat and Visible Smoke Release*.

E. Trapeze Pipe Hangers: Shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 METAL FRAMING SYSTEMS

A. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes, according to Standard MFMA-4. Galvanized steel construction if located indoors; stainless steel construction if located outdoors.

B. Channels: Continuous slotted steel channel with inturned lips.

C. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.

D. Hanger Rods: As specified for Metal Pipe Hangers and Supports above.

E. Coatings: Manufacturer’s standard finish, unless otherwise noted.

2.4 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, stainless-steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.5 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.

D. High-Type, Single-Pipe Stand:

1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
2. Base: Stainless steel.
3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand:

1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
2. Bases: One or more; plastic.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

F. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.6 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

B. Roof Curb-Type Equipment Rails: 18-gauge galvanized steel, unitized construction with integral base plate, continuous welded corner seams, pressure-treated wood nailer, counter-flashing with screws. Internally reinforced to conform with load bearing factors. Wood nailer shall include 1-inch overhang unless otherwise noted. Subject to compliance with requirements, example of acceptable product is The Pate Company's Model ES-5b.

C. Outdoor Equipment Stands: Individual foot supports with elevated adjustable channel cross bars and clamps/fasteners/bolts for ground-supported or roof-supported outdoor equipment components, without roof membrane penetration, in a pre-fabricated system that can be modularly-assembled on site.

1. Foot Material: Rubber or polypropylene.
2. Rails Material and all Hardware: Stainless steel.
3. Wind/Sliding Load Resistance: Up to 100 mph (44 m/s) minimum.

D. Design all suspended equipment supports to resist forces of 0.5 times the equipment weight in any horizontal direction and 1.5 times the equipment weight in the downward direction. These requirements shall be increased to account for forces required by other criteria, such as seismic standards, as may be specified elsewhere.

2.7 MISCELLANEOUS MATERIALS

A. Structural and Miscellaneous Steel: As specified in Division 23 Section "Basic Mechanical Materials and Methods."

B. Grout: As specified in Division 23 Section "Basic Mechanical Materials and Methods."

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT SCHEDULE OF APPLICATIONS

A. Comply with MSS SP-58 for pipe hanger and trapeze selections and applications that are not specified in this Section.

B. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use copper-plated pipe hangers and copper or stainless-steel attachments, or use plastic coatings on attachments for electrolytic protection, where hangers are in direct contact with copper tubing.

E. Use stainless-steel pipe hangers and supports, stainless-steel metal framing systems, and all stainless-steel hardware and attachments for hostile environment applications, including the following:

1. All piping installed outdoors.

F. Use padded hangers with fiberglass or other pad or cushion to support bearing surface of piping for piping that is subject to scratching.

G. Horizontal-Piping Hangers and Supports for the first three hangers/supports or the first 50-feet (whichever is greater) adjacent to Pumps: Use spring hangers and supports. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports shall include the following types:

1. Horizontal (MSS Type 54): Mounted horizontally.
2. Vertical (MSS Type 55): Mounted vertically.
3. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
4. Exception: Spring hangers are not required adjacent to inline pumps that are smaller than 5-horsepower. Use other types of hangers and supports as listed for service below.

H. Horizontal-Piping Hangers and Supports for individual, insulated pipe runs which are both 2½-inch diameter or larger and 20 feet or longer: Unless otherwise indicated, choose among the following types:

1. Single Pipe Rolls (MSS Type 41): For suspension of pipes from two rods.
2. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes from single rod.
3. Complete Pipe Rolls (MSS Type 44): Where vertical adjustment is not necessary.
4. Adjustable Pipe Roll and Base Units (MSS Type 46): For vertical and lateral adjustment.
5. For any of the above, include protection saddles and/or shields as applicable, and as further specified under the heading “Protection of Insulated Piping” elsewhere in this section.
6. Exception: Piping whose normal operating temperature is less than 150ºF (e.g., chilled water, condenser water) may be supported with static hangers specified in the next paragraph.

I. Horizontal-Piping Hangers and Supports for individual pipe runs less than 20 feet long and all piping 2-inch diameter or smaller, regardless of length: Unless otherwise indicated, choose among the following types:

1. Adjustable Steel Clevis Hangers (MSS Type 1).
2. Yoke-Type Pipe Clamps (MSS Type 2): For pipes NPS 4 and larger.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3).
4. Steel Pipe Clamps (MSS Type 4).

J. Horizontal-Piping Hangers and Supports for individual uninsulated pipe runs of any size or length: Unless otherwise indicated, choose among the following types:

1. Adjustable Steel Clevis Hangers (MSS Type 1).
2. Yoke-Type Pipe Clamps (MSS Type 2): For pipes NPS 4 and larger.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3).
4. Steel Pipe Clamps (MSS Type 4).
5. Adjustable Steel Band Hangers (MSS Type 7): For pipes up to NPS 2 only.
6. Adjustable Swivel-Ring Band Hangers (MSS Type 10): For pipes up to NPS 2 only.
7. U-Bolts (MSS Type 24).

K. Vertical-Piping Hangers and Supports for individual, insulated pipe runs which are both 2½-inch diameter or larger and 20 feet or longer: Use spring hangers and supports. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports shall include the following types:

1. Horizontal (MSS Type 54): Mounted horizontally.
2. Vertical (MSS Type 55): Mounted vertically.
3. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

L. Vertical-Piping Hangers and Supports for individual pipe runs less than 20 feet long and all piping 2-inch diameter or smaller, regardless of length: Unless otherwise indicated, choose among the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8). Use pre-engineered riser clamp with TPO insert for insulated copper piping as specified in Part 2 of this Section.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): Where longer ends are required.

M. Vertical-Piping Hangers and Supports for individual uninsulated pipe runs of any size or length: Unless otherwise indicated, choose among the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8).
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): Where longer ends are required.

N. Hanger-Rod Attachments: Unless otherwise indicated, choose among the following types:

1. Steel Turnbuckles (MSS Type 13).
2. Steel Clevises (MSS Type 14).
3. Malleable-Iron Sockets (MSS Type 16).
4. Steel Weldless Eye Nuts (MSS Type 17).

O. Building Attachments: Unless otherwise indicated, choose among the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to concrete ceiling.
2. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
3. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams.
4. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
5. Light Welded-Steel Brackets (MSS Type 31): For support of pipes from below or for suspending from above up to 750 lb. by using clip and rod.
6. Medium Welded-Steel Brackets (MSS Type 32): For support of pipes from below or for suspending from above up to 1500 lb. by using clip and rod.
7. Heavy Welded-Steel Brackets (MSS Type 33): For support of pipes from below or for suspending from above up to 3000 lb. by using clip and rod.
8. Side-Beam Brackets (MSS Type 34): For sides of steel beams.
9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

P. Copper Piping for Refrigerant Liquid: Same as specified above for Drawn-Temper Copper Piping for any liquid-service piping systems.

Q. Cast Iron and/or Ductile Iron Piping: Install hangers at the same maximum spacing and with the same minimum rod sizes as for Steel Piping for hydronic system service, except that maximum spacing shall not exceed 12 feet and smallest rod size allowed is ½-inch.

1. Vertical piping: Shall be supported at each stack base and at each floor. Free standing vertical pipe should be adequately staked or braced during construction to maintain alignment.
2. Horizontal piping: Shall be supported within 18-inches of the coupling joint at maximum 10 foot intervals for 10 foot pipe lengths and at maximum 5 foot intervals for 5 foot pipe lengths. Support or hangers should be properly placed to maintain alignment and grade with provision made to prevent shear. Large diameter pipe should be braced at changes of direction to prevent horizontal movement.

R. Fiberglass (RTRP) Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions, but in no case shall spacing exceed the spacing for steel pipe specified above.

1. Avoid point loading by using weight-distributing saddles at each support. Saddle shall contact piping for a minimum of 180-degrees of circumference. Length of saddle in inches shall equal the nominal diameter of the piping (i.e., a 10-inch long saddle shall be used at each pipe support for a 10-inch nominal pipe diameter). Saddle shall meet MSS SP-58, Type 39.
2. Space and install hangers with the fewest practical rigid anchor points.

S. Support vertical runs at roof, at each floor, and at 10-foot (3-m) intervals between floors.

T. Rod diameters may be reduced one size for double-rod hangers, with 3/8-inch (10 mm) minimum rods.

U. Hanger and support spacing for piping and tubing not listed above shall be according to MSS SP-58 and piping manufacturer's written instructions.

3.2 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-58 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Field fabricate from ASTM A36/A36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M. Comply with MSS SP-58 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers. Support pipes of various sizes together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Required for insulated piping NPS 4 and larger if piping operates below surrounding ambient air temperature.

E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

F. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

G. Install lateral bracing with pipe hangers and supports to prevent swaying.

H. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

I. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2½ (DN 65) and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

K. Repair any building insulation or building fireproofing materials, whether new or existing, that are removed or scraped away in order to attach hangers and supports, so as to maintain an equivalent insulation or fire rating as existed without said hanger or support attachment.

L. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4-inches (100 mm) thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer’s operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer’s written instructions.

M. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Division 07 Section “Roof Accessories” for curbs.

N. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

3.3 PROTECTION OF INSULATED PIPING:

A. Attach clamps and spacers to piping.

1. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.

2. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.

B. Do not exceed pipe stress limits according to ASME B31.9.

C. Piping Operating above Ambient Air Temperature: Clevis- and clamp-type supports shall project through insulation, with pipe support making direct contact with pipe and with insulation applied in a manner that encapsulates the clevis or clamp. For piping on roller-type supports, install MSS SP-58, Type 39 protection saddles, and fill interior voids with insulation that matches adjoining insulation.

1. Contractor's Option: In lieu of the above paragraph, contractor has the option of complying with the same specifications as for "Piping Operating below Ambient Air Temperature" in the following paragraphs.

D. Piping Operating below Ambient Air Temperature: Clevis- and clamp-type supports shall be sized for the outside diameter of the insulation including jacket. Install MSS SP-58, Type 40 protective metal shields. Shields shall span an arc of 180 degrees.

1. Pipe Sizes NPS 4 (DN 100) and larger: Include thermal-hanger shield inserts. Insert shall be same thickness as adjoining pipe insulation and length shall be at least as long as the protective shield. Include steel weight-distribution plate if pipe is installed on rollers.
2. Metal Shield Dimensions for Pipe: Not less than the following:

a. NPS 3½ (DN 90) and smaller: 12-inches (300 mm) long and 0.048-inch (1.22 mm) thick.
b. NPS 4 (DN 100): 12-inches (300 mm) long and 0.06-inch (1.52 mm) thick.
c. NPS 5 and NPS 6 (DN 125 & 150): 18-inches (450 mm) long and 0.06-inch (1.52 mm) thick.
d. NPS 8 to NPS 14 (DN 200 to DN 350): 24-inches (610 mm) long and 0.075-inch (1.91 mm) thick.
e. NPS 16 to NPS 24 (DN 400 to DN 600): 24-inches (610 mm) long and 0.105-inch (2.67 mm) thick.

3. Pipes NPS 8 (DN 200) and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
4. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.4 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor. Provide lateral bracing, to prevent swaying, for equipment supports.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

3.5 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and/or equipment supports. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

B. Field Welding: Comply with AWS D1.1 procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals. Obtain fusion without undercut or overlap. Remove welding flux immediately. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.6 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe. Trim excess length of continuous-thread hanger and support rods to 1½-inches (40 mm).

3.7 PAINTING

A. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

B. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05 mm).

C. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.

END OF SECTION 230529

SECTION 230900 – HVAC INSTRUMENTATION AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY OF REQUIREMENTS

A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.

B. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems.

C. Devices, sensors, and components shall be wired and powered equipment. No wireless devices with battery power allowed, unless specifically noted.

D. The building temperature control system shall be direct digital control with all electric and electronic systems, communication, and devices.

E. An Ethernet-based user interface shall permit interface with the network via dynamic color graphics with each mechanical system, building floor plan, and control device depicted by point-and-click graphics.

F. The temperature control system requirements are defined throughout the Contract Drawings and Specifications, including but not limited to this Section, control schedules and diagrams on the Drawings, and references in the other specification sections. The party responsible for performance of the work of this Section shall review the Documents thoroughly to determine system requirements. Any temperature control system requirement called for in one location in the Contract Drawings and Specifications shall be considered a part of this Section as if fully repeated herein.

G. The temperature control system shall be based on a universal open protocol providing true open communication, interpretability, and integration of building subsystems. Refer to "References" subsection of this Section for examples of acceptable open protocols.

H. In addition to the above, the control system shall interface with the following:

1. Fire alarm system specified in Division 28.

1.2 RELATED DOCUMENTS

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

B. Section 230500 “Basic Mechanical Materials and Methods” all apply to the work of this Section as if fully repeated herein.

C. The following Sections contain requirements that relate to this Section:

1. All Division 23 Sections for coordination of HVAC equipment and systems to be controlled by the building temperature control system.

1.3 DEFINITIONS

A. General: Refer to Division 01, and Division 23 Section “Basic Mechanical Materials and Methods” for additional definitions beyond those identified here.

1. BAS: Building Automation System; i.e., the system provided herein.
2. DDC: Direct-digital controls.
3. DZR Brass: Dezincification-resistant brass alloy containing not more than 15% zinc by weight.
4. HART: Highway addressable remote transducer protocol is the global standard for sending and receiving digital information across analog wires between smart devices and control or monitoring systems through bi-directional communication that provides data access between intelligent field instruments and host systems. A host can be any software application from technician's hand-held device or laptop to a control, asset management, safety, or other system using any control platform.
5. I/O: Input/output.
6. IP: Internet Protocol.
7. JACE: Java Application Control Engine.
8. LAN: Local area network.
9. LCD: Liquid crystal display.
10. mA: Milli-ampere.
11. MS/TP: Master-slave/token-passing.
12. PC: Personal computer.
13. PID: Proportional plus integral plus derivative.
14. RTD: Resistance temperature detector.
15. VAC: Volts, alternating current.
16. VDC: Volts, direct current.

1.4 SYSTEM PERFORMANCE

A. Comply with the following performance requirements:

1. Point-and-Click Graphics: All graphics shall depict realistic representations of floor plans, equipment layouts, and locations. All monitored and controlled points shall be included in the graphics. Graphics shall allow navigation through selection of equipment, or by navigating through floor plans.
2. Graphic Display: Display graphic with minimum 20 dynamic points with current data within 10 seconds.
3. Graphic Refresh: Update graphic with minimum 20 dynamic points with current data within 8 seconds.
4. Graphics Time Lapse: Full graphics page for analyzing and troubleshoot systems up to 24 hours of past operation.
5. Object Command: Reaction time of less than two seconds between operator command of a binary object and device reaction.
6. Object Scan: Transmit change of state and change of analog values to control units or workstation within six seconds.

7. Alarm Response Time: Annunciate alarm at workstation within 45 seconds. Multiple workstations must receive alarms within five seconds of each other.
8. Program Execution Frequency: Run capability of applications as often as five seconds, but selected consistent with mechanical process under control.
9. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.
10. Energy Dashboard and Reports: Energy dashboard that identifies abnormal energy usage per meter, real-time views of energy usage, year-over-year energy cost and other energy analyst tools. The dashboard shall be able to be modified by an operator. Also, can export reports with trends and graphics.

1.5 SUBMITTALS

A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.

1. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, relays/switches, control panels, and operator interface equipment.
2. Control System Software: Include technical data for operating system software, operator interface, color graphics, and other third-party applications.
3. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.

B. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with ASHRAE 135-2016, is BTL-Certified, and carries the BTL logo.

C. Samples for Initial Selection: For each color required, of each type of thermostat or sensor cover with factory-applied color finishes.

D. Graphical User Interface: Submit an indexed list of screens and a flowchart representing hierarchical structure of menu navigation options.

E. Qualification Data: For installer, showing certification of manufacturer's completed training, hours of instruction, and course outlines.

F. Field quality-control test reports.

G. Operation and Maintenance Data: For HVAC instrumentation and control system to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Maintenance instructions and lists of spare parts for each type of control device and compressed-air station.
2. Interconnection wiring diagrams with identified and numbered system components and devices.
3. Keyboard illustrations and step-by-step procedures indexed for each operator function.

4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
5. Calibration records and list of set points.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this Project; and who has an established working relationship with the manufacturer of not less than three years.

B. Startup Personnel Qualifications: Engage specially-trained personnel in direct employ of manufacturer of primary temperature control system.

C. Programmer Personnel Qualifications: Engage specially-trained personnel in direct employ of manufacturer of primary temperature control system; whose primary office location is not more than 250 driving miles from the project site.

D. All Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. BACnet Compliance: Comply with ASHRAE Standard 135-2016 for DDC system components and at all layers of system architecture. Each DDC system component shall be BTL-Certified and shall carry the BTL logo. All devices that control and/or monitor equipment shall support BACnet intrinsic reporting; and all devices that meet the B-ASC device profile requirements shall support BACnet intrinsic reporting.

1.7 REFERENCED STANDARDS

A. ANSI/ASHRAE Standard 135-2016: *BACnet - A Data Communication Protocol for Building Automation and Control Networks*, Atlanta, Georgia: American Society of Heating, Refrigerating, and Air-Conditioning Engineers, 2016, including BACnet Secure addendum.

1.8 DELIVERY, STORAGE, AND HANDLING

A. System Software: Update to latest version of software at Project completion.

1.9 COORDINATION

A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.

B. Coordinate equipment with Division 28 Sections regarding Fire Alarm to achieve compatibility with equipment that interfaces with that system.

C. Coordinate supply of conditioned electrical branch circuits for control units and operator workstation.

1.10 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents. In addition, warrant all work as follows.

B. All work shall have a single warranty date, even when the Owner has received beneficial use due to an early system start-up. If the work specified is split into multiple contracts or a multi-phase contract, then each contract or phase shall have a separate warranty start date and period.

C. Exception: The contractor shall not be required to warrant reused devices, except for those that have been rebuilt and/or repaired. The contractor shall warrant all installation labor and materials, however, and shall demonstrate that all reused devices are in operable condition at the time of engineer's acceptance.

1.11 OWNERSHIP OF PROPRIETARY MATERIAL

A. Ownership of Proprietary Material: All project-developed software and documentation shall become the property of the Owner, including but not limited to project graphic images, record drawings, project database, project-specific application programming code, and all documentation.

B. Licenses: All licenses associated with the control systems and its components will be for a duration of five (5) years and begin the same time as the final phase warrantee. After this period the Owner will be responsible for yearly licenses.

PART 2 - PRODUCTS

2.1 DDC EQUIPMENT

A. System Backbone: A server and a universal software infrastructure shall allow building controls integrators, HVAC and mechanical contractors to build custom web-enabled applications for accessing, automating and controlling smart devices real-time via local network or over the Internet. Subject to compliance with requirements, provide an enterprise-level server with open communication protocol and with architecture by one of the manufacturers listed beneath the manufacturer heading above.

B. System software shall be based on a server/thin-client architecture, designed around the open standards of web technology. The control system server shall be accessed using a Web browser over the control system network, the owner's local area network, and remotely over the Internet through the owner's LAN).

C. The intent of the thin-client architecture is to provide operators complete access to the control system via a Web browser. No special software other than a Web browser shall be required to access graphics, point displays, and trends, configure trends, configure points and controllers, or to edit programming.

D. Performance Monitoring. The BAS will provide the specified performance monitoring functionality, including required monitoring points and performance metrics, improved through

system accuracy, data acquisition and data management capabilities, and required graphical and data displays.

E. Event Response. The BAS will provide the specified operational changes based on event response from the energy service provider.

F. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; and backup power source.

1. Units monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation or diagnostic terminal unit.
2. Stand-alone mode control functions operate regardless of network status. Functions include the following:

    a. Global communications.
    b. Discrete/digital, analog, and pulse I/O.
    c. Monitoring, controlling, or addressing data points.
    d. Software applications, scheduling, and alarm processing.
    e. Testing and developing control algorithms without disrupting field hardware and controlled environment.

3. Standard Application Programs:

    a. Electric Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, night setback/setup, on-off control with differential sequencing, staggered start, anti-short cycling, PID control, DDC with fine tuning, and trend logging.
    b. HVAC Control Programs: Optimal run time, supply-air temperature reset, and economizer switchover.
    c. Chiller Control Programs: Control function of condenser-water temperature reset, chilled-water temperature reset, and equipment sequencing.
    d. Programming Application Features: Include trend point; alarm processing and messaging; weekly, monthly, and annual scheduling; energy calculations; run-time totalization; and security access.
    e. Remote communications.
    f. Maintenance management.
    g. Units of Measure: Inch-pound and SI (metric).

4. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
5. ASHRAE 135 Compliance: Control units shall use ASHRAE 135-2016 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.

G. Local Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source.

1. Units monitor or control each I/O point, process information, and download from or upload to operator workstation or diagnostic terminal unit.

2. Stand-alone mode control functions operate regardless of network status. Functions include the following:

    a. Global communications.
    b. Discrete/digital, analog, and pulse I/O.
    c. Monitoring, controlling, or addressing data points.

3. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
4. ASHRAE 135 Compliance: Control units shall use ASHRAE 135-2016 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.

H. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.

1. Binary Inputs: Allow monitoring of on-off signals without external power.
2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.
4. Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation [with three-position (on-off-auto) override switches and status lights].
5. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA) [with status lights, two-position (auto-manual) switch, and manually adjustable potentiometer].
6. Tri-State Outputs: Provide two coordinated binary outputs for control of three-point, floating-type electronic actuators.
7. Universal I/Os: Provide software selectable binary or analog outputs.

I. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:

1. Output ripple of 5.0 mV maximum peak to peak.
2. Combined 1 percent line and load regulation with 100-mic.sec. response time for 50 percent load changes.
3. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.

2.2 APPLICATION SPECIFIC CONTROLLERS

A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.

1. Configuration: Local keypad and display; diagnostic LEDs for power, communication, and processor; wiring termination to terminal strip or card connected with ribbon cable; memory with bios; and [72] <Insert number>-hour battery backup.
2. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms. Perform

scheduling with real-time clock. Perform automatic system diagnostics; monitor system and report failures.

3. ASHRAE 135 Compliance: Communicate using read (execute and initiate) and write (execute and initiate) property services defined in ASHRAE 135-2016. Reside on network using MS/TP datalink/physical layer protocol and have service communication port for connection to diagnostic terminal unit.
4. Enclosure: Dustproof rated for operation at 32 to 120ºF (0 to 50ºC).

2.3 INSTRUMENTATION ENVIRONMENTAL CONDITIONS

A. Instruments shall operate without performance degradation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified and encountered for installed location.

B. If instrument alone cannot meet requirement, install instrument in a protective enclosure that is isolated and protected from conditions impacting performance. Enclosure shall be internally insulated, electrically heated, filtered, and ventilated as required by instrument and application.

C. Instruments and accessories shall be protected with enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Instruments not available with integral enclosures complying with requirements indicated shall be housed in protective secondary enclosures. Instrument's installed location shall dictate following NEMA 250 enclosure requirements:

1. Outdoors, Protected: Type 3.
2. Outdoors, Unprotected: Type 4X.
3. Indoors, Heated: Type 2.
4. Indoors, Heated and Air Conditioned: Type 1.
5. Chiller and Boiler Rooms: Type 12.
6. Air-Moving Equipment Rooms: Type 2.
7. Localized Areas Exposed to Washdown: Type 4.
8. Within Duct Systems and Air-Moving Equipment Not Exposed to Possible Condensation: Type 2.
9. Within Duct Systems and Air-Moving Equipment Exposed to Possible Condensation: Type 4.
10. Hazardous Locations: Explosion-proof rating for condition.

D. Test and inspect assembled instruments, as indicated by instrument requirements. Affix standards organization's certification and label.

2.4 DAMPERS

A. Dampers: AMCA-rated, parallel or opposed-blade design (see schedule on drawings); 0.108-inch- (2.8-mm-) minimum thick, galvanized-steel or 0.125-inch- (3.2-mm-) minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch- (1.6-mm-) thick galvanized steel with maximum blade width of 8 inches (200 mm) and length of 48 inches (1220 mm).

1. Secure blades to ½-inch- (13-mm-) diameter, zinc-plated axles using zinc-plated hardware, with [oil-impregnated sintered bronze] [nylon] blade bearings, blade-linkage hardware of

zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.

2. Operating Temperature Range: From minus 40 to plus 200ºF (minus 40 to plus 93ºC).
3. Edge Seals, Low-Leakage Applications: Use inflatable blade edging or replaceable rubber blade seals and spring-loaded stainless-steel side seals, rated for leakage at less than 10 cfm per sq. ft. (50 L/s per sq. m) of damper area, at differential pressure of 4-inch wg (1000 Pa) when damper is held by torque of 50 in. x lbf (5.6 N x m); when tested according to AMCA 500D.
4. All dampers shall bear the AMCA Certified Ratings Program seal for Air Performance, Air Leakage, and Efficiency.

2.5 ACTUATORS

A. Manufacturers: Subject to compliance with requirements, provide Damper actuators by Belimo Aircontrols USA, Inc. or approved equal.

1. Damper Actuator Location: Install all damper actuators on outside of ducts in accessible locations; except that damper actuators installed outdoors exposed to outdoor weather shall be installed inside the duct with suitable access door adjacent. Access doors are specified in Division 23 Section “Duct Accessories.”

B. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action as indicated.

1. Comply with requirements in Division 23 Section “Motors.”
2. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
3. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft. (2.3 sq. m): Size for running torque of 150 in. x lbf (16.9 N x m) and breakaway torque of 300 in. x lbf (33.9 N x m).
4. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft. (2.3 sq. m): Size for running and breakaway torque of 150 in. x lbf (16.9 N x m).

C. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.

1. Parallel-Blade Damper with Edge Seals: Size for running torque calculated based on 7 inch-lb/sq. ft. (86.8 kg-cm/sq. m) of damper.
2. Opposed-Blade Damper with Edge Seals: Size for running torque calculated based on 5 inch-lb/sq. ft. (62 kg-cm/sq. m) of damper.
3. Parallel-Blade Damper without Edge Seals: Size for running torque calculated based on 4 inch-lb/sq. ft (49.6 kg-cm/sq. m) of damper.
4. Opposed-Blade Damper without Edge Seals: Size for running torque calculated based on 3 inch-lb/sq. ft. (37.2 kg-cm/sq. m) of damper.
5. Dampers with 2- to 3-Inch wg (500 to 750 Pa) of Pressure Drop or Face Velocities of 1000 to 2500 fpm (5 to 13 m/s): Increase running torque by multiplier of 1.5.
6. Dampers with 3- to 4-Inch wg (750 to 1000 Pa) of Pressure Drop or Face Velocities of 2500 to 3000 fpm (13 to 15 m/s): Increase running torque by multiplier of 2.0.

7. Coupling: V-bolt and V-shaped, toothed cradle. Single bolt or set-screw type fasteners are not acceptable.
8. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
9. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.
10. Power Requirements (Two-Position Spring Return): 24 or 120-Volt AC.
11. Power Requirements (Modulating): Maximum 10 VA at 24-Volt AC or 8 W at 24-Volt DC.
12. Proportional Signal: 2- to 10-Volt DC or 4 to 20 mA, and 2- to 10-Volt DC position feedback signal.
13. Temperature Rating: Minus 22º to plus 122ºF (Minus 30º to plus 50ºC).
14. Temperature Rating (Smoke Dampers): Minus 22º to plus 250ºF (Minus 30º to plus 121ºC).
15. Stroke Time: Not more than 120 seconds over full range.
16. External Direction-of-Rotation Switch.

2.6 POWER SUPPLY AND WIRING

A. The work of this section shall include providing all necessary temperature control power wiring except as otherwise described herein.

B. Dedicated 20-amp / 120-volt AC circuits are available at Panels indicated on E-series Drawings. From that point, the party responsible for performance of this Section shall furnish, install, and connect all required power supply to all electric-powered control components. Furnish, install, and connect transformers as required to serve lower voltage and/or DC components. Perform field electrical work in complete and strict accordance with Division 26 requirements and the National Electric Code.

C. Where current-sensing relays are specified or scheduled, the Division 26 installer will provide either a junction box in the power wiring between motor and starter, or space for same within the motor starter.

D. The work of this section includes installing the current-sensing relay, connecting the power wiring leads to same, and providing all control wiring.

E. All power wiring necessary for temperature controls operation not excluded above is the work of this Section.

F. Motor Control Relays: Square D 8501K relays or approved equal. Multi-pole switching applications at 120 volts; industry-standard wiring and pin arrangements; 15 A rated; DPDT; line-voltage throughput; AC or DC signal as compatible with temperature control signal. Provide where indicated via Equipment Data Schedule on the Drawings.

2.7 ELECTRONIC CABLE

A. Single-Conductor Coaxial: 50-ohm characteristic impedance, cellular polyethylene core, 97 percent coverage, bare copper-braid shield, PVC jacket; complying with MIL-C-17, Type RG-58/U.

B. Twin Lead: Bare copper-covered steel; 2-conductor parallel; 300-ohm characteristic impedance; polyethylene insulation and web between conductors; cellular polyethylene oval jacket.

C. Multi-conductor Cable: Quantity of conductors indicated; No. 18 AWG tinned-copper conductors; color-coded, low-loss PVC insulation; aluminum/Mylar shield; No. 22 AWG tinned-copper drain wire; PVC jacket.

D. Twisted Pair: Quantity of twisted pairs indicated; No. 22 AWG tinned-copper conductors; color-coded, PVC insulation; overall aluminum/polyester shield; No. 22 AWG tinned-copper drain wire; PVC jacket.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Examine roughing-in for instruments to verify actual locations of connections before installation.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install software in control units and server. Implement all features of programs to specified requirements and as appropriate to sequence of operation.

B. Connect and configure equipment and software to achieve sequence of operation specified.

C. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.

D. Install labels and nameplates to identify control components according to Division 23 Section “Basic Mechanical Materials and Methods.”

E. Install products level, plumb, parallel, and perpendicular with building construction.

F. Properly support instruments, and conduit to comply with requirements indicated. Brace all products to prevent lateral movement, sway, or a break in attachment.

G. Provide ceiling, floor, roof, wall openings, and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed products that could potentially be damaged. Patch, flash, grout, seal, and refinish openings to match adjacent condition.

H. Seal penetrations to ductwork, plenums, and air-moving equipment to comply with duct static pressure class and leakage and seal classes indicated using neoprene gaskets or grommets.

3.3 GRAPHICAL USER INTERFACE

A. Graphical User Interface shall consist of a turn-key installation on a Hosting Server capable of serving webpages to minimum of 50 computers via a popular web browser software such as Internet Explorer, Goggle Chrome, Mozilla Firefox and Safari.

B. Informational Screens shall consist of text, I/O points and software points to provide dynamic representations of equipment and control sequences. Point values and units shall be displayed against a background that is representative of the applicable equipment or location containing the points.

C. Informational Screens shall be created for the following, where applicable:

1. One home screen containing project identification, site plan and a critical information summary, including ambient conditions, presence of alarm conditions, summarized building conditions, and a Help screen.
2. Individual floor-plans or project-specific areas.
3. Individual equipment.
4. Links to equipment Sequences of Operation.

D. Informational Screens or pull-down menus shall provide access to Schedule Management and Alarm Management.

E. Navigation: User logon shall automatically direct user to the home screen from which navigation to all Informational Screens shall be accessible. Navigational aids shall be consistent in appearance, location and function on all screens. Navigational aids can consist of traditional pull-down menus, or custom menus, such as menu trees, or screen buttons.

F. Screen Summaries: Where multiple areas, or similar pieces of equipment occur, summary screens shall be provided using a matrix format. Summary screens shall allow access to individual areas or equipment with minimal navigation.

3.4 ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. Furnish and install electrical power to products requiring electrical connections. Furnish and install circuit breakers. Install raceways, boxes, and cabinets according to Division 26 Section Sections. Install building wire and cable according to Division 26 Section Sections. Install signal and communication cable according to Division 27 Section Sections.

B. Conceal wire/cable and/or wire/cable raceway, except in mechanical rooms and areas where other conduit and piping are exposed.

C. All line-voltage wiring (greater than 24 Volts) shall be installed in raceway regardless of location or height.

D. All 24-Volt (and less) power, signal, and control wiring located above ceilings shall be installed in raceway or shall be plenum-rated cable meeting a 25/50 flame/smoke spread rating conforming to UL 910.

1. Do not install low-voltage wiring in the same raceway as line-voltage wiring.

2. Where plenum cables are used without raceway, support from structural members; do not support from ductwork, other electrical raceways, piping, or ceiling suspension system.

E. All power, signal, and control wiring located below ceilings, below the ceiling plane, or within walls shall be installed in raceway.

F. All power, signal, and control wiring in mechanical rooms and other rooms without finished ceilings shall be installed in raceway regardless of height.

G. Control wiring shall not be installed in the same conduit or raceway with power conductors. Where signal or control wiring is required (above) to be routed in raceway, provide a raceway separate from any raceway containing power wiring.

H. Bundle and harness multi-conductor instrument cable in place of single cables where several cables follow a common path.

I. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Neatly tie and support conductors at 10-feet (3 m) intervals.

J. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.

K. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.

L. Unless noted otherwise, temperature controls functions shall be wired and connected to the AUTO leg of each respective equipment's HAND-OFF-AUTO selector switch at the respective motor starter. Connect HAND-OFF-AUTO selector switches to override automatic interlock controls when switch is in HAND position.

1. Exception: Connect manual-reset limit controls and safety cutouts independent of manual-control switch positions.
2. Automatic duct heater resets may be connected in interlock circuit of power controllers.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
2. Test and adjust controls and safeties.
3. Test calibration of controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
4. Test each point through its full operating range to verify that safety and operating control set points are as required.

5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
6. Test each system for compliance with sequence of operation.
7. Test software and hardware interlocks.

C. DDC Verification:

1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
2. Check instruments for proper location and accessibility.
3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
4. Check installation of air supply for each instrument.
5. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
6. Check temperature instruments and material and length of sensing elements.
7. Check air-operated dampers. Verify that pressure gages are provided and that proper blade alignment, either parallel or opposed, has been provided.
8. Verify that DDC controller power supply is from emergency power supply, if applicable.
9. Verify that wires at control panels are tagged with their service designation and approved tagging system.
10. Verify that spare I/O capacity has been provided.
11. Verify that DDC controllers are protected from power supply surges.

D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.6 CALIBRATION AND ADJUSTING

A. Check instruments for proper installation with respect to direction of flow, elevation, orientation, insertion depth, or other applicable considerations that impact performance. Check out installed products before continuity tests, leak tests, and calibration. Check instruments for proper location and accessibility.

B. Calibrate instruments. Make three-point calibration test for both linearity and accuracy for each analog instrument.

C. Calibrate equipment and procedures using manufacturer’s written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.

D. Control System Inputs and Outputs:

1. Check analog inputs at 0, 50, and 100 percent of span.
2. Check analog outputs using milliampere meter at 0, 50, and 100 percent output.
3. Check digital inputs using jumper wire.
4. Check digital outputs using ohmmeter to test for contact making or breaking.
5. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.

E. Pressure: Calibrate pressure transmitters at 0, 50, and 100 percent of span. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.

F. Temperature: Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source. Calibrate temperature switches to make or break contacts.

G. Pumps Controlled by a Variable Frequency Drive: Set the minimum allowable speed to be 20 Hertz, or as recommended by the respective pump manufacturer, whichever is higher.

H. Adjust initial temperature and humidity set points.

I. Stroke and adjust control dampers without positioners, following the manufacturer's recommended procedure, so that damper is 100 percent open and closed.

J. Stroke and adjust control dampers with positioners, following manufacturer's recommended procedure, so that damper is 0, 50, and 100 percent closed.

K. Provide diagnostic and test instruments for calibration and adjustment of system.

L. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.

M. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Refer to Division 01 Sections.

1. Provide a total of 32 hours of onsite training at a minimum of two sessions. The sessions shall have a minimum separation of one month.
2. Provide 40 hours of offsite classroom training for two people.

B. Perform field functional testing of the economizer for each air-handling unit, and complete Form NRCA-MCH-05-A NA7.5.4 *Air Economizer Controls Acceptance*. Submit the Certificate of Acceptance.

C. Record training videos on DVD disks. Coordinate training video with operation and maintenance manuals and classroom instruction for use by Owner in operating, maintaining, and troubleshooting. Owner shall have right to make additional copies of training DVD for internal use without paying royalties.

END OF SECTION 230900

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SECTION 232300 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes refrigerant piping used for air-conditioning applications.

1.2 RELATED DOCUMENTS

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

B. Section 230500 “Basic Mechanical Materials and Methods” all apply to the work of this Section as if fully repeated herein.

1.3 PERFORMANCE REQUIREMENTS

A. Line Test Pressure for Refrigerant R-407C: 380 psig (2620 kPa).

B. Line Test Pressure for Refrigerant R-410A: 535 psig (3689 kPa).

1.4 SUBMITTALS

A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop, based on manufacturer’s test data, for the following:

1. Thermostatic expansion valves.
2. Solenoid valves.
3. Hot-gas bypass valves.
4. Filter dryers.
5. Strainers.
6. Pressure-regulating valves.

B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.

1. Shop Drawing Scale: 1/4 inch equals 1 foot (1:50)
2. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.

C. Welding certificates.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

B. Comply with ASHRAE 15-2016 *Safety Code for Refrigeration Systems*.

C. Comply with ASHRAE 34-2016 *Designation and Safety Classification for Refrigerants*.

D. Comply with ASME B31.5 *Refrigeration Piping and Heat Transfer Components*.

E. Comply with NFPA 70 – National Electrical Code.

F. Buy-American: All piping shall be furnished from domestic sources (USA).

1.6 PRODUCT STORAGE AND HANDLING

A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

1.7 COORDINATION

A. Coordinate size and location of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Copper Tube: ASTM B 280, Type ACR.

B. Wrought-Copper Fittings: ASME B16.22.

C. Wrought-Copper Unions: ASME B16.22.

D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.

E. Brazing Filler Metals: AWS A5.8.

F. Flexible Connectors:

1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
2. End Connections: Socket ends.
3. Offset Performance: Capable of minimum ¾-inch (20-mm) misalignment in minimum 7-inch- (180-mm-) long assembly.

4. Pressure Rating: Factory test at minimum 500 psig (3450 kPa).
5. Maximum Operating Temperature: 250°F (121°C).

2.2 VALVES AND SPECIALTIES

A. Packed-Angle Valves:

1. Body and Bonnet: Forged brass or cast bronze.
2. Packing: Molded stem, back seating, and replaceable under pressure.
3. Operator: Rising stem.
4. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
5. Seal Cap: Forged-brass or valox hex cap.
6. End Connections: Socket, union, threaded, or flanged.
7. Working Pressure Rating: 500 psig (3450 kPa).
8. Maximum Operating Temperature: 275°F (135°C).

B. Check Valves:

1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
2. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
3. Piston: Removable polytetrafluoroethylene seat.
4. Closing Spring: Stainless steel.
5. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
6. End Connections: Socket, union, threaded, or flanged.
7. Maximum Opening Pressure: 0.50 psig (3.4 kPa).
8. Working Pressure Rating: 500 psig (3450 kPa).
9. Maximum Operating Temperature: 275°F (135°C).

C. Service Valves:

1. Body: Forged brass with brass cap including key end to remove core.
2. Core: Removable ball-type check valve with stainless-steel spring.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Copper spring.
5. Working Pressure Rating: 500 psig (3450 kPa).

D. Thermostatic Expansion Valves: Comply with ARI 750.

1. Body, Bonnet, and Seal Cap: Forged brass or steel.
2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Packing and Gaskets: Non-asbestos.
4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
5. Suction Temperature: [40°F (4.4°C)]
6. Superheat: [Nonadjustable].
7. Reverse-flow option (for heat-pump applications).
8. End Connections: Socket, flare, or threaded union.
9. Working Pressure Rating: [450 psig (3100 kPa)]

E. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Atofina Chemicals, Inc.
2. DuPont Company; Fluorochemicals Div.
3. Honeywell, Inc.; Genetron Refrigerants.
4. INEOS Fluor Americas LLC.

F. Refrigerants R-407C, and R-410A are defined in ASHRAE Standard 34-2016.

2.3 PIPE INSULATION

A. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C534, Type I for tubular materials and Type II for sheet materials.

1. Thermal Conductivity: 0.28 average maximum at 75ºF mean temperature using test method ASTM C177 or C518.
2. Water Vapor Permeability: Maximum 0.1 perm-inch using test method ASTM E96 Procedure A.
3. Water Absorption: Maximum 0.2% by volume using test method ASTM C209.
4. Product shall pass mold growth, fungi resistance, and bacterial resistance tests per UL 181, ASTM G21, G22, and C1338.
5. Adhesive: Comply with MIL-A-24179A, Type II, Class I; VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Suction, Hot-Gas, and Liquid Lines: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints. Soldered joints will be acceptable for R-134a applications only.

B. Safety-Relief-Valve Discharge Piping: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with soldered joints.

3.2 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

B. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook." Permitted only with R-134a piping systems.

C. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube." Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.

3.3 HANGERS AND SUPPORTS

A. Hanger, support, and anchor products and spacing are specified in Division 23 Section “Hangers and Supports.”

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Comply with ASME B31.5, Chapter VI.
2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 “Performance Requirements” Article. Fill system with nitrogen to the required test pressure. System shall maintain test pressure at the manifold gage throughout duration of test. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.5 SYSTEM CHARGING

A. Charge system using the following procedures:

1. Install core in filter dryers after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers (67 Pa). If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig (14 kPa).
4. Charge system with a new filter-dryer core in charging line.

3.6 PIPE INSULATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application. Verify that systems to be insulated have been tested and are free of defects. Verify that surfaces to be insulated are clean and dry. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

C. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.

D. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified.

E. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

F. Install insulation with longitudinal seams at top and bottom of horizontal runs. Install multiple layers of insulation with longitudinal and end seams staggered.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer. Install insulation with least number of joints practical.

I. Refrigerant suction and hot gas piping indoors 1-inch thick Flexible Elastomeric and outdoors 2-inch thick Flexible Elastomeric with stainless steel jacket.

3.7 ADJUSTING

A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.

B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.

D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:

1. Open shutoff valves in condenser water circuit.
2. Verify that compressor oil level is correct.
3. Open compressor suction and discharge valves.
4. Open refrigerant valves except bypass valves that are used for other purposes.
5. Check open compressor-motor alignment and verify lubrication for motors and bearings.

E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 232300

SECTION 233423 – FANS AND VENTILATORS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Utility set fans.
2. In-line centrifugal fans.
3. Propeller fans.

1.2 RELATED DOCUMENTS

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

B. Section 230500 “Basic Mechanical Materials and Methods” all apply to the work of this Section as if fully repeated herein.

C. The following Sections contain requirements that relate to this Section:

1. Division 23 Section “Motors” specifies the motors required for use with fans.
2. Division 23 Section “HVAC Instrumentation and Controls” for control devices.

D. Products furnished, but not installed, under this Section include roof curbs for roof-mounted exhaust fans.

E. Stand-alone fans are specified herein. Refer to other Division 23 Sections for fans which are an integral part of packaged equipment.

F. Specialty laboratory exhaust fans.

1.3 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base fan-performance ratings on sea level, unless noted otherwise.

B. Operating Limits: Classify according to AMCA 99-16.

C. Fan Unit Schedule: The following information is specified in an equipment schedule on the Drawings.

1. Fan performance data including capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
2. Fan arrangement including wheel configuration, inlet and discharge configurations, and required accessories.

1.4 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 01 Specification Sections.

B. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:

1. Certified fan performance curves with system operating conditions indicated.
2. Certified fan sound-power ratings.
3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
4. Material thickness and finishes, including color charts.
5. Dampers, including housings, linkages, and operators.
6. Roof curbs.
7. Fan speed controllers.

C. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

D. Wiring Diagrams: Detail wiring for power and control systems, and differentiating clearly between manufacturer-installed and field-installed wiring.

E. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Roof framing and support members relative to duct penetrations.
2. Ceiling suspension assembly members.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

F. Field quality-control test reports.

G. Operation and Maintenance Data: For fans and ventilators to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. AMCA Compliance: All fans and ventilators shall bear the AMCA Certified Ratings Program seal for Air and Sound Performance. In addition, compliance with either one or both of the following two subparagraphs is required.

1. All fans and ventilators shall bear the AMCA Certified Ratings Program seal for Fan Efficiency Grade (FEG).

2. All fans and ventilators shall bear the AMCA Certified Ratings Program seal for Fan Energy Index (FEI).

C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

D. UL Standard: Power ventilators shall comply with UL 705.

E. UL Listing: For smoke exhaust applications, provide only fans which are specifically UL-Listed as "Power Ventilators for Smoke Control Systems" which includes UL 705 "Power Ventilators" and UL 793 "Automatically Operated Roof Vents for Smoke and Heat;" tested and listed by UL to operate for 4 hours at 500ºF and 15 minutes at 1000ºF.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.

B. Disassemble and reassemble units, if required for moving to final location, according to manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

1.7 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Sections.

1.8 EXTRA MATERIALS

A. Furnish one complete set of belts for each belt-driven unit that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS APPLICABLE TO ALL FANS AND VENTILATORS

A. Manufacturers: Subject to compliance with requirements, provide fans and ventilators by one of the following:

1. Carnes Company.
2. Greenheck Inc.
3. JenCo Fan.
4. PennBarry, division of Air System Components.
5. Twin City Fan Company.

B. Single Source: All fans of any given type shall all be provided by the same manufacturer.

C. Motors: Refer to Division 23 Section "Motors" for general requirements for factory-installed motors, whose requirements apply to the work of this Section as if fully repeated herein.

1. Motor Construction: NEMA MG 1, general purpose, continuous duty, Design B.
2. Enclosure Type: Open drip-proof, where satisfactorily housed; guarded drip-proof, where subject to contact by employees, maintenance staff, or building occupants.
3. Motor Sizes: Minimum size as indicated, but larger if necessary so driven load will not require motor to operate in service factor range at design point, and larger if necessary so driven load will not require motor to operate beyond the service factor at any point on the fan curve.
4. Provide inverter-ready or inverter-duty motors with shaft grounding rings as specified in Division 23 Section "Motors" everywhere variable speed drives are indicated.

D. Disconnect Switch: Provide a factory-installed and pre-wired non-fused disconnect switch for all fans and ventilators, unless specifically noted otherwise.

E. Factory Finishes: Provide as follows.

1. Sheet Metal Parts: Prime coat before final assembly.
2. Exterior Surfaces: Baked-enamel finish coat after assembly. Finish shall pass a 1,000-hour salt spray test conducted per ASTM B117 method.
3. Aluminum Parts: No finish required.

F. Sound-Power Level Ratings: Comply with AMCA 301-14 *Methods for Calculating Fan Sound Ratings from Laboratory Test Data*. Factory test fans according to AMCA 300-14 *Reverberant Room Method for Sound Testing of Fans*.

G. Wheel Balance: Factory-balance all fan wheels in accordance with AMCA Standard 204-05 (R2012) *Balance Quality and Vibration Levels for Fans*.

H. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to ASHRAE Standard 51-2016 (ANSI/AMCA Standard 210-2016) *Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating*.

I. Fan Capacities and Characteristics: As scheduled on the Drawings.

2.2 UTILITY SET FANS

A. Description: Belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and accessories; suitable for outdoor unsheltered locations.

B. Housing: Bolted and welded construction utilizing corrosion-resistant fasteners, with side sheets fastened with a deep lock seam or welded to scroll sheets.

1. Housing Material: 14-gauge minimum thickness steel.
2. Housing Material: 0.100-inch minimum thickness aluminum.

3. Housing Discharge Arrangement: Field-adjustable to eight standard positions.

C. Fan Wheels: Single-width, single inlet; welded to cast-iron or cast-steel hub and spun-steel inlet cone, with hub keyed to shaft.

1. Blade Materials: Steel Blade Type: Backward inclined.
2. Spark-Resistant Construction: AMCA 99-16, Type A.

D. Fan Shaft: Fan Shaft: AISI C-1045 hot rolled steel and accurately turned, ground, and polished; keyed to wheel hub and designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.

E. Shaft Bearings: Pre-lubricated and sealed, self-aligning, pillow-block-type ball bearings with ABMA 9, L_{10} of 40,000 hours.

F. Belt Drives: Precision-machined cast iron type, keyed and securely attached to the wheel and motor shafts; factory mounted, with final alignment and belt adjustment made after installation.

1. Service Factor Based on Fan Motor Size: 1.4.
2. Motor Pulleys: Adjustable pitch for use with motors through 5 horsepower; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
3. Belts: Oil resistant, non-sparking, and non-static; matched sets for multiple belt drives.
4. Belt Guards: Fabricate of steel for motors mounted on outside of fan cabinet.

G. Required Accessories:

1. Inlet and Outlet: Flanged.
2. Companion Flanges: Rolled flanges for duct connections of same material as housing.
3. Backdraft Dampers: Gravity actuated with counterweight and interlocking aluminum blades with felt edges in steel frame installed on fan discharge.
4. Access Door: Gasketed door in scroll with latch-type handles.
5. Scroll Dampers: Single-blade damper installed at fan scroll top with adjustable linkage.
6. Inlet Screens: Removable wire mesh.
7. Drain Connections: NPS ¾ (DN 20) threaded coupling drain connection installed at lowest point of housing.
8. Weather Hoods: Weather resistant with stamped vents over motor and drive compartment.
9. Discharge Dampers: Assembly with parallel blades constructed of two plates formed around and to shaft, channel frame, sealed ball bearings, with blades linked outside of airstream to single control lever of same material as housing.
10. Variable Inlet Vanes: With blades supported at both ends with two permanently lubricated bearings of same material as housing. Variable mechanism terminating in single control lever with control shaft for double-width fans.
11. Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
12. Any other accessories as indicated via Schedule on Drawings.

H. Coatings: Color-match enamel.

1. Service Factor Based on Fan Motor Size: 1.4.

2. Motor Pulleys: Adjustable pitch for use with motors through 5 horsepower; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
3. Belts: Oil resistant, non-sparking, and non-static; matched sets for multiple belt drives.

I. Required Accessories:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Disconnect Switch: Non-fusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
3. Bird Screens: Removable, ½-inch (13-mm) mesh, aluminum or brass wire.
4. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops. 0.063-inch- (1.6-mm-) thick extruded aluminum frame, with mounting flange. 0.050-inch- (1.2-mm-) thick aluminum blades. Vinyl blade seals, mechanically locked into blade edge. Nonferrous blade axles. Aluminum tie bars and brackets. Adjustable tension return spring.
5. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops. Minimum 16-gauge galvanized sheet steel frame formed into a structural hat channel reinforced at the corners; 14-gauge blades of galvanized steel. Stainless steel bearings. Neoprene or rubber blade edge seals mechanically locked into blade edge. Stainless steel flexible compression jamb seals. Linkage concealed in frame. Square or hex steel axles mechanically locked to blade.
6. Label: A UL-762 label is required where fans are designated for kitchen hood exhaust service.
7. Label: A UL “Power Ventilators for Smoke Control Systems” label is required where fans are designated for smoke exhaust service.
8. Any other accessories as indicated via Schedule on Drawings.

J. Description: Centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and accessories. Provide direct-drive or belt-drive as indicated via Schedule on Drawings.

K. Housing: Bolted and welded construction utilizing corrosion-resistant fasteners. Removable, spun-aluminum, dome top and outlet baffle constructed of 16-gauge marine alloy aluminum; bolted to a square, one-piece, aluminum wall flange with venturi inlet cone. The top cap shall be removable for service access.

L. Fan Wheels: Aluminum hub, inlet cone, and wheel with backward-inclined blades. Fan and motor shall be isolated from exhaust airstream in a weather-tight compartment.

M. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.

N. Shaft Bearings: Pre-lubricated and sealed, self-aligning, pillow-block-type ball bearings with ABMA 9, L_{10} of 40,000 hours.

O. Belt Drives: Precision-machined cast iron type, keyed and securely attached to the wheel and motor shafts; resiliently-mounted to housing, with final alignment and belt adjustment made after installation.

1. Service Factor Based on Fan Motor Size: 1.4.
2. Motor Pulleys: Adjustable pitch for use with motors through 5 horsepower; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
3. Belts: Oil resistant, non-sparking, and non-static; matched sets for multiple belt drives.

P. Required Accessories:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Disconnect Switch: Non-fusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
3. Bird Screens: Removable, ½-inch (13-mm) mesh, aluminum or brass wire.
4. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in wall sleeve; factory set to close when fan stops. 0.063-inch- (1.6-mm-) thick extruded aluminum frame, with mounting flange. 0.050-inch- (1.2-mm-) thick aluminum blades. Vinyl blade seals, mechanically locked into blade edge. Nonferrous blade axles. Aluminum tie bars and brackets. Adjustable tension return spring.
5. Motorized Dampers: Parallel-blade dampers mounted in wall sleeve with electric actuator; wired to close when fan stops. Minimum 16-gauge galvanized sheet steel frame formed into a structural hat channel reinforced at the corners; 14-gauge blades of galvanized steel. Stainless steel bearings. Neoprene or rubber blade edge seals mechanically locked into blade edge. Stainless steel flexible compression jamb seals. Linkage concealed in frame. Square or hex steel axles mechanically locked to blade.
6. Wall Grille: Ring type for flush mounting.
7. Any other accessories as indicated via Schedule on Drawings.

2.3 PROPELLER FANS

A. Description: Propeller fans consisting of fan blades, hub, housing, orifice ring, motor, drive assembly, and accessories.

1. Provide direct-drive or belt-drive as indicated via Schedule on Drawings.
2. Provide intake or exhaust air direction as indicated via Schedule on Drawings.

B. Housing: 14-gauge galvanized steel wall panel with continuously-welded corners and integral venturi; with flanged edges and bolted construction using corrosion-resistant fasteners.

C. Fan Wheel: Replaceable, cast or extruded-aluminum blades riveted to a painted steel hub; factory set pitch angle of blades.

D. Fan Wheel: Replaceable, cast or extruded-aluminum blades riveted to cast-aluminum hub; factory set pitch angle of blades.

E. Fan Wheel: Formed-steel blades riveted to heavy-gage steel spider bolted to cast-iron hub.

F. Belt-Driven Drive Assembly: Resiliently mounted to housing, statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.

1. Service Factor Based on Fan Motor Size: 1.4.
2. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
3. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings of life ABMA 9, L_{10} of 40,000 hours.
4. Pulleys: Cast iron with split, tapered bushing; dynamically balanced at factory.
5. Motor Pulleys: Adjustable pitch for use with motors through 5 HP; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
6. Belts: Oil resistant, non-sparking, and non-static; matched sets for multiple belt drives.
7. Belt Guards: Fabricate of steel for motors mounted on outside of fan cabinet.

G. Required Accessories:

1. Gravity Shutters: Aluminum blades in aluminum frame; interlocked blades with nylon bearings.
2. Motor-Side Back Guard: 12-gauge galvanized steel wire guard, complying with OSHA specifications, removable for maintenance.
3. Wall Sleeve: Galvanized steel to match fan and accessory size.
4. Weathershield Hood: Galvanized steel to match fan and accessory size.
5. Weathershield Front Guard: Galvanized steel with expanded metal screen.
6. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
7. Any other accessories as indicated via Schedule on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements of installation tolerances and other conditions affecting performance of the fans and ventilators. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install fans and ventilators level and plumb, and in accordance with manufacturer’s written instructions.

B. Install fans and ventilators using vibration isolators. Vibration- and seismic-control devices are specified in Division 20 Section “Seismic Protection” and Division 23 Section “Mechanical Vibration Isolation.”

C. Install fans and ventilators using vibration isolators. Vibration-control devices are specified in Division 23 Section “Mechanical Vibration Isolation.”

D. Install fans and ventilators using vibration isolators. Vibration-control devices are specified in Part 2 of this Section.

E. Install floor-mounting units on concrete bases designed to withstand, without damage to equipment, the seismic force required by code. Concrete, reinforcement, and formwork

requirements are specified in Division 03 Section "Cast-in-Place Concrete." Secure vibration isolators and seismic controls to concrete bases using anchor bolts cast in concrete base.

F. Install floor-mounting units on concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete." Secure vibration isolators to concrete bases using anchor bolts cast in concrete base.

G. Roof-Mounted Fans: Place fan or ventilator onto roof curb and center. In cases where the gap between the 2 components is larger than ¾-inch (19 mm), install a wood filler strip on all 4 sides between the fan curb cap and the roof curb.

1. Refer to Division 07 Section "Roof Accessories" for installation of roof curbs.
2. Positively attach roof-mounting fan's curb cap to the roof curb using a minimum of two lag screws, anchor bolts, or other suitable metal fasteners per side. Use cadmium-plated hardware of at least ¼-inch; larger if recommended by manufacturer.

H. See Division 23 Section "Basic Mechanical Materials and Methods" for additional anchorage and concrete base requirements.

I. Install units with clearances for service and maintenance.

J. Label units according to requirements specified in Division 23 Section "Mechanical Identification."

K. Label units according to requirements specified in Division 23 Section "Basic Mechanical Materials and Methods."

3.3 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Duct Accessories."

B. Coordinate ducts, pipes, conduit, and other work adjacent to fans and ventilators to allow service and maintenance clearance in accordance with manufacturer's installation instructions.

C. Connect wiring and ground equipment according to Division 26 Sections.

3.4 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Lubricate bearings.

D. Testing, Adjusting and Balancing is the work of Division 23 Section "Testing, Adjusting, and Balancing", which shall include adjustment of fan to indicated rpm. After initial testing and balancing, the work of this Section shall include pulley/sheave replacement to meet operating

conditions indicated. Remove, size, select, and install the proper pulley/sheave sizes, to match specified performance.

1. Exception: Pulley/sheave replacement is not required for fans whose speed is controlled by a variable frequency drive, provided that specified performance can be met with speed controller at or below 100% output.
2. Exception: Pulley/sheave replacement is not required where pulley/sheave is adjustable in pitch.

3.5 CLEANING

A. On completion of installation, internally clean fans according to manufacturer's written instructions. Remove foreign material and construction debris. Vacuum fan wheel and cabinet.

B. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

3.6 FIELD QUALITY CONTROL

A. Manufacturer’s Field Service: Provide the services of a factory-authorized field service representative to inspect the installation of fans, including duct and electrical connections, and to report the results in writing. The field service representative shall perform, or shall witness the contractor’s performance of, the following field tests and inspections and prepare test reports.

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Adjust belt tension.
6. Adjust damper linkages for proper damper operation.
7. Verify lubrication for bearings and other moving parts.
8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
9. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
10. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
11. Shut unit down and reconnect automatic temperature-control operators.
12. Remove and replace malfunctioning units and retest as specified above.
13. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fans and ventilators. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.

B. Review data in maintenance manuals. Refer to Division 01.

C. Schedule training with Owner, through Architect, with at least seven days' advance notice.

D. Demonstrate operation of fans and ventilators. Conduct walking tour of the Project. Briefly identify location and describe function, operation, and maintenance of each fan and ventilator.

END OF SECTION 233423

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SECTION 238126 – SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes split-system air-conditioning and heat-pump units 5-tons and smaller, consisting of separate evaporator-fan and compressor-condenser components.

1.2 RELATED DOCUMENTS

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

B. Section 230500 “Basic Mechanical Materials and Methods” all apply to the work of this Section as if fully repeated herein.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

B. Wiring Diagrams: For power, signal, and control wiring.

C. Field quality-control reports.

D. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

E. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. AHRI Compliance: All split-system units shall be rated in accordance with Air-conditioning Heating Refrigeration Institute’s (AHRI) Standard 210 and bear the AHRI Certification label.

C. Fabricate and label refrigeration system to comply with ASHRAE 15-2019 *Safety Standard for Refrigeration Systems.*

D. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1-2016, Section 4 - “Outdoor Air Quality,” Section 5 - “Systems and Equipment,” Section 6 - “Procedures,” and Section 7 - “Construction and System Start-Up.”

E. Energy Compliance: No condensing unit and/or split-system will be accepted which does not meet Table 6.8.1 values in ASHRAE Standard 90.1-2016 *Energy Standard for Buildings Except Low-Rise Residential Buildings*.

1.5 COORDINATION

A. Coordinate sizes and locations of equipment supports, and wall penetrations with actual equipment provided.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-systems that fail in materials or workmanship within five (5) years from date of Substantial Completion. Failures include, but are not limited to, compressor failure and/or refrigerant coil leak.

1.7 EXTRA MATERIALS

A. Furnish one additional complete set of filters for each unit that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:

1. Daikin Applied Americas Inc.
2. LG Products.
3. Trane Technologies plc.

2.2 INDOOR UNITS, 5 TONS (18 kW) OR LESS

A. Ductless Wall Cabinet: Galvanized steel frame with enameled steel or extruded thermoplastic panels; with removable panels on front and ends in color selected by Architect. Insulate interior with faced glass-fiber duct liner insulation. Include integral, user-adjustable discharge grille.

B. Evaporator Coil: Seamless copper tube, with mechanically bonded aluminum fins and electronic expansion valve. Comply with AHRI 210/240.

C. Electric Heating Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow proving device, and one-time fuses in terminal box for overcurrent protection.

D. Fan: Direct-drive, centrifugal. The fan shall be statically and dynamically balanced, with permanently lubricated bearings.

E. Fan Motors: Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Division 23 Section “Motors.”

1. Multi-tapped, multispeed with internal thermal protection and permanent lubrication.
2. Wiring Terminations: Connect motor to chassis wiring with plug connection.
3. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.

F. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2016.

G. Condensate Drain Pans: Single-wall, stainless-steel sheet, fabricated with not less than one-percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends), and to direct water toward drain connection. Drain connection shall be located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.

H. Disposable Panel Filters: Comply with NFPA 90A; MERV-6 according to ASHRAE 52.2. Media shall be interlaced glass fibers sprayed with nonflammable adhesive.

2.3 OUTDOOR UNITS, 5 TONS (18 kW) OR LESS

A. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.

B. Scroll Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor. Reciprocating compressors will not be accepted.

C. Refrigerant Charge: R-407C or R-410A.

D. Condenser Coil: Seamless copper tube, with mechanically bonded aluminum fins and liquid subcooler; or microchannel coil of all-aluminum assembled via brazing. Comply with AHRI 210/240. The coil shall be protected with an integral metal guard.

E. Refrigerant Circuit: Each circuit shall include a thermal expansion valve, refrigerant charging connections, compressor suction and discharge shutoff valves, a liquid-line shutoff valve, a replaceable-core filter drier, a sight glass with moisture indicator, a liquid-line solenoid valve, and an insulated suction line; all of which are specified elsewhere in this Section.

F. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.

G. Condenser Fan: Aluminum-propeller type, directly connected to motor. The fan shall be provided with a safety guard to prevent human contact with moving parts

H. Fan Motor: Permanently lubricated, with integral thermal-overload protection.

I. Low Ambient Kit: Permit operation down to 5ºF (2 C).

J. Mounting Base: Polyethylene.

K. Enclosure: Furnish and ship loose for field installation, manufacturer's heavy-gage wire-mesh screen or louvered skirt to protect machine from entry by unauthorized personnel. Such screen or skirt shall mount directly to the machine and completely enclose or protect all exposed parts, including but not limited to fans, compressors, piping, controls, and accessories.

2.4 VALVES AND SPECIALTIES

A. General: All of the following devices are required as either factory-installed and pre-piped; or field-provided if not factory-provided. All of the following devices shall be Working Pressure Rated for 500 psig (3450 kPa) at an Operating Temperature of 240ºF (116ºC).

B. Service Valves:

1. Body: Forged brass with brass cap including key end to remove core.
2. Core: Removable ball-type check valve with stainless-steel spring.
3. Seat: PTFE.
4. End Connections: Copper spring.

C. Flexible Connectors:

1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
2. End Connections: Socket ends.
3. Offset Performance: Capable of minimum ¾-inch (20-mm) misalignment in minimum 7-inch-(180-mm-) long assembly.

D. Solenoid Valves: Comply with AHRI 760 and UL 429; listed and labeled by UL or ETL.

1. Body and Bonnet: Plated steel.
2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
3. Seat: PTFE.
4. End Connections: Threaded.
5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with ½-inch conduit adapter, and coil voltage coordinated with Condensing Unit.

E. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.

1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
2. Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Seat Disc: PTFE.
4. End Connections: Threaded.

F. Thermostatic Expansion Valves: Comply with AHRI 750.

1. Body, Bonnet, and Seal Cap: Forged brass or steel.
2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Packing and Gaskets: Non-asbestos.

4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
5. End Connections: Socket, flare, or threaded union.

G. Strainers:

1. Body: Welded steel with corrosion-resistant coating.
2. Screen: 100-mesh stainless steel.
3. End Connections: Socket or flare.

H. Moisture/Liquid Indicators:

1. Body: Forged brass.
2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
3. Indicator: Color coded to show moisture content in ppm.
4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
5. End Connections: Socket or flare.

I. Replaceable-Core Filter Dryers: Comply with AHRI 730.

1. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated alumina.
4. End Connections: Socket.

2.5 ACCESSORIES

A. Control equipment is specified in Division 23 Section “HVAC Instrumentation and Controls.”

B. Thermostat: Low voltage with sub-base to control compressor and evaporator fan.

C. Thermostat: Wireless infrared functioning to remotely control compressor and evaporator fan, with the following features:

1. Compressor time delay.
2. 24-hour time control of system stop and start.
3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
4. Fan-speed selection including auto setting.

D. Automatic-reset timer to prevent rapid cycling of compressor.

E. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.

2.6 CAPACITIES AND CHARACTERISTICS

A. Capacities and characteristics are scheduled on the Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units level and plumb, and in accordance with manufacturer's written installation instructions. Set equipment supports so top surface of equipment is level.

B. Install evaporator-fan and compressor-condenser components using manufacturer's standard mounting devices securely fastened to building structure.

C. Install components on resilient mountings as further specified in Division 23 Section "Mechanical Vibration Isolation."

D. See Division 23 Section "Basic Mechanical Materials and Methods" for additional anchorage requirements.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

1. Install and connect pre-charged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit. If manufacturer's pre-charged refrigerant tubing is of insufficient length, field-provide copper ACR refrigeration tubing with brazed joints.
2. Condensate Drain: Plastic drain hose is not acceptable. Field-furnish and install copper DWV piping.
3. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

B. Insulate all field piping as further specified in Division 23 Section "Refrigerant Piping."

C. Connect wiring and ground equipment in accordance with Division 26 Sections.

D. Furnish and install signal and control wiring, including but not limited to interconnection between condensing unit associated evaporator unit, as the work of this Section but meeting all applicable requirements of Division 23 Section "HVAC Instrumentation and Controls."

3.3 SYSTEM CHARGING

A. Charge system using the following procedures:

1. Install core in filter dryers after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
4. Charge system with a new filter-dryer core in charging line.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Required Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

D. Prepare and submit test and inspection reports.

3.5 CLOSEOUT

A. Engage a factory-authorized service representative to perform startup service, and to train Owner's maintenance personnel to adjust, operate, and maintain units. Complete installation and startup checks according to manufacturer's written instructions.

END OF SECTION 238126

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SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. This Section specifies the basic requirements for electrical installations and includes requirements common to all sections of Division 26. It expands and supplements the requirements specified in sections of Division 00.

B. Drawings and general provisions of the Contract, including general and supplementary conditions and specification sections Divisions 00 through 01, apply to this Section.

C. Codes and Standards: All equipment, material and installations shall comply with applicable codes, standards, and installation practices. Comply with the requirements of the applicable local building codes, the applicable NEC, all local rules and regulations including those of the fire authorities. Comply with all applicable NFPA standards. All material and equipment shall be listed by the Underwriters Laboratories (UL) standard that is applicable for the specific purpose of the material and equipment. The National Electrical Code, National Electrical Manufacturer's Association (NEMA) Standards, and applicable ANSI and IEEE standards shall apply to the pertinent materials, equipment, and installation practices. Testing shall be in accordance with the applicable International Electrical Testing Association (NETA) standards.

1. These specifications include references to the 2017 edition of the NFPA 70 "National Electrical Code." Where a different edition of the NEC has been adopted by the local Authority Having Jurisdiction, the references associated with that edition of the Code shall be applicable.

1.2 SUMMARY OF WORK

A. The word "furnish" means supply for use, the word "install" means install in its proper location and connect up complete and ready for operation, and the word "provide" means to furnish and install.

B. Provide all new materials as indicated on the drawings and specifications and all items required to make the electrical system complete and in working order.

C. System descriptions included in scope of work are as follows:

1. Electrical power systems, including luminaires, distribution equipment, motors, wiring devices, etc.
2. Grounding system.
3. Fire alarm system.
4. Power and communications for temperature control system.
5. Wiring of equipment furnished by the Owner or other Divisions.
6. Selective demolition work and modification of existing systems and equipment.
7. Low voltage systems as described in Divisions 27 and 28.
8. Low voltage systems rough-in, as indicated on drawings, for installation of low voltage equipment by others.

D. Work not included:

1. Temperature control wiring for plumbing and HVAC equipment (unless otherwise indicated) shall be by other Divisions.

1.3 WORK SEQUENCE

A. All work that produces excessive noise or interference with normal building operations shall be coordinated and scheduled with the Owner. Such work may require scheduling of work after occupied hours or weekends. The Owner reserves the right to determine when such work is conducted.

1.4 QUALITY ASSURANCE

A. Responsibility Prior to Submitting Pricing or Bid Data:

1. Thoroughly review the contract documents and specifications and visit the site prior to issuing bid. Resolve all reported deficiencies with the Engineer prior to awarding any subcontracts, ordering material, or starting any work.

B. Qualifications:

1. Only products of specified manufacturers, or approved equals as determined by the Engineer, are acceptable.
2. Employ only workmen who are skilled in their trades.

C. Compliance with Codes, Laws, and Ordinances:

1. Conform to all requirements of the state, city and local codes, laws and ordinances and other regulations having jurisdiction over this installation.
2. If there are any discrepancies between the codes and regulations and these specifications, the Engineer shall determine the method or equipment to be used.
3. Inform the Engineer in writing, requesting a clarification at the time of the bidding, if any parts of the drawings or specifications are found not to comply with the codes or regulations. Submit a separate price to make the system comply if there is insufficient time for this procedure.
4. Inform the Engineer in writing requesting a clarification if there is any discrepancy between a manufacturer's recommendation and these specifications.
5. Follow the current issue of NFPA 70 "National Electrical Code" if there are no local codes having jurisdiction.

D. Examination of Drawings:

1. The drawings for the indicated work are diagrammatic, intended to convey the scope of the electrical work and to indicate the general arrangements and locations of equipment, wiring devices, etc., and the approximate sizes of equipment. Field verification of dimensions on plans is required. The actual conditions, including heights, lengths and orientation shall be the basis of the work.
2. The architectural, structural, mechanical and electrical drawings and specifications shall be considered as mutually explanatory and complementary. Any electrical work called

for by one and not by the other shall be performed as though required by all. All sections and subsections of the Electrical work shall be governed by and subject to the general and supplementary conditions. Report any discrepancies in or between the drawings and specifications, or between the drawings and actual field conditions to the Engineer in sufficient time to issue an addendum for clarification.

3. Determine the exact locations for equipment and rough-ins, and the exact routing of raceways.
4. Do not scale drawings to determine equipment and system locations.
5. Not all required components are shown on the documents, including junction boxes, pull boxes, conduit fittings, etc. Provide all components required for proper installation of the work.
6. Any item either shown on the drawings or called for in the specifications shall be included in this contract.
7. Determine quantities and quality of material and equipment required from the documents. Provide the more expensive or higher quality amount where discrepancies arise among drawings, schedules or specifications.

E. Electronic Media and Files:

1. Electronic media files of the contract drawings in AutoCAD or PDF format and copies of the specifications in PDF format may be requested.
2. Complete and return a signed “Electronic File Transmittal” form provided by Introba upon request for electronic media.
3. Obtain approval from the appropriate Design Professional for use of their part of the documents if the information requested includes information prepared by other than Introba.
4. The electronic contract documents may be used for preparation of shop drawings and record drawings only. The information may not be used in whole or in part for any other project.
5. The drawings prepared by Introba for bidding purposes may not be used directly for raceway layout drawings or coordination drawings.
6. The use of these documents does not allow relief from the responsibility for coordination of work with other trades and verification of space available for the installation.
7. The information is provided to expedite the project with no guarantee by Introba as to the accuracy or correctness of the information provided. Introba accepts no responsibility or liability for the use of the provided information.

1.5 ROUGH-IN

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

B. Coordinate equipment rough-in requirements with Divisions 02 through 28.

1.6 SUBMITTAL REVIEW RESPONSIBILITIES

A. General: Submittals are not requested for all products covered in the specifications. Submit only the data requested under the submittals portion of each specification section or where indicated in a Submittal Log, if included within Division 01. Un-requested submittals will not be processed or reviewed and will be returned to the submitter. Refer to “Submittal Register” for

all required submissions of each specification section. All required submissions of that specification section are to be submitted for review in one all-inclusive submission. Any deviation from specified items is considered a substitution.

1. Non-requirement of submittals, when so noted, is not to be construed as an allowance for substitutions and does not provide relief from full compliance with the contract documents.
2. Any deviation from specified items is considered a substitution. A formal request for substitution must be submitted prior to bid date (no exceptions), in accordance with the procedures and time limitations set forth in Division 02, if the use of other than specified items is being proposed. Where not defined in Division 01, requests for substitutions shall be submitted no less than ten (10) working days prior to bid date. The submitter must pay the engineer for review of substitution requests. Charges for this substitution review will be calculated based on the Engineer's standard hourly rates, as defined in their contract with the Owner.

B. Definitions:

1. Product Data: Pre-printed manufacturer's data.
2. Shop Drawings: Drawings made specifically for the manufacture of a particular piece of equipment to be used on this project.
3. Operation and Maintenance Data: Information containing instructions on the proper operation, maintenance and repair of the equipment, complete with written text, diagrams, photos, exploded views and parts lists.
   Record Documents: Information indicating the actual installed conditions of the project on Mylar, electronic media, photographs or typed paper. Photographs are not allowed as a substitute for correcting the construction documents; the photographs are for the Owner's future reference. Submit type, quantities and on media specified where indicated to be submitted.

C. Where more than one model is shown on a manufacturer's sheet, clearly indicate exactly which item and which data is relevant to the work.

D. Where the manufacturer lists multiple part numbers or options on a single data sheet, the part number and options to be used shall be clearly set apart from other part numbers shown on that sheet.

E. Ensure that all submittals have been reviewed for total completeness and accuracy as to the requirements of the specifications and drawings before being submitted to the Engineer for review. The Contractor's approval stamp is required on all submittals before submittal to the Engineer. Approval will indicate the Contractor's review of all material and a complete understanding of exactly what is to be furnished. Clearly mark all deviations from the contract documents on all submittals. The item shall be required to meet all drawing and specification requirements if deviations are not clearly marked.

1. One comprehensive submittal shall be provided for each individual specification section. All required submittal information called for in each individual specification section shall be included in the submittal. Partial or incomplete submissions will be rejected.

2. The Engineer shall not be responsible for informing the submitter on items that have not been included and are necessary for a complete review of the required submittal information for a specification section.
3. The Engineer shall have the option of returning any submittal, unmarked, if all required documentation called for in the specifications has not been provided in the submittal.
4. The Engineer shall review each submittal no more than two times and return to the submitter with the appropriate disposition.
5. If the Engineer is required to review a submittal a second time, it will be limited to review of the changed information, which must clearly be highlighted by the submitter. The submittal will be returned to the submitter with the appropriate disposition.
6. If the submittal is required to be reviewed a third time, it shall be done at the expense of the submitter. Charges for this additional submittal review will be calculated based on the Engineer's standard hourly rates, as defined in their contract with the Owner.

F. Operation and Maintenance Manuals: All items required for insertion into each Operation and Maintenance (O&M) Manual are called out in the submittals portion of each specification section or in a Submittal Log, if included within Division 01. Ensure that the O&M submittal has been reviewed and includes all the requirements of the specifications. Submit only the data requested under the submittals portion of each specification section. FAX or photo copies are not allowed as submittals for operating and maintenance manuals. The Engineer will review the submittal for the Operation and Maintenance Manual one time and return to the submitter with the appropriate disposition.

1. If the submittal is required to be reviewed a second time, it shall be done at the expense of the submitter. Charges for this additional submittal review will be calculated based on the Engineer's standard hourly rates, as defined in their contract with the Owner.
2. Submittals for the Operation and Maintenance Manual must be original documentation.
3. Photo copies of marked up Operations and Maintenance submittals are not acceptable.

G. Coordination Drawings: Prepare and submit Coordination Drawings as further described herein and as indicated in the Special Conditions. Provide the Engineer with one copy of all coordination drawings supplied to the Owner when required in this specification. Coordinate the work as outlined herein. Receipt by the Engineer of a copy of the coordination drawings is to verify conformance to the submittal requirements set forth in this specification section. It is not an admission by the Engineer as to the accuracy or completeness of the coordination proposed.

H. Refer to Division 01 and each individual Division 26 Section for additional submittal requirements.

1.7 PRODUCT OPTIONS AND MATERIAL SUBSTITUTIONS

A. Where two or more materials are listed in the "Part 2 – Products" subsection of any Division 26, 27 or 28 section, do not assume that the selection of materials is an option. Refer to "Part 3 – Execution" subsection of that same specification section for an explanation of which specific material(s) shall be used for which specific application(s). For example, Part 2 may list several types and grades of conductors, and Part 3 will describe which type and grade of conductors to use for a given application.

B. When two or more items of same material or equipment are required they shall be of the same manufacturer. Product manufacturer uniformity does not apply to raw materials, bulk materials,

wire, conduit, fittings, sheet metal, steel bar stock, welding rods, solder, fasteners, motors for dissimilar equipment units, and similar items used in Work except as otherwise indicated.

C. Provide products which are compatible within systems and other connected items.

D. Substitutions: Products other than those specified must be submitted, approved and secured in writing from the Engineer via Addendum. If requested, a sample of the proposed substitution must be submitted to the Engineer for evaluation. This sample shall be supplied at no cost to the Engineer, and will be returned to the submitter, at the submitter's expense at the end of the evaluation period.

E. Where several manufacturers' names are given, the manufacturer for which a catalog number is given is the basis of design and establishes the quality required.

F. Any material, article or equipment of other unnamed manufactures which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured in writing from the Engineer via Addendum. Assume all costs incurred as a result of using the offered material, article or equipment, including the part of other Divisions whose work is affected.

G. Voluntary add or deduct prices for alternate materials may be listed on the bid form. These items will not be used in determining the low bidder. Assume all costs incurred as a result of using the offered material or equipment on his part or on the part of other Divisions whose work is affected.

H. All material substitutions requested after the final Addendum must be listed as voluntary changes on the bid form.

1.8 PRODUCT, DELIVERY, STORAGE, HANDLING AND MAINTENANCE

A. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels and similar information needed for distinct identifications; adequately packaged and protected to prevent damage during shipment, storage and handling. Protect stored equipment and materials from damage.

B. Coordinate deliveries of electrical materials and equipment to minimize construction site congestion. Limit each shipment of materials and equipment to the items and quantities needed for the smooth and efficient flow of installations. Review the site prior to bid for path locations and any required building modifications to allow movement of equipment.

C. Exercise care in transporting and handling to avoid damage to materials. Store materials on the site to prevent damage.

D. Keep all materials clean, dry and free from damaging environments.

1.9 MISCELLANEOUS MATERIALS

A. Miscellaneous Materials Include:

1. Miscellaneous metals for support of electrical materials and equipment.
2. Wood grounds, nailers, blocking, fasteners and anchorage for support of electrical materials and equipment.
3. Concrete bases for equipment.
4. Sealers for sealing around electrical materials and equipment; and for sealing penetrations in floors and walls.
5. Access panels and doors in walls, ceilings, and floors for access to electrical materials and equipment.

1.10 WARRANTIES

A. Refer to the Division 01 “Closeout Procedures” for procedures and submittal requirements for warranties. Refer to individual equipment specifications for warranty requirements.

B. Compile and assemble the warranties specified in Divisions 26, 27 and 28 into a separated set of vinyl covered, three-ring binders, tabulated and indexed for easy reference.

C. Provide complete warranty information for each item to include product or equipment, date of beginning of warranty or bond; duration of warranty or bond; and names, addresses, telephone numbers and procedures for filing a claim and obtaining warranty services.

D. Warranty requires correction of all work found to be defective or nonconforming to the Contract Documents, without cost to the Owner. Bear all costs associated with corrective measures and damage due to defects or nonconformance with the Contract Documents, excluding repairs required as a result of improper maintenance or operation, or normal wear and tear as determined by the Engineer.

PART 2 - PRODUCTS

2.1 MISCELLANEOUS LUMBER

A. All lumber shall be fire-treated.

B. Framing Materials: Standard Grade, light-framing-size lumber of any species. Number 3 Common or Standard Grade boards complying with WCLIB or AWPA rules, or Number 3 boards complying with SPIB rules. Lumber shall be preservative-treated in accordance with AWPB LP-2, and kiln-dried to a moisture content of not more than 19 percent.

2.2 ACCESS DOORS

A. Steel Access Doors and Frames: Factory-fabricated and assembled units, complete with attachment devices and fasteners ready for installation. Joints and seams shall be continuously welded steel, with welds ground smooth and flush with adjacent surfaces.

B. Frames: 16-gage steel, with a 1-inch-wide exposed perimeter flange for units installed in unit masonry, pre-cast, or cast-in-place concrete, ceramic tile or wood paneling.

C. For Installation in Masonry, Concrete, Ceramic Tile, or Wood Paneling: 1 inch-wide-exposed perimeter flange and adjustable metal masonry anchors.

D. For Gypsum Wallboard or Plaster: Perforated flanges with wallboard bead.

E. For Full-Bed Plaster Applications: Galvanized expanded metal lath and exposed casing bead, welded to perimeter of frame.

F. Flush Panel Doors: 14-gage sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees; factory-applied prime paint.

G. Fire-Rated Units: Insulated flush panel doors with continuous piano hinge and self-closing mechanism.

H. Locking Devices: Flush, screwdriver-operated cam locks.

I. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Bar-Co., Inc.
2. J.L. Industries.
3. Karp Associates, Inc.
4. Milcor Div. Inryco, Inc.
5. Nystrom, Inc.

2.3 SLEEVES FOR RACEWAYS AND CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Sleeves for Rectangular Openings: Galvanized sheet steel.

1. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section “Penetration Firestopping.”

2.4 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Manufacturers: Subject to compliance with requirements. Provide products by one of the following:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.

c. GPT Link-Seal
d. Metraflex Co.
e. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
3. Pressure Plates: Plastic. Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.
5. Place head end of bolts on accessible side of wall to allow for future adjustments.

2.5 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time and recommended for interior and exterior applications.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounted items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right-of-Way: Give to piping systems installed at a required slope.

F. Jobsite Safety: The Contractor is the sole entity responsible for jobsite safety.

3.2 EXAMINATION

A. Examine substrates, areas, and conditions, with installer present, for compliance with requirements for installation tolerances and other conditions affecting installation and application of sealants and access panels. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Install equipment and materials in accordance with manufacturer instructions and the requirements in Section 20 0800 "Seismic Protection."

3.3 ROUGH-IN

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

B. Coordinate equipment rough-in requirements with Divisions 01 through 28.

3.4 ELECTRICAL INSTALLATIONS

A. Coordinate electrical equipment and materials installation with other building components.

B. Verify all dimensions by field measurements.

C. Arrange for chases, slots, and openings in other building components to allow for electrical installations.

D. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components as they are constructed.

E. Sequence, coordinate and integrate installations of electrical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing-in the building.

F. Coordinate connection of electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.

G. Install systems, materials and equipment to conform to project requirements and approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Engineer.

H. Systems, materials and equipment which will be exposed in finished areas shall be installed level and plumb, parallel and perpendicular to other building systems and components.

I. Install electrical services and overhead equipment to provide the maximum headroom possible where mounting heights are not detailed or dimensioned.

J. Install electrical equipment to facilitate maintenance and repair or replacement of equipment components. Maintain code clearances in front of and about all electrical equipment. As much as practical, connect equipment for ease of disconnecting with minimum of interference with other installations.

K. Coordinate the installation of electrical materials and equipment above ceilings with suspension system, mechanical equipment and systems and structural components.

L. Include in the Work all labor, materials, equipment, services, apparatus and drawings (in addition to the Contract Documents) as required to complete the intended Work.

M. Control and interlock wiring shall be installed in a separate raceway and shall not be installed in the same raceway as power conductors.

N. Only new, clean and perfect equipment, apparatus, materials and supplies of latest design and manufacture shall be incorporated in the Work in order to assure an electrical system of high quality.

O. The Work required in order to obtain utility services such as telephone and electric, is delineated in these specifications and on the drawings. Unless otherwise noted, construction or connection charges (except for temporary power) by those companies shall be paid by the Owner.

P. Determine electrical utility elevations prior to installation and coordinate with other trades. Installation priorities at a minimum shall be as follows:

1. Luminaires.
2. Gravity flow piping, including steam and condensate.
3. Electrical bus duct.
4. Sheet metal.
5. Cable trays, including access space.
6. Other piping.
7. Conduits and wireway.

3.5 CONNECTIONS TO EQUIPMENT AND APPLIANCES

A. In many instances the drawings show an outlet box and power supply for specific equipment, be it Owner- or Contractor-furnished. It is to be understood, unless otherwise noted, that the Work includes a connection from the box to the equipment or appliance. Verify circuit conductor quantities and sizes and overcurrent device number of poles and rating as well as any special grounding requirements, for all Owner-furnished equipment and adjust the required work accordingly.

B. Owner Furnished Equipment:

1. Install and connect Owner-supplied items electrical items indicated on Architectural Equipment Plans and Schedules even if not shown on the electrical plans. Connect all Owner-supplied items requiring electrical connections, whether or not shown on the electrical plans. Make all electrical system connections required for fully functional units.
2. The Owner will supply manufacturer’s installation data for new equipment purchased by owner for this project.
3. Repair all damage to Owner-furnished equipment caused during installation, to the satisfaction of the Owner.

3.6 CUTTING AND PATCHING

A. General: Perform cutting and patching in accordance with Division 01 Section "Execution." In addition to the requirements specified in Division 01, the following requirements apply:

1. Perform cutting, fitting and patching of electrical equipment and materials required to:

a. Uncover Work to provide for installation of ill-timed Work.
b. Remove and replace defective Work.
c. Remove and replace Work not conforming to requirements of the Contract Documents.
d. Remove samples of installed Work as specified for testing.
e. Install equipment and materials in existing structures.
f. Cut, remove, and legally dispose of selected electrical equipment, components, and materials as indicated, including but not limited to, removal of electrical items indicated to be removed and items made obsolete by the new Work.

2. Coordinate the cutting and patching of building components to accommodate the installation of electrical equipment and materials.

a. Protect the structure, furnishings, finishes and adjacent materials not indicated or scheduled to be removed.
b. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

3.7 CONCRETE BASES

A. Provide concrete bases for all floor-mounted electrical equipment, except that stand alone dry type transformers with integral floor channels may be placed without equipment bases when located in finished areas and electrical closets.

B. Form concrete equipment bases using nominal 2 inch by 4 inch framing lumber (use larger framing if larger pads, such as for engine-generators are required) with form release compounds. Locate as indicated and construct 4 inches larger in both directions than supported unit. Except where otherwise indicated, pour bases 4 inches higher than surrounding slab. Anchor or key to floor slab in accordance with Section 20 0800 "Seismic Protection." Chamfer top edges and corners.

C. Include all concrete materials and workmanship required for the electrical work. Materials and workmanship shall conform to the applicable standards of the Portland cement Association. Reinforce with 6-inch x 6-inch, W1.4-W1.4 welded wire fabric. Concrete shall withstand 3,000 pounds compression per square inch at twenty-eight days.

D. Where the base is less than 12-inches from a wall, the base shall be carried to the wall to prevent a “dirt-trap.”

E. Place concrete and allow to cure before installation of equipment.

3.8 ERECTION OF METAL SUPPORTS AND ANCHORAGE

A. Cut, fit, and place miscellaneous metal fabrications accurately in location, alignment and elevation to support and anchor electrical materials and equipment.

B. Field Welding: Comply with AWS "Structural Welding Code."

3.9 ERECTION OF WOOD SUPPORTS AND ANCHORAGE

A. Cut, fit and place wood grounds, nailers, blocking and anchorage accurately in location, alignment and elevation to support and anchor electrical materials and equipment.

B. Select fastener sizes that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.10 APPLICATION OF SEALERS

A. General: Comply with sealer manufacturers' printed application instructions applicable to products and applications indicated, except where more stringent requirements apply.

1. Comply with recommendations of ASTM C 962 for use of elastomeric sealants.

B. Tooling: Immediately after sealant application and prior to time shinning or curing begins, tool sealants to form smooth, uniform beads; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

3.11 INSTALLATION OF ACCESS DOORS

A. Set frames accurately in position and securely attached to supports with face panels plumb and level in relation to adjacent finish surfaces.

B. Adjust hardware and panels after installation for proper operation.

3.12 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Contract shall X-ray concrete slabs and walls prior to core drilling to avoid damage to utilities or reinforced steel.

D. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

F. Cut sleeves to length for mounting flush with both surfaces of walls.

G. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.

H. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable, unless indicated otherwise.

I. Seal space outside of sleeves with grout for penetrations of concrete and masonry

1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."

K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."

L. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

M. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

N. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.13 SLEEVE-SEAL INSTALLATION

A. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve.

B. Install to seal exterior wall penetrations.

C. Install in concrete slabs and walls and all other fire-rated floors and walls for raceways and cable installations. Provide insulated bushings at each end of sleeve. For sleeves through fire rated-wall or floor construction, apply UL-listed firestopping sealant in gaps between sleeves and enclosed conduits and cables.

1. Conduit Seals: Install seals for conduit penetrations of slabs on grade and exterior walls below grade and where indicated. Tighten sleeve seal screws until sealing grommets have expanded to form watertight seal.

3.14 FIRESTOPPING

A. Apply rated firestopping sealants at all penetrations of fire and smoke walls; at all penetrations of floors and at other locations as noted on the drawings or where required by Code. Consider walls that are common to different abutting buildings, to different additions to buildings, and to fire and smoke separations within buildings as requiring firestopping sealant. Refer to architectural drawings. For existing buildings where fire separations are not noted on any drawings, use reasonable logic as to which separations are fire-rated. When in doubt, consult with Engineer or Architect.

B. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.15 PAINTING

A. Paint all electrical equipment that is marred or damaged prior to the Owner’s acceptance. Paint and color shall match original equipment paint and shall be obtained from the equipment supplier if available. All equipment shall have a finished coat of paint applied unless specifically allowed to be provided with a prime coat only.

B. Paint equipment, conduit, boxes, hangers, etc. as covered under Division 9.

C. Equipment in occupied spaces, or if standard to the unit, shall have a baked primer with based enamel finish coat free from scratches, abrasions, chipping, etc. Verify color preference with the Engineer before ordering equipment if a color option is specified.

3.16 ADJUST AND CLEAN

A. Thoroughly clean all equipment and systems prior to the Owner’s final acceptance of the project.

B. Clean all foreign paint, grease, oil, dirt, labels, stickers, etc., from all equipment.

C. Remove all rubbish, debris, etc., accumulated during construction from the premises.

D. Refer to the Division 01 Section "Closeout Procedures" for general requirements for final cleaning.

3.17 SPECIAL REQUIREMENTS

A. Coordinate the installation of all equipment, controls, devices, etc., with other trades to maintain clear access area for servicing.

B. Install all equipment to maximize access to parts needing service or maintenance. Review the final location, placement and orientation of equipment with the Owner’s representative prior to setting equipment.

C. Include removal and reinstallation of equipment and devices if they were installed without regard to coordination of access requirements and without previous confirmation with the Owner’s representative.

3.18 SYSTEM COMMISSIONING

A. The electrical systems shall be complete and operating. Include system start-up, testing, balancing and satisfactory system performance. This includes all calibration and adjustment of electrical controls, balancing of loads, troubleshooting and verification of software, and final adjustments that may be needed.

B. All operating conditions and control sequences shall be tested during the start-up period. Testing all interlocks, safety shut-downs, controls and alarms.

1. Utilize only skilled technicians to ensure that all systems perform properly. Reimburse the Owner on a time and materials basis for services rendered at the Engineer's standard hourly rates in effect when the services are requested if the Engineer is requested to visit the job site for troubleshooting, assisting in start-up, obtaining satisfactory equipment operation, resolving installation, workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period, through no fault of the design. Pay the Owner for services required that are project-, installation- or workmanship-related. Payment is due within 30 days after services are rendered.

3.19 FIELD QUALITY CONTROL

A. General:

1. All required equipment and systems tests shall be made during and post-Construction as required.
2. All required testing instruments, meters, etc., shall be provided.
3. Technicians operating testing equipment shall be trained in testing procedures.
4. Testing shall confirm that equipment and systems provided by the Contractor have been installed properly.
5. Unsatisfactory test results shall result in revisions or replacement of equipment or settings as required to provide a system capable of meeting test requirements. Tests shall be repeated or additional tests made as necessary to confirm system capability as required by the Owner, Engineer or Authority Having Jurisdiction.

3.20 OPERATION AND MAINTENANCE DATA

A. Refer to the Division 01 Section: "Closeout Procedures" for procedures and requirements for preparation and submittal of maintenance manuals.

B. In addition to the information required by Division 01 for Maintenance Data, include the following information:

1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of all replaceable parts.
2. Manufacturer's printed operating procedures to include start-up, break-in, routine and normal operating instructions, regulation, control, stopping, shut-down, and emergency instructions; and summer and winter operating instructions.

3. Maintenance procedures for routine preventive maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
4. Servicing instructions and lubrication charts and schedules.

C. Submit three (3) properly indexed and bound copies in "D" ring style notebooks, of the Operations and Maintenance Instructions to the Architect or Engineer. Make all corrections or additions required.

D. Operation and Maintenance Instructions shall include:

1. Notebooks shall be heavy duty locking three-ring binders, black in color, and incorporate clear vinyl sheet sleeves on the front cover and spine for slip-in labeling. "Peel and stick" labels are not acceptable. Sheet lifters shall be supplied at the front of each notebook. Size notebooks a minimum of 1/2 inch thicker than the material for future inserts. Label the spine and front cover of each notebook. If more than one notebook is required, label in consecutive order. For example; 1 of 2, 2 of 2. No other forms of binding will be acceptable.
2. Prepare binder covers (front and spine) with printed title "Operation and Maintenance Instructions," title of project, and subject matter of binder when multiple binders are required.
3. Title page with project title, Architect, Engineer, Contractor, and Subcontractor with addresses, telephone numbers, and contacts.
4. Table of Contents describing all index tabs.
5. Listing of all Subcontractors and major equipment suppliers with addresses, telephone numbers and contacts.
6. Index tabs dividing information by specification section, major equipment, or systems. All tab titles shall be clearly printed under reinforced plastic tabs. Label all equipment to match the identification in the construction documents.
7. Copies of warranties.
8. Copies of all final approved shop drawings and submittals. Copy of power system study and overcurrent protective device settings.
9. Copies of all factory inspections and or equipment start-up reports.
10. Schematic wiring diagrams of the equipment that have been updated for field conditions. Field wiring shall have label numbers to match drawings.
11. Dimensional drawings of equipment.
12. Detailed parts lists, each with a list of suppliers.
13. Operating procedures for each system.
14. Maintenance schedule and procedures. Include a chart listing maintenance requirements and frequency.
15. Repair procedures for major components.
16. Replacement parts and service material requirements for each system and the frequency of service required.
17. Instruction books, cards, and manuals furnished with the equipment.

E. Operation and maintenance data shall consist of written instructions for the care, maintenance, and operation of the equipment and systems. Instruction books, cards, manuals furnished with the equipment shall be included.

F. In addition to the information required by Division 01 for Maintenance Data, include the following information:

1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of all replaceable parts.
2. Manufacturer's printed operating procedures to include start-up, break-in, routine and normal operating instructions, regulation, control, stopping, shut-down, and emergency instructions; and summer and winter operating instructions.
3. Maintenance procedures for routine preventive maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
4. Servicing instructions and lubrication charts and schedules.

G. Adequately instruct the Owner’s designated representative in the maintenance, care, and operation of the complete systems installed under this contract.

H. Provide verbal and written instructions to the Owner’s representatives by factory personnel in the care, maintenance and operation of the equipment and systems.

I. Make DVD format compact disc of the instructions to the Owner while explaining the system so additional personnel may view the instructions at a later date. The video shall become the property of the Owner.

J. The instructions shall include:

1. Maintenance of equipment.
2. Start-up procedures for all major equipment.
3. Description of emergency system operation.

K. Notify the Engineer of the time and place for the verbal instructions to the Owner’s representative so his representative can be present if desired.

L. Minimum hours of instruction time for each item and/or system shall be as indicted in each individual specification section.

M. Operating Instructions:

1. Include instructions to the Owner’s representatives for the electrical and specialized systems, using factory-authorized technical representatives.

3.21 RECORD DOCUMENTS

A. Prepare record documents in accordance with the requirements in Division 01 Section "Closeout Procedures." In addition to the requirements specified in Division 01, indicate installed conditions for:

1. Raceways of 2-inches and larger, indicating size and location, for both exterior and interior; locations of control devices; distribution and branch electrical circuitry; and fuse and circuit breaker size and arrangements.
2. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
3. Location of every home run point, such as receptacle, lighting fixture, or switch.

4. Approved substitutions, Contract modifications, and actual equipment and materials installed.
5. Mark Drawings to indicate revisions to conduit size and location both exterior and interior; actual equipment locations, dimensioned from column lines; concealed equipment, dimensioned to column lines; distribution and branch electrical circuitry; fuse and circuit breaker size and arrangements; support and hanger details; change orders; concealed control system devices.
6. Mark Specifications to indicate approved substitutions, change orders, actual equipment and materials used.

B. Maintain at the job site a separate and complete set of electrical drawings and specifications with all changes made to the systems clearly and permanently marked in complete detail.

C. Mark Drawings to indicate revisions to conduit size and location both exterior and interior; actual equipment locations, dimensioned from column lines; concealed equipment, dimensioned to column lines; distribution and branch electrical circuitry; fuse and circuit breaker size and arrangements; support and hanger details; Change Orders; concealed control system devices.

D. Mark drawings and specifications to indicate approved substitutions; Change Orders, and actual equipment and materials used. Mark all Change Orders, RFI responses, clarifications, and other supplemental instructions on the documents. Record documents that merely reference the existence of the above items are not acceptable. Reimburse the Engineer for all costs for the Engineer to develop record documents which comply with this requirement if unable to comply with said above requirements. Reimbursement shall be made at the Architect or Engineer’s hourly rates in effect at the time of the work.

E. Record changes daily and keep the marked drawings available for the Architect or Engineer’s examination at any normal work time.

F. Upon completing the job, and before final payment is made, give the marked-up drawings to the Engineer.

3.22 PROJECT CLOSEOUT

A. The following paragraphs supplement the requirements of Division 01:

B. Final Jobsite Observation:

1. Certify that the project jobsite is ready for the final jobsite observation.
2. Notify the Engineer a minimum of two working days prior to installation of ceiling tiles or lay-in ceilings to allow the Engineer to visit the project site.

C. Submit the following documents to the Architect or Engineer prior to requesting final payment:

1. Operation and maintenance manuals with copies of approved shop drawings.
2. Record documents including electronic AutoCAD or REVIT drawings and specifications.
3. Documentation of completion of all required training of Owner's personnel.
4. Provide spare parts, maintenance and extra materials in quantities specified in individual specification sections.
5. Inspection and testing reports.

6. Start-up reports on all equipment requiring a factory installation or start-up.
7. Submittals required by commissioning of the electrical systems.

END OF SECTION 260500

SECTION 260519 - CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Conductors and Cables.
2. Metal Clad Cable (MC).
3. Mineral Insulated Cable (MI).
4. Remote Control and Signal Cable.

1.3 SUBMITTALS

A. Submittals for approval by the Engineer are not required for this section. Unrequested submittals will not be processed or reviewed. Non-requirement of submittals is not to be construed as an allowance for substitutions and does not allow relief from full compliance with the contract documents.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70 “National Electrical Code.”

1. Conform to applicable codes and regulations regarding toxicity of combustion products of insulating materials.

C. UL Compliance: Provide components which are listed and labeled by Underwriters Laboratories under the following standards.

1. UL Std. 83 Thermoplastic-Insulated Wires and Cables.
2. UL Std. 486A Wire Connectors and Soldering Lugs for Use with Copper Conductors.
3. UL Std. 1569 Metal Clad Cables.

D. NEMA and ICEA Compliance: Provide components which comply with the following standards:

1. WC-70: Power Cables Rated 2,000V or Less for the Distribution of Electrical Energy.

E. IEEE Compliance: Provide components which comply with the following standard.

1. Std. 82: Test procedures for Impulse Voltage Tests on Insulated Conductors.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. American Insulated Wire Corp.; a Leviton Company.
2. General Cable Corporation.
3. Senator Wire & Cable Company.
4. Southwire Company.
5. Cerro Wire.
6. Superior Essex.
7. Encore Wire Corporation.

B. Copper Conductors: Comply with NEMA WC 70.

C. Conductor Insulation: Comply with NEMA WC 70 for Types THW, THHN-THWN, XHHW and SO.

D. Multiconductor Cable: Comply with NEMA WC 70 for metal-clad cable, Type MC, metal-sheathed cable and Type SO with ground wire.

2.2 CONDUCTORS AND CABLES

A. General: Provide wire and cable suitable for the temperature, conditions and location where installed.

B. Feeders: Copper for feeders smaller than No. 4 AWG; copper for feeders No. 4 AWG and larger, 600 volt insulation. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

C. Branch Circuits: Copper, 600 volt insulation. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

D. Control Circuits: Copper, stranded conductor, 600 volt insulation.

E. Wire for the following specialized systems shall be as shown on drawings or as dictated within these specifications. Where not designated, the systems manufacturer’s recommendations shall be adhered to for the following systems:

1. Fire Alarm.
2. Low Voltage Switching.
3. Electronic Control.
4. Data.
5. Telephone.
6. Security.

F. Single Conductors for Feeders and Branch Circuits:

1. Stranding: Provide solid conductors for branch circuits and non-vibrating power utilization equipment utilizing Number 10 AWG and smaller. Provide stranded conductors for

Number 8 AWG and larger. Provide stranded conductors, regardless of size, for connections to vibrating equipment such as motors and transformers.

2.3 METAL CLAD, TYPE MC CABLE

A. General: Metal clad cables may be utilized for branch circuit wiring as defined in NFPA 70, Article 330 subject to acceptance by State and Local Codes.

B. Construction: Metal Clad cable to be a factory assembly of one or more individually insulated conductors enclosed in a metal sheath with armor ground. MC cable shall be listed and labeled under UL 1569.

C. Sheathing: Steel or aluminum interlocking tape, smooth tube or corrugated tube. Convolutions of interlocking tape shall not separate when cable is bent at a radius as tight as seven times the external diameter of the cable sheath.

D. Conductor Material: Copper, minimum 12 AWG.

E. Conductor Insulation: Minimum temperature rating of 90 degrees Celsius and of a type listed in NEC Table 310-13.

F. Metal clad cable shall **not** be used for circuits connected to the essential electrical system.

G. Approved use of metal clad cable is limited. Refer to Part 3 of this specification for permitted uses.

2.4 REMOTE CONTROL AND SIGNAL CABLE

A. Control Cable for Class 1 Remote Control and Signal Circuits: Copper conductor, 600 volt insulation, rated 60 degrees C, individual conductors twisted together, shielded, and covered with a PVC jacket.

B. Control Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, 300 volt insulation, rated 60 degrees C, individual conductors twisted together, shielded, and covered with a PVC jacket; UL listed.

C. Plenum Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, 300 volt insulation, rated 60 degrees C, individual conductors twisted together, shielded and covered with a nonmetallic jacket; UL listed for use in air handling ducts, hollow spaces used as ducts, and plenums.

2.5 CONNECTORS AND SPLICES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AFC Cable Systems, Inc.
2. Hubbell Power Systems, Inc.
3. O-Z/Gedney; EGS Electrical Group LLC.
4. 3M; Electrical Products Division.

5. Tyco Electronics Corp.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type and class for application and service required.

PART 3 - EXECUTION

3.1 CONDUCTOR INSULATION, APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN-THWN, single conductors in raceway.

B. Concealed in Ceilings, Walls, Partitions, Raised Flooring and Crawlspaces: Type THHN-THWN, single conductors in raceway.

C. Concealed in Concrete, below Slabs-on-Grade and Underground: Type THWN, single conductors in raceway.

D. Exposed, Including in Crawlspaces: Type THHN-THWN, single conductors in raceway.

E. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

F. Class 1 Control Circuits: Install per NEC Article 725.

G. Class 2 Control Circuits: Install per NEC Article 725.

3.2 DEVIATION FROM CONTRACT DRAWINGS

A. Basis of Design is copper conductors installed in raceway, based on 30 degrees C ambient temperature (NEC Table 310.15(B)(16)). If materials or methods selected for installation differ from the basis of design, size conductors and conduits to meet or exceed the ampacity of circuits selected for the basis of design.

B. Routing multiple conductors within a single conduit requires the conductor ampacity to be derated per National Electrical Code Article 310. Do not provide more than 4 conductors within a single conduit to serve loads such as panelboards, motor control centers, motors over 1/4 horsepower, etc.

C. Underground duct conductor ampacity is based on table B.310.15(B)(2)(7) of the National Electrical code, or has been calculated in accordance with Informative Annex B: Application Information for Ampacity Calculation. Deviation from the contract documents in regards to conductor and conduit quantities or orientation shall require supporting calculations and a sketch for Engineer approval.

D. Where ungrounded conductors are increased in size for any reason, equipment grounding conductors shall be increased in size proportionally according to the circular mil area of the ungrounded conductors.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

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

B. Conceal cables in finished walls, ceilings and floors unless otherwise indicated.

C. Completely and thoroughly swab raceway before installing wire.

D. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

E. Use pulling means including fish tape, cable, rope, and basket weave wire and cable grips which will not damage cables or raceways. Do not use rope hitches for pulling attachment to wire or cable. Do not exceed maximum tensile strength of conductor or grip. Do not exceed maximum sidewall pressure limitations of cables.

F. Pull conductors simultaneously where more than one is being installed in the same raceway.

G. Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.

H. Feeder conductors shall be continuous and shall not contain splices.

I. Provide adequate length of conductors within electrical enclosures and train the conductors to terminal points with no excess. Bundle multiple conductors, with conductors larger than Number 10 AWG cabled in individual circuits. Make terminations so there is no more than 1/8 inch of exposed bare conductor at the terminal. Observe NEC 310.15 (B)(2)(a) adjustment factors.

J. Verify that interior of building has been protected from weather and mechanical work likely to damage wire and cable has been completed prior to installing wire and cable.

K. Use conductor not smaller than Number 12 AWG for power and lighting circuits.

L. Single conductors used for control circuits shall not be smaller than Number 14 AWG.

M. Use Number 10 AWG conductors (phase, neutral and ground) for 20 ampere, 120 volt branch circuits longer than 75 feet, unless drawings requirements are more stringent.

N. Use Number 10 AWG conductors (phase, neutral and ground) for 20 ampere, 277 volt branch circuits longer than 200 feet, unless drawings requirements are more stringent.

O. Use Number 8 AWG conductors (phase, neutral and ground) or larger for outdoor lighting circuits.

P. Place an equal number of conductors for each phase, neutral and ground of a circuit within the same raceway or cable when routing parallel conductors. Conductor lengths must be equal.

Q. Support cables according to Division 26 Section "Hangers and Supports."

R. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

3.4 CABLE INSTALLATION, APPLICATIONS AND WIRING METHODS

A. Open cabling shall be routed in a symmetrical manner, tight and parallel to walls.

B. Support open cable by appropriate size bridle rings or j-hooks at five foot intervals. Open cable may not rest on suspended ceilings. Wire and cable from different systems shall not be installed within the same bridle rings or j-hooks. Neatly bundle grouped cables every two-and-a-half feet with a nylon tie wrap.

C. Open cable may only be installed where specifically dictated on drawings or permitted elsewhere within these specifications.

3.5 METAL CLAD CABLE INSTALLATION

A. Metal clad cables may be utilized for 20A and 15A branch circuit wiring as defined in NFPA 70, Article 330 and Article 517 subject to acceptance by State and Local Codes. Feeder wiring must consist of individual insulated conductors in conduit.

B. Metal clad cable installations shall comply with the requirements stipulated within Article 330 of the National Electrical Code.

C. Provide individual insulated conductors in conduit from branch panelboard to junction box(es) located above the ceiling in the same room as the final device(s) or luminaire(s) being served.

1. Metal clad cable is permitted to be extended from this junction box to electrical devices and luminaires in the same room where all other requirements of this specification are met. Horizontal length of HCF metal clad cable extending from the local room junction box to the final in-wall device shall not exceed 25 feet.
2. In rooms or spaces with inaccessible ceilings, the aforementioned junction box may be located in the nearest accessible ceiling, corridor preferred.

D. Metal clad cable is allowed for flexible connection to luminaires in lengths not to exceed 6’-0”.

E. Metal clad cable is allowed for branch circuits of 30 amperes and less when run from a junction box located above an accessible ceiling, within 8 feet of the partition containing the served wiring device box (or within 6 feet of a lighting fixture). Wiring between the above junction box and the panelboard shall consist of individual conductors in conduit.

F. Metal clad cable shall only be run concealed.

G. Metal clad cable shall not be daisy chained from [receptacle-to-receptacle or from] luminaire to luminaire. Metal clad cable runs shall be from a junction box to the final device or luminaire.

H. Metal clad cable shall not be used for circuits serving the Essential Electrical System.

3.6 CONNECTIONS AND TERMINATIONS

A. Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A.

B. Clean conductor surfaces before installing lugs and connectors.

C. Utilize solderless compression terminals applied with circumferential compression for conductor sizes 8 AWG and larger and crimp in accordance with manufacturer instructions. Indenter compression method may be used for conductor sizes 10 AWG and smaller.

D. Phase Sequence: Connections to phase conductors at electrical equipment shall be made such that the A-B-C conductors, when facing the equipment, are oriented top to bottom, or left to right.

E. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

3.7 SPLICES AND TAPS

A. Conductor splices shall be kept to a minimum.

B. Only splice within accessible junction boxes or enclosures.

C. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors. Splices and taps shall be capable of carrying the full ampacity of the conductors without perceptible temperature rise.

1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.

D. Above Grade:

1. Use copper compression connectors applied with circumferential compression for conductor sizes 6 AWG and larger.
2. Use pre-molded insulated tap connectors for copper conductor splices and taps, Number 8 AWG and smaller. Insulate with UL listed insulating cover supplied by same manufacturer as connector.
3. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, Number 10 AWG and smaller.
4. Tape uninsulated conductors and connectors with electrical tape to 150 percent of insulation rating of conductor, or three layers of tape, whichever is greater.

E. Below Grade:

1. Use specified insulated connectors suitable and approved for below grade wiring connectors. Ensure that conductors do not apply tension to splice.

3.8 FIELD QUALITY CONTROL

A. Inspect wire for physical damage and proper connection.

B. Measure tightness of bolted connections with properly scaled and calibrated torque tool and compare torque measurements with manufacturer's recommended values.

C. Before energizing, test wires and cables for electrical continuity and for short circuits.

D. Remove and replace malfunctioning conductors and retest as specified above.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes solid grounding of electrical systems and equipment. It includes basic requirements for grounding for protection of life, equipment, circuits and systems. Grounding requirements specified in this Section may be supplemented in other sections of these Specifications.

1.3 SUBMITTALS

A. Submittals for approval by the Engineer of products to be used are not required for this section. Unrequested submittals will not be processed or reviewed. Non-requirement of submittals is not to be construed as an allowance for substitutions and does not allow relief from full compliance with the contract documents.

1. Requirements.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

C. Listing and Labeling: Provide products specified in this Section that are listed and labeled for the specific purposes by Underwriters Laboratories.

D. Testing Agency Qualifications: Member Company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING PRODUCTS

A. Products: Of types indicated and of sizes and ratings to comply with NEC. Where types, sizes, ratings and quantities indicated are in excess of NEC requirements, the more stringent requirements and the greater size, rating, and quantity indications govern.

2.2 CONDUCTORS

A. General: Comply with Division 26 Section "Conductors and Cables" for insulated grounding conductors. Conform to NEC Table 8, except as otherwise indicated, for conductor properties, including stranding.

B. Equipment Grounding Conductor: Green insulated; conductor metal shall match branch circuit conductor metal.

C. Grounding Electrode Conductor: Stranded cable.

D. Underground Conductors: Bare, stranded copper except as otherwise indicated.

E. Copper Conductors: Conform to the following:

1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
2. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
3. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
4. Bonding Strap Conductor/Connectors: Soft copper, 0.05 inch thick and 2 inches wide, except as indicated.

2.3 GROUNDING BUS

A. Predrilled rectangular bars of annealed copper, 1/4-inch by 6 inches in cross section, with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

2.4 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure (clamp) type with at least two bolts.

C. Bus-bar Connectors: Mechanical type, cast silicon bronze, solderless compression type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

D. Pressure Connectors: High-conductivity-plated units.

E. Bolted Clamps: Heavy-duty units listed for the application.

F. Exothermic Welded Connections: Provided in kit form and selected for the specific types, sizes, and combinations of conductors and other items to be connected.

G. Compression Connectors: Irreversible compression connectors must be factory filled with oxide inhibitor and fully crimped with a 14-ton or larger hydraulic tool so that index number is embossed on the connector. May be used above or below grade.

H. Lightning Protection Aluminum-To-Copper Connections: Bimetallic type, conforming to UL 96, "Lighting Protection Components," or UL 467.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Route grounding electrode conductors within rigid polyvinyl chloride (PVC) conduit.

C. Seal all exterior wall penetrations air-tight.

D. Do not use aluminum conductors in direct contact with earth, concrete, masonry or similar materials.

3.2 GROUNDING ELECTRODES

A. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors in conduit from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

3.3 GROUNDING BUS

A. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment and elsewhere as indicated.

1. Install bus on insulated spacers 2 inches (50 mm) minimum from wall, 6 inches (150 mm) above finished floor unless otherwise indicated.
2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down to specified height above floor; connect to horizontal bus.

3.4 EQUIPMENT GROUNDING.

A. Equipment Grounding Conductor Application: Comply with NEC Article 250 for sizes and quantities of equipment grounding conductors, except where larger sizes or more conductors are indicated.

B. Install separate insulated equipment grounding conductors with all feeders and branch circuit conductors. Terminate each end on a grounding lug or bus.

3.5 BONDING

A. Air Duct Equipment Circuits: Install an insulated equipment grounding conductor to duct-mounted electrical devices operating at 120-V and above including air cleaners and heaters. Bond the conductor to each such unit and to the air duct.

B. Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, pumps, blowers, electric heaters and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

C. Water Heater, Heat Tracing, and Anti-Frost Heater Circuits: Install separate insulated equipment ground conductor to each electric water heater, heat tracing and surface anti-frost heating cable. Bond this conductor to heater units, piping and connected equipment and components.

D. Building Expansion Joints: Provide flexible bonding jumper between columns and beams on both sides of each expansion joint.

E. Separately Derived Systems: Where the NEC requires separately derived systems to be grounded, provide grounding in accordance with the NEC.

F. Connection to Other Systems: Bond electrical system grounding, lightning protection, telephone, CATV, other communications systems, metal water piping, metal gas piping and other piping systems together.

G. Signal and Communication Equipment: In addition to grounding and bonding required by NFPA 70, provide a separate grounding system complying with requirements in TIA/ATIS J-STD-607-A.

1. For telephone, alarm, voice and data and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet and central equipment location.
2. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-inch by-4-inch by-12-inch (6.3-by-100-by-300-mm) grounding bus.
3. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

H. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

I. Braided-Type Bonding Jumpers: Install to connect ground clamps on water meter piping to bypass water meters electrically. Use elsewhere for flexible bonding and grounding connections.

3.6 CONNECTIONS

A. General: Select connectors, hardware and conductors and make connections in such a manner as to minimize possibility of galvanic action or electrolysis.

1. Make connections with clean bare metal at points of contact.
2. Aluminum to steel connections shall be with stainless steel separators and mechanical clamps.
3. Aluminum to galvanized steel connections shall be with tin-plated copper jumpers and mechanical clamps.
4. Coat and seal connections involving dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
5. Exothermic Welded Connections or Compression-type Connections: Use for connections to structural steel and for underground connections except those at test wells. Install at connections to ground rods and plate electrodes. Comply with manufacturer's written recommendations. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable. Compression connections should be inspected for visible die index number matching the die and connector used. Connections that do not show this are not acceptable.

B. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Exothermic-welded or compression-type connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Exothermic-welded or compression-type ground stud connector.

C. Equipment Grounding Conductors: Terminate insulated equipment grounding conductors for feeders and branch circuits with pressure-type grounding lugs.

D. Metallic Raceway Continuity: Where metallic raceways terminate at metallic housings without mechanical and electrical connection to the housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to the ground bus in the housing. Bond electrically non-continuous conduits at both entrances and exits with grounding bushings and bare grounding conductors.

E. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with torque tightening values specified in UL 486A.

F. Compression-Type Connections: Use hydraulic compression tools of at least 14-ton size to provide the correct circumferential pressure for compression connectors. Use tools and dies recommended by the manufacturer of the connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on the ground conductor.

3.7 FIELD QUALITY CONTROL

A. Tests and Inspections: After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements:

1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal at individual ground rods. Make tests at ground rods before any conductors are connected.

    a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    b. Perform tests by fall-of-potential method according to IEEE 81.

3. Prepare dimensioned drawings locating each test well, ground rod and ground-rod assembly and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
4. Maximum Ground Resistance Values:

    a. Service neutral to reference ground: 5 Ohms
    b. Equipment rated 500 kVA and Less: 10 Ohms.
    c. Equipment rated 500 to 1000 kVA: 5 Ohms.
    d. Equipment rated greater than 1000 kVA: 3 Ohms.

5. Where resistance to ground exceeds specified values, notify Engineer and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Secure support from the building structure for electrical items by means of hangers, supports, anchors, sleeves, inserts, seals and associated fastenings.
2. Construction requirements for concrete bases.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

D. RNC: Rigid non-metallic conduit.

E. Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of four times the applied force.

1.4 SUBMITTALS

A. Submittals for approval by the Engineer are not required for this section. Unrequested submittals will not be processed or reviewed. Non-requirement of submittals is not to be construed as an allowance for substitutions and does not allow relief from full compliance with the contract documents.

1.5 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Electrical components shall be listed and labeled for the specific intended purpose by Underwriters Laboratories, Inc.

C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel".

1.6 COORDINATION

A. Coordinate size, shape and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Slotted Metal Angle and U-Channel Systems:

   a. Allied Tube & Conduit.
   b. American Electric.
   c. B-Line Systems, Inc.
   d. GS Metals Corp.
   e. Unistrut Diversified Products.

2. Conduit Sealing Bushings:

   a. Bridgeport Fittings, Inc.
   b. Killark Electric Mfg. Co.
   c. O-Z/Gedney.
   d. Raco, Inc.
   e. Red Seal Electric Corp.

2.2 COATINGS

A. Coating: Supports, support hardware, and fasteners shall be protected with zinc coating or with treatment of equivalent corrosion resistance using approved alternative treatment, finish or inherent material characteristic.

2.3 MANUFACTURED SUPPORTING DEVICES

A. Raceway Supports: Clevis hangers, riser clamps, conduit straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets and spring steel clamps.

B. Fasteners: Types, materials and construction features as follows:

1. Expansion Anchors: Carbon steel wedge or sleeve type.
2. Toggle Bolts: All steel springhead type.
3. Through Bolts: Structural type, hex head, high strength. Comply with ASTM A 325.

C. Conduit Sealing Bushings: Factory-fabricated watertight conduit sealing bushing assemblies suitable for sealing around conduit or tubing passing through concrete floors and walls. Construct seals with steel sleeve, malleable iron body, neoprene sealing grommets or rings, metal pressure rings, pressure clamps and cap screws.

D. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for non-armored electrical cables in riser conduits. Provide plugs with number and size of conductor gripping holes as required to suit individual risers. Construct body of malleable-iron casting with hot-dip galvanized finish.

E. U-Channel Systems: 16-gauge steel channels, with 9/16-inch-diameter holes, between one and one half and two and one half inches on center, in top surface. Provide fittings and accessories that mate and match with U-channel and are of the same manufacture.

2.4 FABRICATED SUPPORTING DEVICES

A. General: Shop- or field-fabricated supports or manufactured supports assembled from U-channel components.

B. Steel Brackets: Fabricated of angles, channels and other standard structural shapes. Connect with welds and machine bolts to form rigid supports.

C. Pipe Sleeves:

1. Provide pipe sleeves of one of the following:

   a. Interior Dry Locations: Fabricate from Schedule 40 galvanized steel pipe or Schedule 40 PVC plastic pipe.
   b. Exterior or Interior Wet or Damp Locations: Fabricate from Schedule 40 PVC plastic pipe.

2. Sleeves shall not penetrate structural members without approval from the Structural Engineer.
3. Openings through unexcavated floors and/or foundation walls below the floor shall have a smooth finish with sufficient annular space around material passing through opening so slight settling will not place stress on the material or building structure.
4. Install all sleeves concentric with conduits. Secure sleeves in concrete to wood forms. This Contractor is responsible for sleeves dislodged or moved when pouring concrete.
5. Where conduits rise through concrete floors that are on earthen grade, provide 3/4-inch resilient expansion joint material (asphalt and cork) wrapped around the pipe, the full depth of concrete at the point of penetration. Secure to prevent shifting during concrete placement and finishing.
6. Size sleeves large enough to allow expansion and contraction movement.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install supporting devices to fasten electrical components securely and permanently in accordance with NEC requirements.

B. Coordinate with the building structural system and with other disciplines' installations.

C. Raceway Supports: Comply with the NEC and the following requirements:

1. Conform to manufacturer's recommendations for selection and installation of supports.
2. Strength of each support shall be adequate to carry present and future load multiplied by a safety factor of at least four. Where this determination results in a safety allowance of less than 200 lbs, provide additional strength until there is a minimum of 200 pounds safety allowance in the strength of each support.
3. Install individual and multiple (trapeze) raceway hangers and riser clamps as necessary to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.
4. Support parallel runs of horizontal raceways together on trapeze-type hangers.
5. Support individual horizontal raceways by separate pipe hangers. Spring steel fasteners may be used in lieu of hangers only for 1-inch and smaller raceways serving branch circuits, telephone and data above suspended ceilings only. For hanger rods with spring steel fasteners, use 1/4-inch-diameter or larger threaded steel. Use spring steel fasteners that are specifically designed for supporting single conduits or tubing.
6. Space supports for raceways in accordance with Table I of this section. Space supports for raceway types not covered by the above in accordance with NEC.
7. Support exposed and concealed raceway within 3 feet of boxes, access fittings, device boxes or cabinets.
8. In vertical runs, arrange support so the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports with no weight load on raceway or conductor terminals.
9. Vertical Conductor Supports: Install simultaneously with installation of conductors.
10. Miscellaneous Supports: Support miscellaneous electrical components as required to produce the same structural safety factors as specified for raceway supports. Install metal channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers and other devices.

D. Fastening: Unless otherwise indicated, fasten electrical items and their supporting hardware securely to the building structure, including but not limited to conduits, raceways, cables, cable trays, busways, cabinets, panelboards, transformers, boxes, motor control centers, disconnect switches and control components in accordance with the following:

1. Fasten by means of wood screws or screw-type nails on wood, toggle bolts on hollow masonry units, concrete inserts or expansion bolts on concrete or solid masonry, and machine screws, welded threaded studs, or spring-tension clamps on steel. Do not weld conduit, pipe straps, or items other than threaded studs to steel structures. In partitions of light steel construction, use sheet metal screws.
2. Holes cut to depth of more than 1-1/2 inches in reinforced concrete beams or to depth of more than 3/4-inch in concrete shall not cut the main reinforcing bars. Fill holes that are not used.
3. Do not fasten supports to ceiling systems, piping, ductwork, mechanical equipment or conduit unless otherwise noted.
4. Do not use powder-actuated anchors without specific permission.
5. Do not drill structural steel members.
6. Install surface-mounted cabinets and panelboards with minimum of four anchors.
7. Bridge studs top and bottom with channels to support flush-mounted cabinets and panelboards in stud walls.

E. In wet locations and on all building floors below exterior earth grade install freestanding electrical equipment on concrete pads.

F. Ensure that the load applied to any fastener does not exceed 25 percent of the proof test load. Use vibration- and shock-resistant fasteners for attachments to concrete slabs.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.2 PAINTING

A. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

TABLE I: SPACING FOR RACEWAY SUPPORTS

			Maximum Spacing of Supports (Feet)		
Raceway Size (Inches)	**No. of Conduits in Run**	**Location**	**RMC & IMC***	**EMT**	**RNC**
HORIZONTAL RUNS					
1/2, 3/4	1 or 2	Flat ceiling or wall.	5	5	3
1/2, 3/4	1 or 2	Where it is difficult to provide supports except at intervals fixed by the building construction.	7	7	--
1/2, 3/4, 1	3 or more	Any location.	7	7	--
1 & larger	1 or 2	Flat ceiling or wall.	6	6	--
1 & larger	1 or 2	Where it is difficult to provide supports except at intervals fixed by the building construction.	10	10	--
1 & larger	3 or more	Any location.	10	10	--
Any	--	Concealed.	10	10	--
VERTICAL RUNS					
1/2, 3/4	--	Exposed.	7	7	--
1, 1-1/4	--	Exposed.	8	8	--
1-1/2 and larger	--	Exposed.	10	10	--
Up to 2	--	Shaftway.	14	10	--
2-1/2	--	Shaftway.	16	10	--
3 & larger	--	Shaftway.	20	10	--
Any	--	Concealed.	10	10	--

*Maximum spacings for IMC above apply to straight runs only. Otherwise the maximums for EMT apply.

END OF SECTION 260529

SECTION 260533 - RACEWAYS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following raceways electrical wiring:

1. Metallic Conduit and Tubing.
2. Non-Metallic Conduit and Tubing.
3. Metal Wireways.
4. Non-Metallic Wireways.
5. Low Voltage Cabling Support.
6. Communications Raceway Accessories.

1.3 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70 "National Electrical Code" for components and installation.

C. Comply with NECA "Standard of Installation."

D. Listing and Labeling: Provide products specified in this Section that are listed and labeled by Underwriters Laboratories for the specific purpose and comply with the following standards:

1. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
2. ANSI C80.3 - Electrical Metallic Tubing, Zinc Coated.
3. ANSI/NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
4. ANSI C80.5 – Aluminum Rigid Conduit.
5. ANSI C80.6 – Intermediate Metal Conduit, Zinc Coated.
6. ANSI/NFPA 70 - National Electrical Code.
7. ANSI/NEMA FB 1 – Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable.
8. NECA "Standard of Installation."
9. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.

10. NEMA TC 2 - Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).
11. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Provide conduit, tubing and fittings of types, grades, sizes and weights (wall thicknesses) for each service indicated. Where types and grades are not indicated, provide proper selection determined by installer to fulfill wiring requirements, and comply with applicable portions of NFPA 70 for raceways.

B. Bushings: Bushings for terminating conduits smaller than 1-1/4 inches are to have flared bottom and ribbed sides, with smooth upper edges to prevent injury to cable insulation. Install insulated type bushings for terminating conduits 1-1/4 inches and larger. Upper edge to have phenolic insulating ring molded into bushing. Bushings to have screw type grounding terminal.

C. Raintight Sealing Hubs: Two piece type with outer internally-threaded hub to receive conduit, inner locking ring with bonding screw, insulated throat, and V-shaped ring or O-ring.

2.2 METAL CONDUIT AND TUBING

A. Rigid Steel (Metallic) Conduit:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Allied Tube & Conduit.
    b. LTV Steel Tubular Products Company.
    c. O-Z Gedney.
    d. Wheatland Tube Company.

2. Description: Conduit to be seamless, hot dipped galvanized rigid steel. Threads to be cut and ends chamfered prior to galvanizing. Galvanizing to provide zinc coating fused to inside and outside walls of conduit. Provide an enamel lubricating coating on the inside of the conduit. Conduit to conform to ANSI C80.1 and listed and labeled under UL 6.
3. Fittings and Conduit Bodies: NEMA FB 1, single piece threaded, cadmium plated malleable iron.

    a. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.

4. Joint Compound: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

B. Intermediate Metal Conduit:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allied Tube & Conduit.
b. Republic Conduit.
c. Wheatland Tube Company.

2. Description: Conduit to be seamless, hot dipped galvanized rigid steel. Threads to be cut and ends chamfered prior to galvanizing. Galvanizing to provide zinc coating fused to outside walls of conduit. Provide an enamel lubricating coating on the inside of the conduit. Conduit to be listed and labeled under UL 1242.
3. Fittings and Conduit Bodies: NEMA FB 1, single piece threaded, cadmium plated malleable iron.

a. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.

4. Joint Compound: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

C. Electrical Metallic Tubing:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allied Tube & Conduit.
b. Republic Conduit.
c. Wheatland Tube Company.

2. Description: Conduit to be seamless, hot dipped or electro-galvanized steel tubing. Galvanizing to provide zinc coating fused to outside walls of conduit. Provide an enamel lubricating coating on the inside of the conduit. Conduit to conform to ANSI C80.3 - 1983 and listed and labeled under UL 797.
3. Fittings and Conduit Bodies: Compression or steel set screw.

a. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.

4. Expansion fittings for use with EMT shall allow for a minimum of four inches of movement and shall be similar to O-Z Gedney TX series, complete with bonding jumpers and hardware.

D. Flexible Metal Conduit: Zinc-coated steel Zinc-coated steel or aluminum.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AFC Cable Systems.
b. Alflex Inc.
c. Electri-Flex Co.

2. Description: Interlocked steel or aluminum construction, consisting of spirally wrapped, convoluted hot dip galvanized steel strip. Zinc coating to cover both sides and all edges

of steel strip. Convolutions to be interlocked to prevent separation when conduit is bent at radius equal to 4-1/2 times conduit O.D. Conduit to be listed and labeled under UL 1.

3. Fittings: ANSI/NEMA FB 1 -1988. Threadless hinged clamp type, galvanized zinc coated cadmium plated malleable cast iron.

E. Liquidtight Flexible Metal Conduit:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. AFC Cable Systems.
   b. Alflex Inc.
   c. Electri-Flex Co.

2. Description: Flexible steel conduit with PVC jacket, listed and labeled under UL 360
3. Fittings: and Conduit Bodies: Watertight, compression type, galvanized zinc coated cadmium plated malleable cast iron. Conduit to be listed and labeled under UL 360.

   a. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.

2.3 NONMETALLIC CONDUIT AND TUBING

A. Electrical Non-Metallic Tubing:

1. Description: Tubing to be pliable corrugated PVC raceway of circular cross section, suitable for use in accordance with NEC Article 331. ENT to comply with NEMA TC 13 and listed under UL 1653.
2. Connectors and Couplings: Provide snap-on type manufactured specifically for ENT or solvent-welded rigid nonmetallic PVC fittings. All connectors shall be concrete tight, without the use of an external covering.

B. Rigid Non-Metallic Conduit:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Cantex.
   b. J.M. Manufacturing.
   c. Allied Tube & Conduit.
   d. Lamson & Sessions; Carlon Electrical Products.

2. Description: Conduit to be PVC, Schedule 40 or Schedule 80 as indicated, rated for use with 90 degrees C conductors and suited for direct burial and above ground use in direct sunlight, whether encased in concrete or not. Conduit to conform to latest edition of ASTM F512, NEMA TC-2, and be listed and labeled under UL 651.
3. Fittings and Conduit Bodies: Manufactured per NEMA TC-3 and UL 651 listed to match conduit, type and material. Expansion fittings shall allow for six inch movement, and shall be similar to Carlon E945 series. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.

2.4 METAL WIREWAYS

A. Available Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper B-Line, Inc.
2. Hoffman.
3. Square D; Schneider Electric.

B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1, 12, or 3R as environmental conditions dictate, unless otherwise indicated.

C. Material: Primed and painted sheet steel for indoor locations, galvanized sheet steel for outdoor locations sized as indicated or required, whichever is greater.

1. Wireway up to 6 inch by 6 inch cross section shall be minimum 16 gage.
2. Wireway larger than 6 inch by 6 inch cross section shall be minimum 14 gage.

D. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

E. Wireway Covers: Hinged. Utilize flanged-and-gasketed type for outdoor locations.

F. Finish: Manufacturer's standard gray enamel finish.

2.5 NONMETALLIC WIREWAYS

A. Available Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper B-Line, Inc.
2. Hoffman.
3. Lamson & Sessions; Carlon Electrical Products.

B. Indoor Application Description: PVC plastic, extruded and fabricated to size and shape indicated, with snap-on cover and mechanically coupled connections with plastic fasteners.

C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

2.6 LOW VOLTAGE CABLING SUPPORT

A. General: The following supporting products are for use in systems below 50V.

B. Open top cable supports (J-Hooks):

1. Galvanized steel construction with smooth rounded edges.

2. Complies with UL, cUL, NEC, and ANSI/TIA/EIA requirements for structured cabling systems.
3. Manufacturers:

    a. Erico.
    b. B-Line.
    c. Panduit.

2.7 COMMUNICATIONS RACEWAY ACCESSORIES

A. Pull cords:

1. Pull wires shall be nylon type.
2. Provide in all empty conduits, sleeves, raceways and all cabling pathways for future use.
3. Pull cords shall have a tensile rating of 200 pounds minimum.

B. Fiber Optic Innerduct:

1. NEMA TC 5, UL listed, corrugated, specifically designed for optical fiber cable pathways.
2. Fiber optic innerduct shall be orange in color.
3. Innerduct shall be 1-inch minimum inside diameter, and a minimum pulling strength of 600 pounds.
4. Each innerduct shall include a factory installed pull rope.
5. Each duct shall be suited for the environment in which it is installed.
6. Manufacturers:

    a. Carlon.
    b. Arnco.
    c. Opti-Com.
    d. Maxcell.

C. Cable Spillways:

1. Provide Spillway on sleeves 2 inches and greater.
2. Manufacturers:

    a. Bejed.
    b. BLine.
    c. Panduit.

PART 3 - EXECUTION

3.1 METALLIC AND NON-METALLIC CONDUIT APPLICATION

A. schedule shall be followed for all installations, unless it creates a violation of applicable codes or is otherwise specifically dictated otherwise within the drawings.

1. Outdoor Locations Above Grade (Including Roofs): RMC
2. Indoor Locations:

a. Exposed, not subject to physical damage, or above 7 feet-0 inches of finished floor: RMC, IMC or EMT.
b. Exposed, subject to physical damage, or within 7 feet-0 inches of finished floor: RMC, IMC.
c. Finished spaces, concealed above suspended ceilings and interior walls and partitions: EMT.
d. Wet or Damp Locations: RMC or IMC.

3. Connections to vibrating equipment: FMC, except use LFMC in wet or damp locations.
4. Optical Fiber or Communications Cable: EMT or Flexible type, listed for purpose.
5. Hazardous Locations: As defined by the National Electrical Code, RMC conduit with screwed fittings and conduit seals.
6. Power Circuits Operating above 60Hz: RNC.

B. Conduit Size:

1. Conduits shall be sized as shown on drawings. Where conduit sizes are not indicated, conduits shall be sized in accordance with the latest version of the National Electrical Code (NFPA 70) and shall be limited to a 40 percent conductor fill percentage. Conductor ampacities must be maintained; therefore adjustment factors for temperature and quantity derating values must be observed.

a. Minimum Conduit Size: Unless otherwise noted, 3/4-inch (21-mm) trade size with the following exceptions:

1) Switchlegs, Luminaire Whips and Control Wiring: 1/2-inch.
2) Below Grade: 1-inch.

b. Conduit sizes may change only at the entrance or exit of a junction box.

3.2 METALLIC AND NON-METALLIC CONDUIT INSTALLATION

A. General Installation Requirements

1. Conduits shall be mechanically and electrically continuous from source of current to all outlets unless a properly sizes grounding conductor is routed within the conduit. All metallic conduits shall be bonded per NFPA 70.
2. Do not reduce the indicated sizes of raceways. Conduit sizes may only change junction and pull boxes.
3. Complete raceway installation before starting conductor installation.
4. Use temporary closures to prevent foreign matter from entering raceway.
5. Avoid moisture traps; provide junction box with drain fitting at low points in raceway system.
6. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Empty raceways shall be labeled at each end indicating origin of the raceway. Labels shall be self-adhesive vinyl labels.
7. Raceways containing feeders and circuits associated with branches of the essential power system, the emergency power system, the legally required power system, the optional

standby system must be kept entirely independent from each other and other sources of power.

B. Conduit Routing:

1. Conduit shall be concealed in walls and above ceilings within finished spaces and may be exposed within unfinished spaces (such as mechanical and utility areas) where conditions dictate and as practical. Where routed exposed, headroom shall be maintained for pedestrian and vehicular traffic.
2. Raceway routing proposed on Drawings is diagrammatic in nature and shown in approximate locations unless dimensioned. Coordinate conduit routing with beams, joists, columns, windows, etc., as required to complete wiring system. Verify field measurements, routing and termination locations of raceway with obstructions and other trades prior to rough-in.
3. Conduit installation shall be coordinated with all other systems on the project. The Construction Team shall exchange details of their work in order to ensure adequate and coordinated fit of all systems within ceiling spaces and exposed unfinished areas.
4. Run concealed raceways with a minimum of bends in the shortest practical distance considering the type of building construction and obstructions, except as otherwise indicated.
5. Route exposed conduit and conduits above ceilings parallel and perpendicular to building structural lines, and as close to building structure as possible.
6. Raceways are not to cross pipe shafts or ventilating duct openings, nor are they to pass through HVAC ducts. Support riser raceway at each floor level with clamp hangers. Maintain adequate clearance between raceway and piping.
7. Coordinate layout and installation of conduit with other construction elements to ensure adequate headroom, working clearance and access.
8. Route conduit through roof openings provided for piping and ductwork or rooftop unit curbs where possible. Where unavoidable, route conduit through suitable roof jack with pitch pocket. Coordinate roof penetrations with other trades.
9. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
10. Do not install aluminum conduits in contact with concrete.
11. Raceways routed under-slab on grade must be a minimum of 12 inches below the concrete slab.

C. Conduit Supports:

1. Install raceways level and square and at proper elevations. Provide adequate headroom. Group related conduits; support using conduit rack. Construct rack using steel channel. All conduit supports shall be secured to walls, structural members and bar joists. Do not support conduits from non-structural members, such as ductwork, water or fire suppression piping, or ceiling grid support system.
2. Run parallel or banked raceways together, on common support racks where practical and make bends from same center line to make bends parallel. Use factory elbows only where they can be installed parallel; otherwise, provide field bends for parallel raceways. Provide space within each rack for 20 percent additional conduits.
3. Support raceways as specified in Division 26 Section "Hangers and Supports."

D. Conduit Fittings and Terminations:

1. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
2. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
3. Install raceway sealing fittings according to the manufacturer's written instructions. Locate fittings at suitable, approved, accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank coverplate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings where conduits enter or leave hazardous locations, where conduits pass from warm locations to cold locations, such as the boundaries of refrigerated spaces, such as kitchen cold boxes, air-conditioned spaces and other places indicated on the drawings or required by NFPA 70.
4. Expansion/Deflection Joints: Provide suitable fittings to accommodate expansion and contraction where raceway crosses seismic and expansion joints. Install expansion fittings in the full open position if installed during a period of lowest expected temperature, and in the fully closed position if installed during a period of highest expected temperature. Install at proportionate intermediate position for intermediate temperatures.

    a. In addition to the foregoing, provide expansion fittings according to the following table, for exposed linear runs or runs in hung ceilings where such runs do not contain junction boxes, pull boxes, nor bends totaling more than 30 degrees.
    b. EMT and RMC expansion couplers shall be UL listed with an internal copper braided bonding jumper that meets the requirements of NEC 250.98. Fitting shall be listed as suitable for wet locations and rain water tight when installed in wet or outdoor locations.

Raceway Material	Indoor, conditioned areas	Outdoors and non-conditioned areas
Steel	One expansion fitting in runs longer than 80 feet, additional expansion fittings every 400 feet	One expansion fitting in runs longer than 40 feet, additional expansion fittings every 200 feet
Aluminum	One expansion fitting in runs longer than 40 feet, additional expansion fittings every 200 feet	One expansion fitting in runs longer than 20 feet, additional expansion fittings every 100 feet
PVC	One expansion fitting in runs longer than 20 feet, additional expansion fittings every 100 feet	One expansion fitting in runs longer than 10 feet, additional expansion fittings every 50 feet

5. Flexible Connections: Use maximum of 6 feet of flexible metal conduit for recessed and semi-recessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement and for all motors. Use Liquidtight flexible metal conduit in wet or damp locations. Install ground conductor across flexible connections.

6. PVC Externally Coated Rigid Steel Conduit: Use only fittings approved for use with that material. Patch all nicks and scrapes in PVC coating after installing conduit. All installations shall be completed by a factory certified installer.
7. Avoid use of dissimilar metals throughout system to eliminate possibility of electrolysis. Where dissimilar metals are in contact, coat surfaces with corrosion inhibiting compound before assembling.

E. Conduit Bends:

1. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.
2. Make bends and offsets so the inside diameter is not reduced. Unless otherwise indicated, keep the legs of a bend in the same plane and the straight legs of offsets parallel.
3. Use conduit bodies to make sharp changes in direction, as around beams. Use hydraulic one-shot bender when field-fabricated elbows are required for bends in metal conduit larger than 2 inch size.
4. Stub-Up Connections: Use type of conduit described for stub-ups from slab. Extend conduit through concrete floor for connection to freestanding equipment to a distance 6-inches above the floor. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

3.3 WIREWAY INSTALLATION

A. Wireway shall be securely fastened to walls using steel channels. Mount plumb and level.

B. Raintight wireways may only be installed in horizontal orientations.

3.4 COMMUNICATIONS RACEWAY INSTALLATION REQUIREMENTS

A. General:

1. These guidelines are intended to supplement the requirements listed in other portions of this specifications section.
2. Minimum raceway size shall be as necessary to comply with fill ratio of referenced standards, but in no case less than 1 inch.
3. Provide specified pull wires in all cabling pathways.
4. Conduit terminations for all low voltage wiring shall have nylon bushings installed on each end.
5. Ground and bond all systems in accordance with the NEC and ANSI/TIA/EIA 607.
6. All installation material and practices shall fully comply with NFPA 70 “National Electrical Code” and ANSI/TIA/EIA 569A Commercial Building Standard for Telecommunications Pathways and Spaces (BICSI).
7. Coordinate work with the building structural systems and electrical installation.
8. All work shall fully comply with these Specifications and related Drawings and all manufacturers’ recommended installation practices.
9. Do not install conduit in concrete slab.
10. There shall not be more than the equivalent of 180 degrees of bends in any single run of conduit between adequately sized pull.

11. Conduits entering a Telecommunications room below the finished ceiling shall be extended a minimum of 4-inches below the ceiling, and shall be routed as tight to the adjacent wall as possible.
12. Conduits entering a Telecommunications room through a wall shall extend 15 inches into the room and kept a minimum of 8 feet above finished floor.
13. Conduit bends:

    a. Bends shall be made so that the conduit will not be flattened or kinked and the internal diameter of the conduit will not be reduced.
    b. The radius of the curve of the inner edge of any bend shall not be less than as indicated by the National Electrical Code and ANSI/TIA/EIA 569A Commercial Building Standard for Telecommunications Pathways and Spaces.
    c. In no case shall any conduit be bent or any fabricated elbow be applied to less than the allowable bending radius as specified by the cable manufacturer of the installed conductor.
    d. When necessary to make field bends, use tools designed for conduit bending. Heating of metallic conduit to facilitate bending is not permitted.

14. A conduit run shall not be longer than 100 feet between pull boxes for conduit runs inside a building.
15. Do not cut, burn or drill any structural member to mount electrical equipment or to facilitate tray or conduit installations without having previously received approval, in writing, from the Architect/Engineer/Consultant.
16. Mount all conduit a minimum of [3 inches] [X inches] above any accessible type ceiling.
17. Maintain conduit runs at least 6 inches from insulate pipes, steam lines or any other hot pipes they pass. Where the lines are not insulated, the clearances shall be increased until the temperature of the conduit, with no live conductors enclosed, does not rise above the ambient temperature of the installation area.

B. Communications Pathway Separation Requirements:

1. Provide separation of communications pathways to minimize the effects of electromagnetic interference (EMI) by installing pathways in the following manner:

    a. Provide a minimum of 12 inches separation from power lines exceeding 5kV and communications pathways not concealed in metallic conduit.
    b. Provide a minimum of 6 inches separation from power lines exceeding 5kV and communications pathways concealed properly bonded in metallic conduit.
    c. Provide a minimum of 37 inches separation from electrical motors and transformers and communications pathways.
    d. When power lines or cables of different signal conditions must intersect, crossing shall be made at 90 degree angle, with proper separation as outlined above.

C. Open Top Cable Supports (J-Hooks):

1. Install J-hook pathway, supporting at least every [5 feet], as straight as possible parallel and/or perpendicular to building structure.
2. Shall be mounted to building structure or suspended by threaded rod from the deck above approximately [6 inches] [12 inches] [as noted on drawings] above suspended ceiling.

3. Attachment of J-hooks must be to building structure directly or utilize a minimum of 1/4 inch all-thread rod anchored into deck above.
4. Bundle cables with Velcro cable straps per TIA 596C and at each directional change.
5. Under no condition shall there be more than 12 inches of vertical cable sag between supports.
6. Cinch-tight cable ties are prohibited for all low voltage cabling support.
7. Cable routes of less than ten 4 pair UTP (or equivalent weight) may be supported with bridal rings at maximum 5 feet-0 inch intervals.
8. During installation of cables thru open top cable supports, pulling tension of cables shall not exceed 25 lbs.

3.5 SEISMIC REQUIREMENTS

A. Whenever Specification Section 20 0800 "Seismic Protection" is included in these specifications, the following is also required for those life safety, emergency, fire alarms, etc., conduits that are defined therein. Details on the drawings, when shown, are intended to clarify or supplement these requirements:

1. All expansion joints shall be considered seismic joints that can cause movement in any direction during a seismic event. Conventional expansion fittings are not adequate for this condition.
2. For exposed conduit runs or runs in hung ceilings, provide a length of flexible metal conduit across the joint that will allow 2 inches of conduit movement in any direction. Length of the flexible section shall not exceed 6 feet.

3.6 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.7 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.8 CLEANING

A. Upon completion of installation of system, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches and abrasions.

3.9 MARKING AND IDENTIFICATION

A. Mark and identify conduits in accordance with Section 26 0553 “Identification for Electrical Systems.”

B. Mark and identify communications conduits.

3.10 RECORD DOCUMENTS

A. Accurately record actual routing of all feeder and sub-feeder conduits regardless of size and branch circuits conduits larger than 2-inches.

END OF SECTION 260533

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SECTION 260534 – BOXES, CABINETS AND ENCLOSURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes boxes, cabinets and enclosures for electrical wiring.

1.3 SUBMITTALS

A. Submittals for approval by the Engineer are not required for this section. Unrequested submittals will not be processed or reviewed. Non-requirement of submittals is not to be construed as an allowance for substitutions and does not allow relief from full compliance with the contract documents.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction and marked for intended use.

B. Comply with the following standards:

1. NECA "Standard of Installation."
2. NEMA OS 1: Sheet-Steel Outlet Boxes, Device Boxes, Covers and Box Supports.
3. NEMA OS 2: Non-Metallic Outlet Boxes, Device Boxes, Covers and Box Supports.
4. NEMA FB 1: Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable.
5. NEMA 250: Enclosures for Electrical Equipment (1000 Volts Maximum).

PART 2 - PRODUCTS

2.1 OUTLET BOXES

A. General: Outlet boxes shall be constructed in accordance with National Electrical Code Article 314. Outlet boxes shall be sized for the volume required by the National Electrical Code, but in no case shall they be less than 1-1/2 inches deep.

B. Sheet Metal Boxes: Comply with NEMA OS 1, galvanized steel.

C. Nonmetallic Outlet Boxes: Comply with NEMA OS 2.

D. Cast Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy or aluminum, type FD with gasketed cover and threaded hubs.

E. Boxes for receptacle, telephone and data outlets shall be 4-11/16 inches square by 2-1/8 inches deep and shall be provided with extension rings. Furnish outlet boxes with fixture studs where required.

F. Boxes for switches or local light control shall be 4 inches square by 1-1/2 inches deep and shall be provided with raised cover to fit flush with finished wall line. Provide single box for multiple-ganged devices with single coverplate, sized for the quantity of devices to be installed.

G. Provide 4-inch octagonal and square outlet boxes for all exposed conduit work with fixture extension pan or deep fixture canopy to enclose the outlet box.

H. Boxes for recessed light fixtures shall be 4-inch octagonal or square according to fixture hardware requirements, minimum 1-1/2 inches deep complete with blank cover.

I. Provide corrosion-resistant steel knockout closures for unused openings.

2.2 JUNCTION AND PULL BOXES

A. Small Sheet Metal Pull and Junction Boxes: Comply with NEMA OS 1, galvanized steel. Flush-mounted boxes shall have an overlapping cover.

B. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1, galvanized or aluminum with gasketed cover.

C. Covers: Covers shall be the same material as the box. Covers shall be on the largest access side of the box, unless otherwise indicated.

1. Less than 12 inches in any dimension: Screw-on cover.
2. Greater than 12 inches in any dimension: Hinged cover.

D. Hinged-Cover Enclosures: Comply with NEMA 250, Type 1 with continuous-hinge cover with flush latch, unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures: Plastic.

2.3 CABINETS AND ENCLOSURES

A. Comply with NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.

B. Provide metal barriers to separate wiring of different systems and voltage.

C. Hinged Cover: Hinged door in front cover with flush latch and concealed hinge.

D. Where lockable cabinets are provided, key latch to match panelboards.

E. Provide accessory feet where required for freestanding equipment.

PART 3 - EXECUTION

3.1 BOX AND CABINET INSTALLATION

A. General Installation Requirements:

1. Electrical boxes are shown on drawings in approximate locations unless dimensioned. The Engineer or Architect shall be allowed to adjust the location of boxes up to 10 feet in any direction without additional cost to the project. This is intended for boxes for receptacles and switches and other wiring devices.
2. Provide boxes as shown and for splices, taps, wire pulling, equipment and fixture connections and where required by applicable codes and installation practices.
3. Locate boxes to maintain headroom and present a neat appearance. Locate to allow proper access. Provide access doors for boxes located above inaccessible ceilings.
4. Provide knockout closures to cap unused knockout holes where blanks have been removed.
5. Support all boxes, cabinets and enclosures rigidly and independently of conduit except where specifically allowed by the National Electrical Code. Use supports suitable for the purpose.
6. Boxes located outdoors above ground shall be raintight and gasketed cast aluminum.
7. Provide covers for all boxes.
8. Do not install boxes back-to-back in same wall. Provide at least 6 inch separation or greater where required by the building code. In hollow fire walls, maintain minimum 24 inch horizontal separation between outlets on opposite sides. As an alternate to the 24 inch separation, the use of listed putty pads or other listed materials and methods approved by the Authority Having Jurisdiction are acceptable.

B. Outlet Box Installation:

1. All devices (receptacles, switches, occupancy sensors, fire alarm devices, low voltage devices, telephone jacks, TV jacks, data jacks, microphones jacks, etc., and any other device) furnished under this project shall be mounted on or in an outlet box regardless of whether or not the associated system wiring is in conduit, unless otherwise noted.
2. Flush-mount outlet boxes in finished areas. Outlets in mechanical rooms, electrical rooms, and the above removable ceilings may be surface-mounted.
3. Use multiple gang boxes where more than one device is mounted together. Provide barriers to separate different voltage systems.
4. For outlets mounted above counters, benches, or backsplashes, coordinate location and mounting heights with architectural details. Install with bottom of box minimum 6 inch above backsplash.
5. Align wall-mounted outlet boxes for switches, thermostats and similar devices.
6. Adjust outlet mounting height and horizontal location to agree with required location for equipment served as may be shown on installation instructions or shop drawing for the equipment.
7. Position outlets to locate luminaires as shown on reflected ceiling drawings. For recessed boxes in finished areas, secure to interior wall and partition studs; allow for surface finish thickness.
8. Ensure that thermal insulation will be in place behind outlet boxes before installing them in insulated walls. Do not damage insulation.

9. Special care shall be taken to set all flush boxes square and true with the building finish. The edge of the cover shall meet the building finish or be no greater than 1/8 inch back from the finish surface. All wall outlets shall be rigidly secured to the stud system, using adjustable supports where necessary, to prevent all box movement.
10. Do not set boxes back further than required by Code. Coordinate with building finishes. Do not install any box so that the device pushes back into the wall when pushed. All boxes are to be set so that the device yoke will securely bear upon the box or wall finish. Where the sheetrock contractor cuts an opening too big for this to be achieved, install a fitting such as Caddy # RLC.
11. Installation within Masonry walls:

    a. Adjust position of outlets in finished masonry walls to suit masonry course lines where possible. Do not, however, violate maximum heights defined by accessibility codes such as ADA.
        1) Coordinate cutting in of walls to achieve neat openings for boxes. Locate boxes in walls so that only the corner need be cut from masonry units where possible.
        2) Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.

12. Outlet Box Application: Unless otherwise noted, outlet boxes shall be installed as follows:

    a. Galvanized Steel Box Installation Locations:
        1) Concealed interior locations.
        2) Exposed interior locations above 7 feet-0 inches of finished floor.
        3) Kitchen and laundry rooms, when recessed.

    b. Cast Box Installation Locations:
        1) Exterior locations.
        2) Hazardous locations.
        3) Exposed interior locations within 7 feet-0 inches of finished floor.
        4) Wet or damp locations.
        5) Direct contact with earth or concrete slabs on grade.
        6) Kitchen and laundry rooms, when exposed.

C. Pull and Junction Boxes:

1. Locate above accessible ceilings or in unfinished areas.
2. Locate pull or junction boxes to limit conduit runs to no more than 150 linear feet of four (4) 90 degree bends between pulling points. For telephone/ data limit bends to no more than three (3) 90 degree bends to pulling points.

D. Cabinets and Enclosures:

1. Install hinged cover enclosures and cabinets plumb. At a minimum, support at each corner.
2. Provide knockout closures to cap unused knockout holes where blanks have been removed.

3.2 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.3 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

3.4 CLEANING

A. Upon completion of installation of system, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

3.5 MARKING AND IDENTIFICATION

A. Mark and identify boxes, cabinets and enclosures in accordance with Section 260553 “Identification for Electrical Systems.”

END OF SECTION 260534

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SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification for wires, cables and conductors.
3. Floor marking tape.
4. Warning labels and signs.
5. Instruction signs.
6. Equipment identification labels.
7. Miscellaneous identification products.

1.3 SUBMITTALS

A. Submittals for approval by the Engineer are not required for this section. Unrequested submittals will not be processed or reviewed. Non-requirement of submittals is not to be construed as an allowance for substitutions and does not allow relief from full compliance with the contract documents.

1.4 QUALITY ASSURANCE

A. Comply with the following standards:

1. ANSI A13.1 and IEEE C2.
2. NFPA 70.
3. 29 CFR 1910.144 and 29 CFR 1910.145.
4. ANSI Z535.4 for safety signs and labels.

B. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Electromark - Wolcott, New York.
2. Ideal Industries, Inc.
3. 3M.
4. Panduit Corp.
5. Seton Name Plate Co.
6. Thomas & Betts.
7. W. H. Brady, Co. - Signmark Division - Milwaukee, Wisconsin.

2.2 ELECTRICAL IDENTIFICATION PRODUCTS

A. Self-Adhesive Vinyl Labels (Raceways and Boxes): Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

B. Self-Adhesive Vinyl Tape for Banding (Raceway, Wire and Cable): Colored, heavy duty, waterproof, fade resistant; 2 inches wide.

C. Self-Adhesive Tape Markers (Wire and Cable): Vinyl or vinyl-cloth, self-adhesive, wraparound, cable and conductor markers with preprinted numbers and letters.

D. Colored Adhesive Marking Tape (Raceways, Wires, and Cables): Self-adhesive plastic coated cloth tape similar to Brady 441XX or 442XX series.

E. Conductor Identification Products:

1. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.
2. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

F. Floor Marking Tape:

1. 2-inch- (50-mm-) wide, 5-mil (0.125-mm) pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

2.3 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door or other access to equipment unless otherwise indicated.

C. Engraved, Plastic-Laminated Labels, Signs, and Instruction Plates: Engraving stock melamine plastic laminate, 1/16-inch minimum thick for signs up to 20 square inches, or 8 inches in length; 1/8-inch thick for larger sizes. Engraved legend in black letters on white face and punched for mechanical fasteners.

2.4 EQUIPMENT IDENTIFICATION LABELS

A. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Overlay shall provide a weatherproof and UV-resistant seal for label. Labels shall be at least 2-1/4 inches high. Where space does not permit this label size, smaller stock and lettering is permitted.

B. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with lettering and background colors as indicated. Labels shall be at least 2-1/4 inches high. Where space does not permit this label size, smaller stock and lettering is permitted.

2.5 CABLE TIES

A. Cable Ties: Fungus-inert, self-extinguishing, nylon one-piece, self-locking cable ties, 0.18-inch minimum width, 50-lb minimum tensile strength, and suitable for a minimum temperature range from minus 50 degrees F to 350 degrees F. Provide ties in specified colors when used for color-coding.

B. Identification Cable Ties: Same as "Cable Ties" above, except with integral tab of suitable size for marking requirements.

2.6 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior). Comply with maximum volatile organic compound levels imposed within Division 09.

B. Fasteners for Labels and Signs: Self-tapping, stainless steel screws or stainless steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Increase size of labels and letters to those appropriate for viewing from the floor for elevated components.

C. Lettering and Graphics: Coordinate names, abbreviations, colors and other designations used in electrical identification work with corresponding designations specified or indicated. Install numbers, lettering and colors as approved in submittals and as required by code.

D. Install identification devices in accordance with manufacturer's written instructions and requirements of NEC.

E. Clean and degrease surfaces prior to applying identification products. Apply identification to surfaces that require finish after finish work is completed. Utilize primer for metal surfaces, heavy-duty acrylic resin block filler for concrete masonry, and clear alkali-resistant alkyd binder-type sealer for concrete surfaces.

F. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

G. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

H. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

I. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.2 LABEL COLOR CODE LEGEND

A. Provide the following color coding scheme for each label based on the power system it is identifying:

1. Normal Power: Black letters on white background.
2. Life Safety Power: White letters on green background.
3. Emergency Branch: White letters on red background.

3.3 RACEWAY IDENTIFICATION

A. Where conduits leave a switchboard, panelboard, motor control center, etc., identification shall be provided on each conduit indicating the load being served.

B. Contractor shall be responsible for providing the Owner with laminated, colored, typewritten legends indicating the identification color scheme. At a minimum, these legends should be installed in the main electrical room and branch electrical closets. Provide two additional legends to the Owner to use at their discretion.

C. Identification of Raceways with Labeling:

1. Raceway Labeling: Provide labeling on conduits indicating electrical distribution system contained within (e.g. Normal, Life Safety, etc.) and operating voltage level. Label size shall be as follows:

Nominal EMT conduit size	Nominal RGS conduit size	Length of color background on label	Height of letters
up to 1 inch	up to 3/4 inch	8 inches	1/2 inch
1.25 to 1.5 inches	1 to 1.5 inches	8 inches	3/4 inch
2 to 5 inches	2 to 5 inches	12 inches	1.25 inches
6 inches	6 inches	24 inches	2.5 inches

2. Raceways carrying circuits over 600V: Provide label with 3-inch (75mm) high letters on 20-inch (500mm) centers to read as follows: "DANGER CONCEALED HIGH VOLTAGE WIRING."

3.4 BOX IDENTIFICATION

A. Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage:

1. Normal Power.
2. Emergency Power.

B. At each junction, pull and connection box, identify the following: with self-adhesive vinyl labels. Identification of these boxes shall be located on the inside of cover if located in finished spaces:

1. Power and lighting circuits: Indicate system voltage and identify contained circuits and panelboard serving load (e.g., “120V, PP1-1, 3, 5”).
2. Other wiring: Indicate system type and wiring description (e.g., “FIRE ALARM NAC #2”).

C. Paint box covers to correspond with system types as follows:

1. Fire Alarm: Red.
2. Temperature Control/Building Automation System: Blue.

3.5 CIRCUIT IDENTIFICATION

A. Label conductors as follows:

1. Multiple Power or Lighting Circuits in the Same Enclosure: Where multiple branch circuits are terminated or spliced in a box or enclosure, label each conductor with source and circuit number.
2. Multiple Control Wiring and Communication/Signal Circuits in Same Enclosure: For control and communications signal/wiring, use wire/cable marking tape at terminations in wiring boxes, troughs and control cabinets. Use consistent letter/number conductor designations throughout on wire/cable marking tape.

3.6 CONDUCTOR COLOR CODING

A. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, panelboards, manholes, handholes, switches, etc., use color-coding conductor tape to identify the phase.

1. Color-Coding for Conductors rated 600 V or Less: Use colors listed below for all conductors.

a. Color shall be factory-applied, or field-applied for sizes larger than No. 6 AWG, if Authorities Having Jurisdiction permit

1) Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) 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.

b. Colors for 208/120V Circuits:

1) Phase A: Black.
2) Phase B: Red.
3) Phase C: Blue.
4) Neutral: White.
5) Ground Bond: Green.

c. Colors for 480/277V Circuits:

1) Phase A: Brown.
2) Phase B: Orange.
3) Phase C: Yellow.
4) Neutral: Gray.
5) Ground Bond: Green.

B. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control and signal connections.

1. Identify conductors, cables and terminals in enclosures and at junctions, terminals and pull points. Identify by system and circuit designation.
2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

C. Open Cable Identification

1. Low Voltage Cable (Less than 120V): Provide self-adhesive pre-printed vinyl tape markers at 20 foot intervals to identify all cables run exposed or located above the accessible ceilings. Indicate the associated system by using the following color coding schemes:

a. Fire Alarm: Red lettering on white background.
b. Temperature Controls: Blue lettering on white background.
c. Security System: Black lettering on white background.
d. Telephone System: White lettering on blue background.

3.7 RECEPTACLE IDENTIFICATION

A. Identification Material: Pre-printed, self-laminating vinyl labels, 3/16-inch font height. Utilize black lettering on clear background for normal power circuits and red lettering on a clear background for emergency power circuits.

B. Coverplates: Provide identification on all receptacle coverplates indicating the source panelboard and circuit number serving the device (e.g., PP1#1).

3.8 SIGNAGE

A. Install instructional sign in each electrical room including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

B. Apply warning, caution, and instruction signs and stencils as follows:

1. Install warning, caution or operating instruction signs where required by NEC, where indicated, or where reasonably required to assure safe operation and maintenance of electrical systems and of the items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install fiberglass signs or outdoor items.
2. Emergency Operating Signs: Install engraved laminate signs with white legend on red background with minimum 3/8-inch high lettering for emergency instructions on power transfer, load shedding or other emergency operations where required by NEC or where required to assure safe operation and maintenance.
3. Arc Flash Hazard Warning: Provide signage on all electrical equipment such as switchboards, panelboards, industrial control panels, meter socket enclosures and motor control centers indicating arc flash hazard warning and advising appropriate PPE.

3.9 FLOOR TAPE

A. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

3.10 ELECTRICAL EQUIPMENT IDENTIFICATION

A. On each unit of equipment, install unique designation label that is consistent with wiring diagrams, one-line diagram, schedules and the Operation and Maintenance Manual. Each section of a multiple-section equipment lineup shall be provided with its own identification label. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets and racks of each system. Systems include power, lighting, control, communication, signal, monitoring and alarm systems unless equipment is provided with its own identification.

B. Labeling Instructions:

1. Indoor Equipment: Provide self-adhesive, engraved, laminated acrylic or melamine label.
2. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
3. Nameplate Data: Provide permanent operational data nameplate on each item of power operated equipment, indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances and similar essential data. Locate nameplates in an accessible location.
4. Fusible Switches: Install fuse manufacturer-supplied labels inside the door of the fusible switch indicating the proper type and fuse required for replacement.
5. Automatically Started Equipment: Provide adhesive label reading "DANGER - WARNING THIS MACHINE IS AUTOMATICALLY CONTROLLED. IT MAY START AT ANY TIME" on all motors, generators and other moving or hazardous equipment which is remotely or automatically operated. Sign to be similar to Brady Number 88191.

C. Specific Equipment Requirements:

1. Power Distribution Equipment: Including, but not limited to switchgear, switchboards, distribution panelboards, branch panelboards and motor control centers.

a. Identification label shall include the following:

1) Equipment type and tag designation shown on the contract documents using 1/2 inch high bold lettering.
2) Voltage and phase rating of the equipment using 1/4 inch high bold lettering.
3) The name of the upstream equipment and location/room number it is located in using 1/4 inch high bold lettering.
4) Rating and type of overcurrent protection device serving the equipment (e.g., “FED FROM 200A/3P CIRCUIT BREAKER”) using 1/4 inch high bold lettering.

b. Example Identification Label:

DISTRIBUTION PANEL ‘DP1’
208Y/120V 3-Phase 4-Wire
Fed from Panel MP1; Room 200
Fed from 200A/3P Circuit Breaker

c. Distribution panelboards and switchboards shall be provided with permanent labeling adjacent to each overcurrent protection device indicating the load being served and the location of the equipment.
d. A typewritten directory of circuits shall be provided at all branch panelboards. Provide explicit description and identification of items served by each individual switch and circuit breaker.

2. Transformers:

a. Identification label shall include the following:

1) Equipment type and tag designation shown on the contract documents in 1/2 inch high bold lettering.
2) Voltage and phase rating of equipment using 1/4 inch high bold lettering.
3) The name of the upstream equipment and location/room number it is located in using 1/4 inch high bold lettering.
4) Rating and type of overcurrent protection device serving the equipment (e.g., "FED FROM 70A/3P CIRCUIT BREAKER") using 1/4 inch high bold lettering.

b. Example Identification Label:

TRANSFORMER 'T1'
480Δ:208Y/120V 75kVA
Fed from Panel DP1; Room 200
Fed from 125A/3P Circuit Breaker

3. Control Equipment: Including but not limited to disconnect switches, starters, variable-speed controllers, contactors, motor control centers, pushbutton stations, etc.

a. Identification label shall include the following:

1) Equipment type and tag designation shown on the contract documents of the actual equipment served in 1/2 inch high bold lettering.
2) Location of equipment being served in 1/4 inch high bold lettering. If the equipment being served by the control equipment is located in the same room, identify location as "THIS ROOM."
3) Voltage and phase rating of equipment in 1/4 inch high bold lettering.
4) The name of the upstream equipment and location/room number it is located in using 1/4 inch high bold lettering.

b. Example Identification Label:

AHU-6 Supply Fan 'AHU-6S'
Located in Mechanical Room 001
480V 3-Phase, 3 Wire
Fed from Distribution Panel MHEQ; Room 200

4. Power Transfer Equipment.

a. Identification label shall include the following:

1) Equipment type and tag designation shown on the contract documents in 1/2 inch high bold lettering.
2) The power branch the power transfer equipment serves (e.g., CRITICAL, LIFE SAFETY, EQUIPMENT, NORMAL) in 1/2 inch high bold lettering.
3) Voltage, phase rating and pole quantity of equipment using 1/4 inch high bold lettering.

4) The name of upstream equipment and location/room number it is located in using 1/4 inch high bold lettering. Differentiate upstream sources by indicating Normally Closed (NC) and Normally Open (NO). If the upstream equipment supplying power is located in the same room as the power transfer equipment, identify location as "THIS ROOM."
5) The name of the downstream equipment and location/room number it is located in using 1/4 inch high bold lettering. If the downstream equipment being served is located in the same room as the power transfer equipment, identify location as "THIS ROOM."

b. Example Identification Label:

AUTOMATIC TRANSFER SWITCH 'ATS-C1'
CRITICAL POWER
480Y/277V 3-Phase, 4-Wire, 4-Pole
Upstream Source (NC): Fed from Panel 'SB-1'; Room 200
Upstream Source (NO): Fed From Panel 'SB-GP'; Room 201
Downstream: Feeds Distribution Panel 'DP-C1'

END OF SECTION 260553

SECTION 260573 - POWER SYSTEM STUDIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes computer-based, fault-current analysis and report, overcurrent protective device coordination study and arc flash hazard analysis and report.

1. Electrical service fault current calculation labeling shall be provided based upon the results as required in NFPA 70 Article 110.24.
2. Protective devices shall be set based on results of the protective device coordination study.
3. Arc flash labeling shall be provided based upon results of arc flash analysis Study per the requirements set forth in the current issue of NFPA 70E-Standard for Electrical Safety in the Workplace. The arc flash hazard analysis shall be performed according to the IEEE Standard 1584-2002, the IEE Guide for Performing Arc-Flash Calculations.

B. The scope of the studies shall include the entire electrical system proposed within the contract documents.

1.3 SUBMITTALS

A. Product Certificates: For coordination-study, fault-current-study, and arc flash hazard calculation computer software programs, certifying compliance with IEEE 399.

B. Qualification Data: For coordination-study specialist:

1. The power system studies shall be performed based upon the contract documents and shall include the specific equipment, settings and performance to be provided and estimated conductor lengths.

C. Submittals: The following submittals shall be made after the approval process for system protective devices has been completed. A preliminary Arc Flash Hazard analysis shall be submitted to the Owner’s Representative no later than six (6) weeks after the overcurrent protective device shop drawings have been approved.

1. Documentation shall be provided in a report format, contained within a bound booklet or three-ring binder. Individual studies shall be separated with identification labels. Shop drawings shall be provided for all overcurrent protective devices in a separate section of the same document.

a. The report shall include the following sections:

1) Executive Summary including Introduction, Scope of Work and Results/Recommendations.
2) Short-Circuit Methodology Analysis Results and Recommendations.

    a) Fault current calculations shall be provided for both utility fault current contributions and on-site standby-power generation fault current contributions. Calculation input data shall be provided including fault current contributions. Fault current calculations shall be submitted in both report form and plotted one-line diagrams.

3) Short Circuit Device Evaluation Table.
4) Protective Device Coordination Methodology Analysis Results and Recommendations.

    a) This section shall include Coordination Study input data, including completed computer program input data sheets.

5) Protective Device Settings Table.
6) Time-Current Coordination Graphs and Recommendations.
7) Arc Flash Hazard Methodology Analysis Results and Recommendations.

    a) This section shall include the details of the incident energy and flash protection boundary calculations, along with Arc Flash boundary distances, working distances, Incident Energy levels and Personal Protection Equipment Levels. The arc flash calculation results should consider and evaluate all possible power source scenarios (utility power source, emergency power source, main-tie-main configurations, etc.) and alternate temporary circuit breaker settings (maintenance mode).

8) Arc Flash Labeling.

    a) This section shall include descriptive information as well as typical label images for the types of labels to be provided.

9) Computer Generated One-Line Diagram of the Electrical System.

    a) The One-Line diagram must clearly identify individual equipment buses, bus numbers used in the short-circuit analysis, cable and bus connections between the equipment, calculated maximum short-circuit current at each bus location, device numbers used in the time-current coordination analysis and other information pertinent to the computer analysis.

2. Power system study project model and results shall be submitted on electronic media for use by the Owner. Electrical model information shall include complete coordination files including all device curves. (If using the SKM PowerTools program, Project - Backup shall be used to provide all project electrical model information.)

3. Calculations and analysis shall include the stamp or seal and signature of the preparing Registered Professional Electrical Engineer and shall be reviewed and approved by the Engineer of Record.

1.4 QUALITY ASSURANCE

A. Studies shall use computer programs defined in this specification. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.

B. Coordination Study Specialist Qualifications: An entity experienced in the application of computer software used for studies having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. Engineering Firm: The approved Engineering firm shall have a minimum of fifteen (15) years of experience in performing power system studies.
2. Professional Engineer: The Registered Professional Engineer shall be licensed in the state where Project is located and will be responsible for the studies. All elements of the studies shall be performed under the direct supervision and control of the Registered Professional Engineer.

C. Provide products and installation methods specified in this section that comply with the following Standards:

1. Comply with IEEE 242 for short-circuit currents and coordination time intervals.
2. Comply with IEEE 399 for general study procedures.
3. Comply with IEEE 1584 and NFPA70E-2009/2012 for arc flash hazard analysis.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Computer Software Developers: Subject to compliance with requirements, provide products by one of the following:

1. SKM Systems Analysis, Inc. Power Tools for Windows (PTW).

2.2 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

A. Comply with IEEE 399.

B. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable" and "desirable" features as listed in IEEE 399.

C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.

D. Analysis shall include software capable of calculating arc flash hazard and preparing arc flash hazard labels.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings, in the Specifications, by the Owner, and as required by the applicable edition of the National Electrical Code NFPA 70.

1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.
2. The short circuit, overcurrent protective device coordination analysis and fault hazard calculations shall be based upon a complete electrical model of the electrical system from the utility service through the entire building's electrical distribution system, including branch circuit and lighting panelboards, motor control centers, individual motor control devices, motor disconnect switches and distribution panelboards.

3.2 POWER SYSTEM DATA

A. Gather and tabulate the following input data to support coordination study:

1. Product Data for overcurrent protective devices specified in other Division 26 Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data and recommended device settings.
2. Impedance of utility service entrance.
3. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:

    a. Circuit-breaker and fuse-current ratings and types.
    b. Relays and associated power and current transformer ratings and ratios.
    c. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance and X/R ratios.
    d. Generator kilovolt amperes, size, voltage and source impedance.
    e. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation and length.
    f. Busway ampacity and impedance.
    g. Motor horsepower and code letter designation according to NEMA MG 1.

4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram showing the following:

    a. Special load considerations, including starting inrush currents and frequent starting and stopping.

b. Transformer characteristics, including primary protective device, magnetic inrush current and overload capability.
c. Motor full-load current, locked rotor current, service factor, starting time, type of start and thermal-damage curve.
d. Generator thermal-damage curve.
e. Ratings, types and settings of utility company's overcurrent protective devices.
f. Special overcurrent protective device settings or types stipulated by utility company.
g. Time-current-characteristic curves of devices indicated to be coordinated.
h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range and instantaneous adjustment range for circuit breakers.
i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range and current transformer ratio for overcurrent relays.
j. Panelboards, switchboards, motor-control center ampacity and interrupting rating in amperes rms symmetrical.

3.3 Short-Circuit CURRENT STUDY

A. Calculate the maximum available short-circuit current in Amperes (RMS, Symmetrical) from the utility service to and including circuit-breaker positions of the electrical power distribution system shown on the drawings.

B. Transformer design impedances shall be used when test impedances are not available.

C. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at the main bus of all switchgear, switchboards, distribution panelboards, branch panelboards, motor control centers, motor controllers (including variable frequency drives) and disconnect switches.

D. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.

E. Calculate momentary and interrupting duties on the basis of maximum available fault current.

F. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with the latest edition of the following:

1. IEEE 241 – IEEE Recommended Practice for Electric Power Systems in Commercial Buildings

G. Study Report:

1. Input Data: The study shall include input circuit data including electric utility system characteristics, source impedance data, conductor lengths, number of conductors per phase, conductor impedance values, insulation types, transformer impedances and X/R ratios, motor contributions and other circuit information as related to the short-circuit calculations.

2. One-Line Diagram: Documentation shall be made in one-line diagram form showing the magnitude and location of each calculated fault. A summary of the fault currents available shall also be submitted.
3. Calculations: Provide tabulated form of calculated quantities including short-circuit currents, X/R ratios, equipment short-circuit interrupting or withstand current ratings and notes regarding adequacy or inadequacy of the equipment ratings.
4. Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.
5. Provide a comprehensive discussion section evaluating the adequacy or inadequacy of the equipment and include recommendations as appropriate for improvements to the system.
6. Contractor shall notify the Owner in writing of any circuit protective devices improperly rated for the calculated available fault current.

3.4 OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

A. Perform coordination study using approved computer software program. The analysis shall include comparing time/current curves of primary protective devices, service and distribution transformers, main service overcurrent protective devices, switchgear, switchboard, motor control center, distribution panelboard, panelboards and branch feeder devices.

1. Where applicable, the analysis shall include the standby and emergency power system components, including the standby power source fault currents and overcurrent device operations.
2. Terminate device characteristics curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
3. The protective device settings shall address the need to minimize arc flash hazards while maintaining proper coordination.

B. Comply with recommendations for fault currents and time intervals dictated within the latest edition of the following:

1. IEEE 241 – IEEE Recommended Practice for Electric Power Systems in Commercial Buildings

C. Transformer Primary Overcurrent Protective Devices:

1. Device shall not operate in response to the following:

   a. Inrush current when first energized.
   b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
   c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.

2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

D. Motors served by voltages more than 600 V shall be protected according to IEEE 620.

E. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482 and conductor melting curves in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

F. Selective Coordination Analysis

1. Provide a complete selective coordination analysis, comparing time/current curves of the protective devices to be installed to assure complete selectivity between main and downstream devices for code-required branches and branches identified specifically one the one-line diagram.
2. Provide settings of protective devices to assure complete selectivity between devices as indicated below and as required by Code while providing proper protection.

G. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:

1. One-Line Diagram: Provide a one-line diagram which clearly identifies individual equipment buses, bus numbers, protective device identification numbers and the maximum available short-circuit current at each bus when known.
2. Tabular Format of Settings Selected for Overcurrent Protective Devices: Provide a separate tabular printout containing the type and recommended settings of all adjustable overcurrent protective device parameters, the equipment designation where the device is located, and the device number corresponding to the device on the system one-line diagram.
3. Coordination Curves: Prepare log-log scale graphs using time-current curves to determine settings of series connected overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Identify the device associated with each curve by device identification tag, manufacturer type, function and, if applicable, tap, time delay and instantaneous settings recommended. In addition, include the following information on the time-current curve graphs, where applicable:

    a. Electric utility’s overcurrent protective device.
    b. Medium voltage equipment overcurrent relays.
    c. Medium and low voltage fuses including manufacturer’s minimum melt, total clearing, tolerance and damage bands.
    d. Low voltage equipment circuit breaker trip devices, including manufacturer’s tolerance bands.
    e. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
    f. Medium voltage conductor damage curves.
    g. Ground fault protective devices.
    h. Pertinent motor starting characteristics and motor damage points.
    i. Pertinent generator short-circuit decrement curve and generator damage point.

j. The largest feeder circuit breaker or fuse in each motor control center and applicable panelboard.

4. Include time current curves for both the phase and ground fault settings for each overcurrent protective device including device set points.
5. Completed data sheets for setting of overcurrent protective devices.

H. The Contractor shall notify the Owner in writing of any significant deficiencies in protection and/or coordination, along with recommendations for improvements.

3.5 ARC FLASH HAZARD ANALYSIS

A. Arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2009, Annex D after completion of settings for all overcurrent protective devices in the electrical model and calculation of the maximum available fault currents at each bus.

B. Arc flash hazard analysis shall calculate the flash boundary and incident energy at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway and splitters) where work could be performed on energized parts.

C. Exclude any equipment rated 240V ac or less fed from step down transformers less than 125 kVA.

D. Safe working distances shall be based on IEEE 1584. The calculated arc flash protection boundary shall be determined using those working distances.

E. Arc flash PPE level shall not exceed 2 at any electrical bus or main protective device.

F. The fault calculations and resulting arc flash hazard calculation results shall be compared for multiple scenarios to determine the greatest incident energy for each equipment location. Calculations shall be performed at both maximum and minimum fault currents, and for scenarios where system is operating based upon utility or standby power sources.

1. A minimum calculation shall assume the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off).
2. A maximum calculation will assume a maximum contribution from the utility and will assume the maximum about of motors to be operating.
3. Where applicable, calculations must take into consideration the parallel operation of synchronous generators with the electric utility source.

G. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices shall be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations.

H. The incident energy calculations shall consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or

decremented with time. Fault contribution from motors and generators should be decremented as follows:

1. Fault contribution from induction motors should not be considered beyond 3 to 5 cycles.
2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g., contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).

I. For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.

J. When performing incident energy calculations on the line side of a main breaker (as required per the above), the line side and load side contributions must be included in the fault calculation.

K. Incoordination should be checked among all devices within the branch containing the immediate protective device upstream of the calculation location, and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.

L. Arc flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-2002.

M. Where it is not physically possible to move outside the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.

N. Create and install NFPA 70E compliant labels describing the arc flash hazard level at all switchboards, panelboards, disconnect switches and other locations in the electrical distribution system where work could be performed on energized parts.

1. The label shall include worst-case incident energy calculated in the analysis and the hazard category or appropriate personal protective equipment (PPE) required to perform maintenance on the system when energized, the available short circuit current at the equipment, the study report number and the date the calculations were performed. Labels shall be waterproof vinyl or laminated, with a self-adhesive backing.
2. Provide labels on the front of each individual section of floor standing and wall mounted equipment.
3. Install labels on the front of each individual section of floor standing and wall mounted equipment.

O. A list of all hazard categories and the corresponding PPE requirements shall be posted in the main electric room, engineering office or other location. The list shall be plastic laminate or typewritten and housed in a plastic frame.

P. Contractor shall submit the following:

1. Results of the Arc-Flash Hazard Analysis in tabular form, Include device or bus name, bolted fault and arcing fault current levels, flash protection boundary distances, working

distances, personal-protective equipment classes and Arc Flash Incident Energy Levels. Report shall clearly indicate which analysis scenario yielded the worst-case result.

2. Report incident energy values based on recommended device settings for equipment within the scope of the study.
3. Recommendations to reduce Arc Flash Incident Energy Levels and enhance worker safety, where applicable.

3.6 ADJUSTMENTS

A. Manufacturer's authorized representative or Contractor shall set all adjustable protective devices to values indicated in the approved coordination study.

B. The Contractor shall make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.

C. The Short Circuit Study, Coordination Study and Arc Flash Hazard Analysis shall be reviewed and updated to reflect any changes and corrections to conductor length within one week of the final electrical walk through for punch list.

3.7 TRAINING

A. Provide two hours of Owner training of arc flash hazard risks and labeling.

END OF SECTION 260573

SECTION 260600 - ELECTRICAL DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Electrical coordination, materials and methods for electrical demolition associated with remodeling of an existing area or facility for re-use.

1.3 SELECTIVE DEMOLITION

A. This Section includes limited scope general construction materials and methods for application with electrical installations as follows:

B. Selective demolition including:

1. Nondestructive removal of materials and equipment for reuse or salvage as indicated.
2. Dismantling electrical materials and equipment made obsolete by these installations.
3. Miscellaneous metals for support of electrical materials and equipment required to remain.
4. Firestopping as required to maintain existing partition ratings.

1.4 PROJECT CONDITIONS

A. Conditions Affecting Selective Demolition: The following project conditions apply:

1. Protect adjacent materials indicated to remain. Install and maintain dust and noise barriers to keep dirt, dust and noise from being transmitted to adjacent areas. Remove protection and barriers after demolition operations are complete.
2. Locate, identify and protect electrical services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services for affected areas.
3. Maintain and protect existing building services that transit the area affected by selective demolition.

1.5 SEQUENCE AND SCHEDULING

A. Coordinate the shut-off and disconnection of electrical, fire alarm and communication services with the Owner and the utility companies. Coordinate any electrical outages required for service switchovers or connections with the Owner a minimum of five working days prior to the interruption. Comply with Owner's specific requirements for partial or complete outage requests.

B. All work that produces excessive noise and/or interference with normal building operations, as indicated on the drawings, shall be coordinated and scheduled with the Owner.

C. Assume that all required re-connection of existing systems or equipment not indicated for demolition must remain operational unless otherwise noted. Provide temporary connections to maintain electrical services and systems serving adjacent areas during required outages.

D. Maintain existing electrical service, electrical distribution, fire alarm and communication equipment in operation until the new electrical service or distribution equipment is energized, tested and accepted.

1.6 DRAWINGS AND SPECIFICATIONS

A. The architectural, structural, mechanical and electrical drawings and specifications shall be considered as mutually explanatory and complementary. Any electrical demolition work called for by one and not by the other shall be performed as though required by all. All sections and subsections of the Electrical work shall be governed by and subject to the general and supplementary conditions. Any discrepancies in or between the drawings and specifications, or between the drawings and actual field conditions shall be reported to the Engineer/Architect in sufficient time to issue an addendum for clarification.

B. The electrical drawings are diagrammatic and the drawings indicate the general layout of the electrical systems. Field verification of scale dimensions on plans is directed since actual locations, distance and levels will be governed by actual field conditions.

PART 2 - PRODUCTS

2.1 MATERIALS AND METHODS

A. Materials and methods required for removing, patching, connections, etc., shall be as specified in the associated specification sections.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL DEMOLITION

A. Comply with NECA 1.

3.2 EXAMINATION AND COORDINATION

A. Examine substrates, areas and conditions with Installer present for compliance with requirements for conditions affecting demolition.

B. Coordinate the demolition scope of work with the Owner and other Contractors to confirm that all required electrical demolition is addressed and scheduled to avoid disputes.

3.3 SELECTIVE DEMOLITION

A. The Electrical Contractor shall remove, cap and/or relocate equipment, outlets, conduit, wire, etc., as shown and specified on drawings and as may become necessary because of existing field

conditions. It shall be the responsibility of the Electrical Contractor to visibly examine all existing walls designated for removal to determine the conduit and the wiring that will require capping and/or removal, whether or not such conditions are indicated on the drawings. The contractor shall be held to having visited the site and taken all existing conditions into consideration.

B. Where the architectural drawings indicate that partitions, walls, ceilings, etc., are to be removed the Electrical Contractor shall be responsible for removal of all electrical components within those structures including equipment, lighting fixtures, lighting controls, wiring devices, raceways, wiring, electrical systems, etc.

C. In addition to the foregoing, comply with the following:

1. Maintain circuit continuity to all existing fixtures, equipment, outlets, etc., to remain in use whether noted on the plans or not. Field-verify existing items to remain in use. Wiring for existing circuits which must be re-routed or which are partially abandoned, shall be reconnected to service the remaining outlets on the circuit.
2. In the demolition work, remove all unused wiring and cables and unused conduit that is exposed or within accessible ceilings which is affected by and is in the area of the work of this contract.

D. The intention of the electrical demolition drawings is to disconnect and remove all electrical work made void by the scope of the construction and alteration. Field-verify exact material quantities required to be removed.

E. Abandoned electrical power distribution equipment, including switchboards, motor controllers, panelboards, lighting fixtures and controls and wiring devices shall be disconnected and removed unless otherwise noted. All supporting equipment for this equipment to be removed, including hangers, supporting rods, ballasts, etc., shall be removed.

F. All existing electrical work and associated raceway and wiring, which has been made obsolete by the work and/or is shown dashed on the electrical demolition drawings shall be disconnected and removed back to the source of power unless otherwise noted. Although an attempt has been made to indicate all of this work, total accuracy is not guaranteed. Contractor shall visibly examine all areas and walls and ceilings scheduled for removal to determine existing electrical items to remain.

G. Where electrical equipment, conduit, boxes and supporting hardware are removed, patch and finish the surface as required to match the existing unless otherwise noted.

H. Where buried conduits extending out of a concrete slab become abandoned, cut and grind the conduits off flush with top of slab and plug with non-shrink waterproof grout fill.

I. All removed materials, other than removed materials to be relocated, or stored or turned over to the Owner shall become the property of the Contractor and shall be removed from the project site.

J. Acceptance of contract means installer accepts existing conditions.

K. Contractor shall coordinate all demolition work with all other trades.

L. In walls or floors where a flush device is being removed, but the wall or floor remains or for any outlet which must remain, but has a device removed, provide a blank cover over the outlet. Match the color and material of existing remaining covers in the room or space.

M. In areas where the partitions, ceilings, etc., are indicated to be temporarily removed, the Electrical Contractor shall be responsible for the disconnection, storage, re-installation and re-connection of equipment or devices within that partition, ceiling, etc., unless otherwise noted.

N. Legally dispose of hazardous materials and ballasts or other equipment containing PCBs and lamps containing mercury or equipment containing oil. Comply with all Federal, state, and local laws. This includes HID and fluorescent lamps determined to be hazardous waste. These shall be disposed of at a permitted hazardous waste disposal facility or other appropriately permitted entity.

O. Provide manifests and travel and disposal forms and documents to Owner when required by Owner or regulatory agencies.

3.4 CLEANING

A. Clean existing electrical distribution equipment affected by the project, including switchboards, motor controllers, panelboards, etc. Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide coverplates for openings. Modify existing panelboard directories (or replace) for panelboards which have had alterations to the circuits originating therein. Describe the load and location.

B. Where luminaires are indicated to be retained and re-used, the Electrical Contractor shall clean all exterior and interior surfaces. Lamps and ballasts shall be replaced with new. Broken electrical parts, including guards and lens shall be replaced to match existing construction unless otherwise noted.

3.5 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical demolition to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 260600

SECTION 262200 - LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following types of dry-type transformers with primary voltages rated 600 V and less:

1. Distribution transformers.

1.3 SUBMITTALS

A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, loss data, sound level, insulation system type, rated temperature rise and efficiency performance for each type and size of transformer indicated.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each transformer type through one source from a single manufacturer.

B. Comply with the following standards:

1. NEMA ST 1 – Specialty Transformers.
2. NEMA ST 20 – Dry Type Transformers for General Applications.
3. ANSI/IEEE C57.12.01 – General Requirements for Dry Type Distribution and Power Transformers.
4. ANSI/IEEE C57.12.91 – Test Code for Dry-Type Distribution and Power Transformers.

C. All transformers shall be listed by Underwriters Laboratories and bear the UL label.

D. Provide transformers that are constructed to withstand seismic forces specified in Division 20 Section "Seismic Protection."

E. Base kVA rating shall not be obtained by use of fans or other external cooling methods.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Handle transformers in accordance with manufacturer’s recommendations. Utilize factory provisions for all lifting, rigging or hoisting.

B. Store transformers prior to installation in a temperature and humidity controlled space with the ventilation openings covered to mitigate dust intrusion. If such a space is not available, apply

temporary heat in accordance with manufacturer's instructions within each ventilated type transformer case to exclude moisture and condensation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Cutler-Hammer.
2. Siemens Energy & Automation, Inc.
3. Square D Co.
4. General Electric

2.2 DISTRIBUTION TRANSFORMERS

A. Description: DOE 2016 Efficiency compliant, General purpose, self-cooled, two winding, dry type designed for 60Hz operation.

B. Insulation System:

1. 220 degrees C, with a maximum of **115**-deg. C rise above 40-deg. C ambient temperature.

C. Core: High-grade, non-aging, silicon steel with high magnetic permeability and low hysteresis and eddy current losses.

D. Coils: Continuous windings with brazed or welded terminations.

1. Coil Material: Copper or aluminum.

E. Grounding:

1. Core and coil assembly shall be grounded by means of a flexible safety ground strap or conductor.
2. All transformer grounding and bonding connects shall be made to a ground bus bar secured inside the transformer enclosure. Refer to Division 26 section "Grounding and Bonding" for ground bus bar requirements.

F. Electrostatic Shielding: Independent, single, full-width electrostatic shield placed between each primary and secondary winding and ground. Provide as shown on drawings.

G. Winding Taps: Rated for full capacity on primary winding.

1. Transformer size less than 15kVA: Minimum of two (2) 5 percent below normal rated voltage.
2. Transformer size greater than 15kVA and less than 750kVA: Minimum of two (2) 2-1/2 percent above and four (4) 2-1/2 percent below normal rated voltage.

H. Enclosure: NEMA ST 20, Type 1, front and rear removable covers.

1. Core and coil assembly shall be isolated from the enclosure utilizing rubber vibration dampening pads.
2. Each transformer shall have a securely attached nameplate providing complete electrical ratings, wiring diagram, tap connections and catalog number as applicable.
3. The maximum temperature of the enclosure shall not exceed 90 degrees C.

I. Mounting Capability: Suitable for the following:

1. Transformer size less than 75kVA: Wall, Floor or Trapeze.
2. Transformer size greater than 75kVA: Floor or Trapeze.

J. Sound Levels: Shall not exceed the following ANSI and NEMA levels for self-cooled ratings:

kVA Rating	Sound Levels
0 – 9 kVA	40 dB
10-50 kVA	45 dB
51-150 kVA	50 dB
151-300 kVA	55 dB
301-500 kVA	60 dB
501-700 kVA	62 dB
701-1000 kVA	64 dB
1001-1500 kVA	65 dB

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that ground connections are in place and requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" have been met.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install transformers level and plumb. Utilize a maximum of 2 feet-0 inches of flexible conduit for connections to side of transformer case.

B. Identify transformers and install warning signs according to Division 26 Section "Identification for Electrical Systems."

C. Use lugs rated for 75 degree Celsius when connecting conductors to transformer.

3.3 FIELD QUALITY CONTROL

A. Schedule tests and provide notification at least one week in advance of test commencement.

B. Tests: Include the following minimum inspections and tests according to the manufacturer's instructions.

1. Inspect accessible components for cleanliness, mechanical and electrical integrity, for presence of damage or deterioration and to ensure removal of temporary shipping bracing. Do not proceed with tests until deficiencies are corrected.

a. Include internal inspection through access panels and covers.
b. Inspect bolted electrical connections for tightness according to manufacturer's published torque values or, where not available, those of UL standards 486A and 486B.

2. Insulation Resistance: Perform megohmmeter test of primary and secondary winding-to-winding and winding-to-ground. Use a minimum test voltage of 1,000 V D.C. Minimum insulation resistance is 500 megohms.
3. Duration of Each Test: 10 minutes.
4. Temperature Correction: Correct results for test temperature deviation from 20 degrees C standard.

C. Test Failures: Correct deficiencies identified by tests and retest. Verify that equipment meets the specified requirements.

D. Submit certification that tests have been performed.

E. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies and equipment installations including connections and to assist in testing.

F. Remove and replace units that do not pass tests or inspections and retest as specified above.

G. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.

1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
2. Perform 2 follow-up infrared scans of transformers, one at 4 months and the other at 11 months after Substantial Completion.
3. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken and scanning observations after remedial action.

3.4 ADJUSTING

A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions.

B. Connect buck-boost transformers to provide nameplate voltage of equipment being served plus or minus 5 percent at secondary terminals.

3.5 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 262200

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SECTION 262413 – SWITCHBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Distribution switchboards rated 600 V and less.
2. Instrumentation.
3. Control power.
4. Accessory components and features.

1.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Switchboards shall withstand the effects of earthquake motions determined.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event".

1.4 SUBMITTALS

A. Review of submittals for this equipment will not be considered complete without an approved Power System Study to confirm adequate short-circuit current ratings and protective device coordination. Refer to specification 260573 for additional information.

B. Product Data: For each type of switchboard, overcurrent protective device, transient voltage suppression device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Product data for each product and component specified.
2. Shop drawings for each switchboard including dimensioned plans and elevations, component and device lists, and a one-line diagram showing main and branch bus current ratings and short-time and short circuit ratings of switchboard.
3. Manufacturer's Schematic Wiring Diagram.
4. Point-to-Point Control Wiring Diagram: Differentiating between manufacturer-installed and field-installed wiring (may be submitted upon delivery of switchboard).
5. Report of field tests and observations certified by the testing organization.
6. Maintenance data for materials and products, for inclusion in Operating and Maintenance Manual specified in Division 01 and in Division 26 Section "Common Work Results for Electrical."

C. Shop Drawings: For each switchboard and related equipment.

1. Include dimensioned plans, elevations, sections and details including required clearances and service space around equipment. Show tabulations of installed devices, equipment features and ratings.
2. Detail enclosure types for types other than NEMA 250, Type 1.
3. Detail bus configuration, current and voltage ratings.
4. Detail short circuit current rating of switchboards and overcurrent protective devices.
5. Detail features, characteristics, ratings and factory settings of individual overcurrent protective devices and auxiliary components.
6. Include short circuit current calculation results to show the short-circuit current rating for this equipment exceeds the available short-circuit fault current available. Refer to specification 26 0573.
7. Include overcurrent protective device study to show all essential electrical systems, emergency systems and legally required standby system protective devices coordinate with upstream and downstream overcurrent protective devices to the code required interval, or specific interval indicated. Refer to specification 26 0573.]
8. Include manufacturer’s selective coordination tables indicating coordination between the main and branch circuit breakers. The main breaker and branch breakers being provided shall be clearly labeled on the tables.
9. Include schematic and wiring diagrams for power, signal and control wiring.

D. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

E. Operation and Maintenance Data: For switchboards and components to include in emergency, operation and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Routine maintenance requirements for switchboards and all installed components.
2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
3. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graph paper; include selectable ranges for each type of overcurrent protective device.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.

B. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency and marked for intended location and application.

D. Comply with NEMA PB 2 “Deadfront Distribution Switchboards.”

E. Comply with NFPA 70 “National Electrical Code.”

F. Comply with UL 891 “Deadfront Switchboards.”

G. Listing and Labeling: Provide switchboard assemblies that are listed and labeled by Underwriters Laboratories for the specific purpose.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the site under provisions of Section 26 0500.

B. Deliver in 48 inch maximum width shipping splits unless approved otherwise by both the Contractor and Engineer, individually wrapped for protection and mounted on shipping skids.

C. Store and protect products under provisions of Section 26 0500.

D. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris and traffic.

E. Handle in accordance with NEMA PB2.1 and manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to switchboard internal components, enclosure and finish.

F. Handle and prepare switchboards for installation according to NECA 400 "General Instructions for Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards." Use factory-installed lifting provisions.

1.7 PROJECT CONDITIONS

A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels and structures to provide pathway for moving switchboards into place.

B. Environmental Limitations:

1. Do not deliver or install switchboards until spaces are enclosed and weathertight; work in spaces is complete and dry; work above switchboards is complete; and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

    a. Ambient Temperature: Not exceeding 104 degrees F (40 degrees C).
    b. Altitude: Not exceeding 6600 feet (2000 m).

C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Owner no fewer than seven days in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without Construction Manager's and Owner's written permission.
4. Comply with NFPA 70E.

1.8 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Indicating Lights: Equal to 10 percent of quantity installed for each size and type, but no fewer than one of each size and type.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. General Electric.
2. ABB Power Distribution, Inc.
3. Eaton.
4. Siemens Energy & Automation, Inc.
5. Square D Co.

B. Front-Connected, Front-Accessible Switchboards:

1. Main Devices: Fixed, individually mounted.
2. Branch Devices: Panel mounted.
3. Sections front and rear aligned.

C. Front- and Side-Accessible Switchboards:

1. Main Devices: Fixed, individually mounted.
2. Branch Devices: Panel mounted.
3. Sections front and rear aligned.

D. Provide nominal system voltage, continuous main bus amperage, and short circuit current ratings as indicated on the Drawings.

E. Seismic Requirements: Fabricate and test switchboards according to IEEE 344 to withstand seismic forces defined in Division 20 Section "Seismic Protection".

F. Indoor Enclosures: Steel, NEMA 250, Type 1.

G. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.

1. Power for Space Heaters, Ventilation, Lighting, and Receptacle: Include a control-power transformer within the switchboard. Supply voltage shall be [120] [120/240] [120/208]-V A.C.

H. Barriers: Between adjacent switchboard sections.

I. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.

J. Hinged Front Panels: Allow access to circuit breaker, metering, accessory and blank compartments.

K. Buses and Connections: Three-phase, four-wire unless otherwise indicated.

1. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity, silver plated**.**
2. Ground Bus: 1 inch x 1-1/4 inch, hard-drawn copper of 98 percent conductivity equipped with mechanical connectors for feeder and branch-circuit ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.
3. Main Phase Buses and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
4. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with mechanical connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.

2.2 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Refer to one-line diagram for additional requirements.

B. Fusible Switch Assemblies (600 Amperes and Smaller): Quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle. Provide interlock to prevent opening front cover with switch in ON position. Handle lockable in OFF position.

1. Fuse Clips: Designed to accommodate Class 'R' fuses, type as specified, with Class 'R' rejection clips.

C. Fusible Switch Assemblies (800 Amperes and Larger): Bolted pressure contact switches.

1. Fuse Clips: Designed to accommodate Class L fuses.

D. Molded Case Circuit Breakers: Provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Provide breaker interrupting ratings as indicated on the plans. Where necessary to meet interrupting ratings, breakers shall be provided with automatically resetting current limiting elements in each pole.

E. Solid State Molded Case Circuit Breakers: All breakers identified on plans as solid-state with 2,500 ampere frame sizes and below**.** Provide molded case switch with electronic sensing, timing and tripping circuits for fully adjustable time current characteristic settings including ground fault trip, instantaneous trip, long time trip, long time delay, short time trip and short time delay. Trip

setting shall be field programmable with a sealable clear cover. Provide stationary mounting. Provide zero sequence type ground fault sensor.

2.3 INSTRUMENTATION

A. Current Transformers: ANSI C57.13; 5 ampere secondary, bar or window type with single secondary winding, unless otherwise required for application and secondary shorting device, primary/secondary ratio as required, burden and accuracy consistent with connected metering and relay devices, 60 Hertz.

B. Potential Transformers: ANSI C57.13; 120 volt single secondary, disconnecting type with integral fuse mountings, primary/secondary ratio as required, burden and accuracy consistent with connected metering and relay devices, 60 Hertz.

C. Digital AC Power Monitor capable of measuring, calculating and directly displaying: Volts (L-L, L-N), Amps, KW, KWH. Monitor shall be true RMS measurement with programmable set-up parameters. All set-up parameters data shall be stored in non-volatile memory to protect from power outages. Monitor shall be provided with communication capability with an 10/100 Base Tx UTP port, and an RS485 Modbus Serial Master port.

2.4 CONTROL POWER

A. Control Circuits: 120-V A.C., supplied through secondary disconnecting devices from control-power transformer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install switchboards and accessories according to NEMA PB 2.1 and in accordance with manufacturers' written installation instructions and the following specifications.

B. Equipment Mounting: Install switchboards on concrete base, 4-inch (100-mm) nominal thickness. Comply with requirements for Concrete Bases specified in Division 26 Section "Common Work Results for Electrical."

C. Anchor each switchboard assembly to slab or housekeeping pad (as indicated) using bolt sizes and types and quantities as recommended by manufacturer and to meet seismic force requirements. When secured to a pad that is separately poured, the bolts are to be installed through the pad and into the slab. Use appropriate length bolts.

D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels and brackets and temporary blocking of moving parts from switchboard units and components.

E. Comply with mounting and anchoring requirements specified in Division 20 Section "Seismic Protection".

F. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards including control and key interlocking sequences and emergency procedures. Fabricate frame of

finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.

G. Install filler plates in unused spaces of panel-mounted sections.

H. Install overcurrent protective devices and instrumentation.

1. Set field-adjustable switches and circuit-breaker trip ranges.

I. Comply with NECA 1.

3.2 GROUNDING

A. Connections: As indicated. Tighten connections to comply with tightening torques specified in UL 486A.

B. Ground equipment according to the contract documents and the National Electrical Code.

3.3 CONNECTIONS

A. Comply with requirements for terminating feeder bus specified in Division 26 Section "Enclosed Bus Assemblies." Drawings indicate general arrangement of bus, fittings, and specialties.

B. Comply with requirements for terminating cable trays specified in Division 26 Section "Cable Trays for Electrical Systems." Drawings indicate general arrangement of cable trays, fittings, and specialties.

C. Tighten switchboard bus joint bolts and electrical connector and terminal bolts in accordance with manufacturer's published torque-tightening values. Where manufacturer's torque values are not stated, use those specified in UL 486A and UL 486B.

3.4 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring and components; provide warning signs complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

D. Identify field-installed wiring and components and provide warning signs as specified in Division 26 Section “Identification for Electrical Systems.”

3.5 FIELD QUALITY CONTROL

A. Inspect completed installation for physical damage, proper alignment, anchorage and grounding.

B. Measure insulation resistance of each bus section phase-to-phase and phase-to-ground for one minute each. Test voltage shall be 1000 volts and minimum acceptable value for insulation resistance is 2 megohms.

C. Check tightness of accessible bolted bus joints using a calibrated torque wrench. Tightness shall be in accordance with manufacturer's recommended values.

D. Physically test key interlock systems to ensure proper function.

3.6 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as indicated on the drawings or as instructed by the engineer.

3.7 CLEANING

A. Upon completion of installation, inspect interior and exterior of switchboards. Remove paint splatters and other spots, dirt and debris. Touch-up scratches and mars of finish to match original finish.

END OF SECTION 262413

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.

1.3 SUBMITTALS

A. Review of submittals for this equipment will not be considered complete without an approved Power System Study to confirm adequate short-circuit current ratings and protective device coordination. Refer to specification 260573 for additional information.

B. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings and finishes.

C. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections and details. Show tabulations of installed devices, equipment features and ratings such as voltage, main bus ampacity, integrated short circuit ampere rating, overcurrent protective device arrangement and sizes.
2. Include short-circuit current calculation results to show the short-circuit current rating for this equipment exceeds the available short-circuit fault current available. Refer to specification 26 0573.
3. Include overcurrent protective device study to show all essential electrical systems, emergency systems and legally required standby system protective devices coordinate with upstream and downstream overcurrent protective devices to the code required interval, or specific interval indicated. Refer to specification 260573.
4. Include manufacturer’s selective coordination tables indicating coordination between the main and branch circuit breakers. The main breaker and branch breakers being provided shall be clearly labeled on the tables.

D. Seismic Qualification Certificates: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 20 Section "Seismic Procedures."

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain panelboards, overcurrent protective devices, components and accessories from single source from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70 by a qualified testing agency and marked for intended location and application.

D. Comply with NEMA PB 1 “Panelboards.”

E. Comply with NFPA 70 “National Electrical Code.”

1.5 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.6 WARRANTY

A. Warranty: Panelboard and components shall be warranted to be free from manufacturing defects for a period of one year after project acceptance by Owner.

1.7 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Keys: Two spares for each type of panelboard cabinet lock.
2. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Division 20 Section "Seismic Protection."

B. Enclosures: NEMA PB 1, Type 1, flush or surface mounted as shown on drawings.

1. Rated for environmental conditions at installed location, unless otherwise noted on drawings, the following types shall be used in the listed locations:

Location	NEMA Type
Dry, clean indoor	NEMA 1
Outdoor or Damp or wet interior locations	NEMA 3R
Indoor or outdoor corrosive areas or areas subjected to hose streams	NEMA 4X
Dusty indoor areas	NEMA 12

2. Finishes:

   a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
   b. Back Boxes: Same finish as panels and trim.

3. Directory Card: Inside panelboard door, mounted in transparent card holder.

C. Phase, Neutral, and Ground Buses:

1. Material: Copper or Tin-plated aluminum.
2. Main bussing shall be fully rated, non-tapered, ready to receive those overcurrent devices indicated as spaces without modifying the bus. Neutral bus to be rated at 100 percent of the main bus rating, capable of accepting terminations based on the maximum number of branch circuit protective devices allowed in the panelboard plus 6 additional conductors.
3. Equipment Ground Bus: Adequate for panelboard feeder and branch-circuit equipment ground conductors. Equipment ground bus shall be large enough and have sufficient quantity and sizes of terminations to allow for termination of panelboard feeder plus one equipment-grounding conductor per circuit, based on the maximum number of branch circuit protective devices allowed in the panelboard plus 6 additional conductors. Increase terminations to accommodate additional feeder conductors where double-lugged panelboards are indicated. When panelboards are multiple sections, provide equipment ground busses in each section of sufficient size for all grounding conductors in that section. Ground busses to be insulated from the panelboard enclosure where isolated ground busses are called for. Ground busses shall be bonded to enclosure when isolated ground buses are not called for.

D. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Main, Neutral, and Ground Lugs and Buses: Provide mechanical connectors for conductors. Provide necessary additional wire bending and terminating space when sub-feed and feed-through lugs are called for.

E. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.

F. Future Devices: Mounting brackets, bus connections, filler plates and necessary appurtenances required for future installation of devices.

G. Overcurrent Protection Devices: Multiple pole overcurrent protection devices shall be provided with a common trip handle for all poles. Tandem circuit breakers are not allowed.

H. Panelboard Short-Circuit Current Rating: All distribution and branch circuit panelboards shall be fully rated to interrupt symmetrical short circuit current available at terminals. Series rated equipment is not allowed.

2.2 DISTRIBUTION PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

240/120V 208Y/120V 480Y/277V and 480 V rated panelboards:

Manufacturer	Panelboard
General Electric	Spectra Series
Siemens	P series
Square D	QMB/I-Line
Cutler-Hammer	Pow-R-Line 4F

B. Panelboards: NEMA PB 1, power and feeder distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.

D. [Contactors in Main Bus: NEMA ICS 2, Class A, [electrically] [mechanically] held, general purpose controller with same short-circuit interrupting rating as panelboard.

1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.]

E. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents. Refer to one-line diagram for additional requirements.

1. Circuit Breakers: Provide molded-case, thermal-magnetic, trip-free, bolt-on circuit breakers (unless otherwise noted), replaceable without disturbing adjacent units. Circuit breaker escutcheon shall have ON and OFF markings. Circuit breaker handle accessories shall provide provisions for locking handle in the "ON" or "OFF" position. Circuit breaker faceplate and handle shall indicate rated ampacity. Circuit breaker faceplate shall indicate UL certification standards with applicable voltage systems and corresponding AIC ratings. Circuit breakers 30 amperes and less shall be UL listed to accept copper conductors with insulation rated at 75 degrees Celsius, with conductors sized from the 60 degree Celsius column of Table 310.15(B)(16) of the NEC. Circuit breakers larger than 30 amperes shall be UL listed to accept copper conductors with insulation rated at 75 or

90 degrees Celsius with conductors sized from the 75 degree Celsius column of Table 310.16 of the NEC.

2. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
3. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field adjustable trip setting.
4. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:

    a. Instantaneous trip.
    b. Long- and short-time pickup levels.
    c. Long- and short-time time adjustments.
    d. Ground-fault pickup level, time delay, and I^2t response.

5. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.

F. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

1. Fusible Switches: Three pole, with quick-make, quick-break knife blade and jaw silver alloy contacts that provide high speed positive switching action independent of the speed at which the handle is operated. Provide externally operable handle capable of being padlocked in the ON and OFF positions. Provide metal holder for circuit identification on each switch cover. Switches to be provided with interlocks to prevent opening switch cover while switch contacts are closed, and to prevent switch contacts from being closed unless the switch cover is completely closed and latched. Cover shall have provisions for padlocking the cover closed. Switch contacts shall be capable of interrupting 12 times their rated full load current. There shall be a visible air gap between the line side jaws and the knife blades when the switch contacts are open. Barriers between phases for switch contacts and fuse clips shall be provided. Provide Class R fuse clips for switch sizes 600 amperes and smaller to prevent installation of other than [UL Class RK [J]] current limiting fuses. All switches, regardless of size, shall be bolted to the main bus; plug-on switches are not acceptable. Lugs on fusible switches 30 amperes and less shall be UL listed to accept copper conductors with insulation rated at 60, 75 and 90 degrees Celsius, with conductors sized from the 60 degree Celsius column of Table 310.16 of the NEC. Lugs on fusible switches larger than 30 amperes shall be UL listed to accept copper conductors with insulation rated at 75 or 90 degrees Celsius with conductors sized from the 75 degree Celsius column of Table 310.16 of the NEC.
2. Fused Switch Features and Accessories: Standard ampere ratings and number of poles

G. Short Circuit Rating: Provide short circuit rating for each panelboard as indicated on drawings. Ratings indicated are minimum values. Manufacturer shall provide the next larger rating if the value indicated is unavailable.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Doors: Hinged front cover, entire front trim hinged to box and with standard door within concealed hinged trim cover (door-in-door). Provide flush locks, keyed alike.

D. Interiors: Provide physical means to prevent installation of more overcurrent protection devices than the quantity for which the enclosure was listed. Interiors shall be field convertible for top or bottom feed.

E. Box: Box shall be nominally 5-3/4 inches deep by 20 inches wide.

F. Circuit Numbering: Provide factory fabricated circuit numbers adjacent to each circuit breaker pole position. Numbering shall be continuous from topmost pole position to last possible pole position. Number sequence on left shall be 1-3-5-7, etc., and number sequence on right shall be 2-4-6-8, etc. Numbering material shall be insertable or strip type, as manufactured by the panelboard manufacturer for the specific panelboard. Adhesive markers and pen type markers are not acceptable.

G. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Circuit Breakers: Provide molded-case, thermal-magnetic, trip-free, bolt-on circuit breakers (unless otherwise noted) replaceable without disturbing adjacent units. Circuit breaker escutcheon shall have ON and OFF markings. Circuit breaker handle accessories shall provide provisions for locking handle in the "ON" or "OFF" position. Circuit breaker faceplate and handle shall indicate rated ampacity. Circuit breaker faceplate shall indicate UL certification standards with applicable voltage systems and corresponding AIC ratings. Circuit breakers 30 amperes and less shall be UL listed to accept copper conductors with insulation rated at 60, 75 and 90 degrees Celsius, with conductors sized from the 60 degree Celsius column of Table 310.15(B)(16) of the NEC. Circuit breakers larger than 30 amperes shall be UL listed to accept copper conductors with insulation rated at 75 or 90 degrees Celsius with conductors sized from the 75 degree Celsius column of Table 310.16 of the NEC.
2. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits; Type HACR for feeding heating, air conditioning or refrigeration loads. Provide UL Class A ground fault interrupter circuit breakers where scheduled on drawings. Arc fault circuit breakers shall comply with UL 1699; 120/240-V, single-pole configuration.

H. Short Circuit Rating: Provide short circuit rating for each panelboard as indicated on drawings. Ratings indicated are minimum values. Manufacturer shall provide the next larger rating if the value indicated is unavailable.

2.4 OVERCURRENT PROTECTIVE DEVICE ACCESSORY OPTIONS

A. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

B. Shunt Trip: 120V trip coil energized from separate circuit, set to trip at [55] [75] percent of rated voltage.

C. Auxiliary Contacts: [One SPDT switch] [Two SPDT switches] with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.

D. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.

E. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in the “ON” or “OFF” position.

F. Handle Clamp: Loose attachment for holding circuit-breaker handle in on position.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

B. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1.

B. Comply with mounting and anchoring requirements specified in Division 20 Section "Seismic Protection."

C. Mounting height: Mount panelboards such that the center grip of any operating handle, when in its highest position, is not more than 79 inches above the floor. Align top edges of panelboard covers where multiple panelboards are installed in the same general area.

D. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit breaker trip ranges as dictated on drawings within approved selective coordination study.

E. Fuse Labels: Install pre-printed label from fuse manufacturer inside the cover of each fusible switch indicating the proper replacement fuse.

F. Install filler plates in unused spaces.

G. Stub four 1-inch empty conduits from each recessed panelboard into accessible ceiling space or space designated to be ceiling space in the future.

3.3 IDENTIFICATION

A. Comply with requirements within Division 26 Section "Identification for Electrical Systems."

B. Circuit Directory: Provide typed circuit directory reflective of final circuit changes. Identify all circuits including spares. Spaces shall be left blank. Circuit designations shall describe the load type and location. For example, “Lighting - North Corridor” or “Receptacles - Rooms A, B, C and X, Y, Z.” Use Owner's room designations, not designations shown on the plans, if different. Type on cardboard stock installed behind clear acrylic holder enabling removal of the directory.

3.4 FIELD QUALITY CONTROL

A. Visual and Mechanical Inspection: Include the following inspections and related work:

1. Inspect for defects and physical damage, labeling and nameplate compliance with requirements of up-to-date drawings and panelboard schedules.
2. Exercise and perform operational tests of all mechanical components and other operable devices in accordance with manufacturer's instruction manual.
3. Check panelboard mounting, area clearances, alignment and fit of components.
4. Check tightness of bolted electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.

B. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.

1. Measure as directed during period of normal system loading.
2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Receptacles, receptacles with integral GFCI and associated device plates.
2. Snap switches and wall-box dimmers.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

D. RFI: Radio-frequency interference.

E. TVSS: Transient voltage surge suppressor.

F. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.

B. Comply with NFPA 70.

C. Comply with UL 498: “Attachment Plugs and Receptacles.”

D. Comply with UL 943: “Ground-Fault Circuit-Interrupters.”

E. Listing and Labeling: Provide products which are listed and labeled by Underwriters Laboratories for their applications and installation conditions and for the environments in which installed.

1.6 COORDINATION

A. Receptacles for Owner-Furnished Equipment: Match plug configurations.

1. Cord and Plug Sets: Match equipment requirements.]

PART 2 - PRODUCTS

2.1 WIRING DEVICES

A. Comply with NEMA Standard WD 1, "General Purpose Wiring Devices" and NEMA Standard WD6 “Wiring Device Dimensional Requirements.”

B. Enclosures: NEMA 1 equivalent, except as otherwise indicated.

C. Receptacles, Straight-Blade and Locking Type: Except as otherwise indicated, comply with UL Standard 498, "Electrical Attachment Plugs and Receptacles." Provide UL labeling of devices to verify these compliances. Provide straight blade receptacles per table on the following page.

D. Any receptacles that are controlled by an automatic control device shall have the centralized receptacle marking furnished with the device or cover plate.

E. Receptacles and switches having plug tail connectors consisting of a female at the device and a matching male on the pigtail are acceptable provided that that ratings and listings and other portions of this specification apply. The device shall have no exposed parts or wiring when the mating connector is installed.

2.2 STRAIGHT BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper: 5352.
b. Hubbell: 5352.
c. Leviton: 5352.
d. Pass & Seymour: 5362.

2.3 GFCI RECEPTACLES

A. General Description: Straight blade, non-feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper: VGF20.

b. Hubbell: GF20L.
c. Leviton: GFNT2.
d. Pass & Seymour: 2095.

C. Weather-Resistant, Duplex GFCI Convenience Receptacles:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper: WRVGF20.
b. Hubbell: GFTR20.
c. Leviton: GFWR2.
d. Pass & Seymour: 2095WR.

2.4 SNAP SWITCHES

A. Snap Switches: Quiet-type a.c. switches, Underwriters Laboratories listed and labeled as complying with UL Standard 20 "General Use Snap Switches." Switches shall be heavy duty industrial rated, 20A, 120/277V, ivory handle, back and side wired, number of poles as required, with ground screw.

B. Comply with NEMA WD 1 and UL 20.

C. Switches, 120/277 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper: AH1221 (single pole), AH1222 (two pole), AH1223 (three way), AH1224 (four way).
b. Hubbell: HBL1221 (single pole), HBL1222 (two pole), HBL1223 (three way), HBL1224 (four way).
c. Leviton: 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
d. Pass & Seymour: 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).

2.5 WALL PLATES

A. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: Smooth, high-impact thermoplastic
3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover and listed and labeled for use in "wet locations."

B. Device Enclosures for Outdoor and Other Wet and Damp Locations: Enclosure shall be suitable for wet locations while in use in accordance with Article 406.8 (B) and listed and labeled for the specific use by Underwriters Laboratories. Enclosure shall be clearly and visibly marked by the factory with the wording "Suitable For Wet Locations While In Use." Enclosure shall be non-metallic with hinged clear cover and integral key operated cover lock. Cover to have two exit

holes for up to 3/8 inch diameter cords with holes located at bottom of cover. Provide cover with device opening matched to type of wiring device used, e.g., duplex receptacle, GFCI receptacle, and toggle switch.

C. Color: Match wiring device except as otherwise indicated.

2.6 FINISHES

A. Color: Wiring device catalog numbers in Section Text do not designate device color.

1. Wiring Devices Connected to Normal Power System: As selected by the Architect, unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Emergency Power System: Red

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1 including the mounting heights listed in that standard, unless otherwise noted.

B. Coordination with Other Trades:

1. Take steps to ensure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint and other material that may contaminate the raceway system, conductors and cables.
3. Install device boxes in brick or block walls so that the coverplate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete. Protect devices and assemblies during painting if installed prior to wall painting.

C. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:

    a. Cut back and pigtail, or replace all damaged conductors.
    b. Straighten conductors that remain and remove corrosion and foreign matter.
    c. Pigtailing existing conductors is permitted provided the outlet box is large enough.

D. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.
10. Install devices and assemblies plumb and secure.
11. Install wall plates when painting is complete.
12. Utilize weather-resistant receptacles in wet or damp locations and outdoors.
13. For all devices mounted flush in walls where communications backboards are installed, provide extension ring with sufficient depth for the outlet and coverplate to mount flush to the face of the communications backboard. Devices and coverplates that mount recessed to the communications backboard are not acceptable.
14. Provide GFCI receptacles when installed within 6 ft. of the outside edge of a sink.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the left.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multi-gang wall plates.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."

3.3 GROUNDING:

A. Isolated Ground Receptacles: Connect to isolated grounding conductor routed to designated isolated equipment ground terminal of electrical system.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943 and per manufacturer's recommendations.
5. Test wiring devices for proper polarity and ground continuity. Operate each operable device at least 6 times.
6. Using the test plug, verify that the device and its outlet box are securely mounted.
7. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones and retest as specified above.
8. Replace damaged or defective components.

3.5 CLEANING

A. General: Internally clean devices, device outlet boxes, and enclosures. Replace stained or improperly painted wall plates or devices.

END OF SECTION 262726

SECTION 262816 - ENCLOSED SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Fusible and non-fusible switches.
2. Molded-case circuit breakers.
3. Molded-case switches.

1.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to Division 20 “Seismic Protection.”

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.4 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, enclosure type, performance, electrical characteristics, ratings and accessories.

1. Electrical characteristics shall include voltage, current and short-circuit ratings, factory settings of individual overcurrent protective devices, accessories, and auxiliary components.

B. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device. Submit on translucent log-log graph paper.

1. Include selectable ranges for each type of overcurrent protective device where applicable.
2. Include selective coordination study to prove all enclosed switches and circuit breakers associated with the essential electrical systems, emergency systems and legally required standby system selectively coordinate with the upstream overcurrent protective devices.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components and accessories within same product category from single source and from single manufacturer.

B. Electrical Component Standards: Provide components complying with NFPA 70 "National Electrical Code" and which are listed and labeled by UL. Comply with UL Standard 98 and NEMA Standard KS 1.

1.6 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS - GENERAL

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Cutler-Hammer.
2. General Electric.
3. Square D Company.
4. Siemens.

2.2 FUSIBLE AND NONFUSIBLE SWITCHES

A. General: Provide circuit and motor disconnect switches in types, sizes, duties, features, ratings, enclosures and accessories as indicated within Disconnect Schedule, located on the drawings.

B. Fusible and Non Fusible Switches: Type HD heavy-duty, quick-make, quick-break load interrupter enclosed knife switch, externally operable, lockable handle, interlocked with cover in closed position. Unless indicated otherwise, provide 3-blade with solid neutral when a neutral is provided. Compliant with NEMA KS 1.

C. Provide positive pressure, reinforced Type Class R fuse clips for fusible switches 600 amps or less to prevent other than UL Class RK current limiting fuses. Provide for Class L fuses for switches over 600A.

D. Service Switches: Shall be as above but shall also be UL listed for use as service equipment under UL Standard 98 or 869.

2.3 MOLDED-CASE CIRCUIT BREAKERS

A. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3. Provide circuit breakers in sizes, ratings, enclosures and accessories as indicated within Equipment Data Schedule or Disconnect Schedule located on the drawings, with interrupting capacity to comply with available fault currents.

B. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

C. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

D. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing with the following field-adjustable settings:

1. Instantaneous trip.
2. Long- and short-time pickup levels.
3. Long- and short-time time adjustments.
4. Ground-fault pickup level, time delay, and I^2t response.

E. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller and let-through ratings less than NEMA FU 1, RK-5.

2.4 MOLDED-CASE SWITCHES

A. General Requirements: Molded-case circuit breaker with fixed, high-set instantaneous trip only and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating. Provide molded-case switches in sizes, ratings, enclosures and accessories as indicated within Disconnect Schedule, located on the drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install enclosed switches and circuit breakers in locations as indicated level and plumb, according to manufacturer's written instructions. Provide interconnection wiring for control and indication devices where applicable.

B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

C. Install fuses in fusible disconnect switches such that label and rating information is readable without removing the fuse. Provide permanent label affixed to the inside of the disconnect switch cover indicating the fuse class and size installed.

3.3 IDENTIFICATION

A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

3.4 ADJUSTING

A. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section "Overcurrent Protective Device Coordination Study".

3.5 CLEANING

A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish including chips, scratches, and abrasions.

END OF SECTION 262816

SECTION 263600 - TRANSFER SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes transfer switches rated 600 V and less, including the following:

1. Automatic transfer switches.

1.3 REFERENCES

A. NEMA ICS 1 - General Standards for Industrial Control and Systems

B. NEMA ICS 2 - Standards for Industrial Control Devices, Controllers and Assemblies

C. NEMA ICS 6 – Enclosures for Industrial Controls and Systems

D. NEMA ICS 10 - AC Automatic Transfer Switches

E. UL 1008 – Standard for Automatic Transfer Switches

1.4 SUBMITTALS

A. Review of submittals for this equipment will not be considered complete without an approved Power System Study to confirm adequate short-circuit current ratings and protective device coordination. Refer to specification 26 0573 for additional information.

B. General: Submit the following according to Conditions of Contract and Division 01 Specification Sections.

1. Shop drawings or published product data for each transfer switch, including dimensioned plans, sections, and elevations showing minimum clearances; conductor entry provisions; gutter space; installed features and devices, wiring diagrams, materials lists.

a. Where the short-circuit current rating of the transfer switch is dependent on the upstream overcurrent protective device, submit manufacturer published literature indicating tested overcurrent protective devices and the resultant short-circuit current rating of the transfer switch. Indicate the applicable rating for the submitted transfer switch based on actual overcurrent protective device being provided as part of the related shop drawings.

2. Include short-circuit current calculation results to show the short-circuit current rating for this equipment exceeds the available short-circuit fault current available. Refer to specification 260573.

3. Manufacturer’s installation instructions.

C. Manufacturer Seismic Qualification Certification: Submit certification that transfer switches accessories, and components will withstand seismic forces defined in Division 20 Section "Seismic Protection." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Features and operating sequences, both automatic and manual.
2. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in automatic transfer equipment with minimum three (3) years documented experience.

B. Source Limitations: Obtain transfer switches, remote panels and accessories through one source from a single manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Emerson; ASCO Power Technologies, LP.
2. GE Zenith Controls.
3. Russelelectric, Inc.

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

A. Provide transfer switches with number of poles, voltage and current ratings and accessories as shown on drawings.

B. Transfer switches shall be electrically operated and mechanically held.

C. The electrical operator shall be a solenoid mechanism, momentarily energized to minimize power consumption and heat generation.

D. Transfer switches shall include both electrical and mechanical interlocks to prevent both sets of main contacts from being closed at the same time.

E. Transfer switches shall be positively locked and unaffected by momentary outages, so that contact pressure is maintained at a constant value and contact temperature rise is minimized.

F. Transfer switches shall be provided with a microprocessor control panel and a door-mounted display panel for user interface.

G. Inspection of all contacts shall be possible from the front of the switch, without disassembly of operating linkages and without disconnection of power conductors.

H. Transfer switches shall be capable of handling continuous-duty repetitive transfer of full-rated current between active power sources.

I. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for communicating with remote programming devices, annunciators, or annunciator and control panels shall have communication capability matched with remote device.

J. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, either by color-code or by numbered or lettered wire and cable tape markers at terminations. Color-coding and wire and cable tape markers are specified in Division 26 Section "Identification for Electrical Systems."

1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.

2.3 RATINGS

A. Available interrupting capacity (AIC) rating for each transfer switch shall meet or exceed the values listed within the drawings.

1. Series rating with upstream devices shall be allowed per UL-1008.
2. The required series rating shall be the larger of the two AIC values when the AIC rating of the equipment feeding the normal and emergency sides of the transfer switch is not equivalent.

2.4 AUTOMATIC TRANSFER SWITCHES

A. Transition type: Open, unless otherwise specifically indicated on drawings.

B. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.

C. Automatic transfer switch shall be capable of manual operation under load with the door closed with either or both sources energized. Transfer time shall be the same as for electrical operation. The control circuit shall automatically disconnect from the electrical operator during manual operation.

D. Automatic Transfer-Switch Sequence of Operation:

1. Initiate Time Delay to Start Alternate Source Engine Generator: Upon initiation by normal source monitor.
2. Time Delay to Start Alternate Source Engine Generator: Zero (0) to ten (10) seconds, adjustable.
3. Initiate Transfer Load to Alternate Source: Upon initiation by normal source monitor and permission by alternate source monitor.
4. Time Delay Before Transfer to Alternate Power Source: Zero (0) to thirty (30) seconds, adjustable.
5. Initiate Retransfer Load to Normal Source: Upon permission by normal source monitor.
6. Time Delay Before Transfer to Normal Source: Zero (0) to thirty (30) minutes, adjustable. Bypass shall have a time delay in the event of an alternate source failure.
7. Time Delay Before Engine Shut Down: Zero (0) to thirty (30) minutes, adjustable. Time delay shall begin when generator is unloaded.

2.5 REQUIRED ACCESSORIES FOR ALL TRANSFER SWITCHES

A. In-Phase Monitor: Provide factory-wired, internal relay controls transfer so it occurs only when the two sources are synchronized in phase. Relay compares phase relationship and frequency difference between normal and emergency sources and initiates transfer when both sources are within 15 electrical degrees, and only if transfer can be completed within 60 electrical degrees. Transfer is initiated only if both sources are within 2 Hz of nominal frequency and 70 percent or more of nominal voltage.

B. Indicating Lights: Provide indicating lights mounted in cover of enclosure to indicate the following:

1. Normal Source Available.
2. Alternate Source Available.
3. Switch Position.

C. Return to Normal Switch: Provide switch mounted in cover of enclosure to initiate manual transfer from alternate to normal source.

D. Source Monitor: Provide source monitor for each line of the normal and alternate source voltage and frequency; initiate transfer when voltage drops below 85 percent or frequency varies more than 3 Hertz from rated nominal value. Threshold values shall be field adjustable.

E. Test Switch: Provide switch mounted in cover of enclosure to simulate failure of normal source.

F. Transfer Switch Auxiliary Contacts: Provide the following isolated dry contacts to indicate the following conditions:

1. Normal source is available.
2. Emergency source is available.
3. Transfer switch position connected to normal source.
4. Transfer switch position connected to emergency source.

G. Facility Management Control System Interface: Provide auxiliary contacts, prewired to an accessible terminal strip.

2.6 OPTIONAL ACCESSORIES

A. Refer to Transfer Switch Schedule on drawings for requested optional accessories.

B. Engine Exerciser: Provide an integral engine exerciser to automatically test the engine generator set with or without load on a set schedule and duration. Parameters associated with start time (day, week, month), frequency and duration of test shall be fully programmable.

1. Provide integral battery operation of time switch when normal control power is not available.

C. Elevator Emergency to Normal Pre-signal: Provide selective load disconnect control contacts capable of sending a pre-transfer and post-transfer signal to disconnect elevator controls prior to transfer and reset after transfer is complete. Contacts shall have an adjustable advance interval of 0.5 to 60 seconds and shall be independently adjustable in the emergency and normal transfer directions.

D. Strip Heater: Equip switches exposed to outdoor temperatures and humidity, and other units indicated, with an internal heater. Provide thermostat within enclosure to control heater.

E. Communications Interface: Provide serial and Ethernet communication module for interface with building automation system.

F. Power Monitoring: Provide a microprocessor-based power monitor with user interface to record and display the following parameters:

1. Voltage (line-to-line and line-to-neutral).
2. Frequency.
3. Current.
4. Real and reactive power.
5. Power factor.

G. Load Shed Feature: Provide controller circuit such that operation of a remote contact or voltage signal connected to the transfer switch controller initiates transfer of the connected load back to the normal source or to a center off position regardless of the source availability.

H. Surge Protection: Provide integral surge protection device providing load side protection. Provide protection for each phase and neutral (where utilized). Coordinate system voltage configuration with drawings.

I. Transfer Inhibit: Provide a remote means to inhibit power transfer in either direction.

2.7 FINISHES

A. Enclosures: Manufacturer's standard enamel over corrosion-resistant pretreatment and primer.

2.8 SOURCE QUALITY CONTROL

A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Design each fastener and support to carry load indicated by seismic requirements and according to seismic-restraint details. See Division 20 Section “Seismic Protection."

B. Floor-Mounting Switch: Anchor to floor by bolting.

1. Concrete Bases: Install transfer switches on cast-in-place concrete equipment base. Unless otherwise noted, cast-in-place concrete base shall be 4” deep and extend 4” beyond equipment outer edge.

C. Identify components according to Division 26 Section "Identification for Electrical Systems."

D. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

E. Provide wiring to elevator controller for emergency source mode and emergency to normal pre-signal.

F. Provide self-adhesive vinyl label indicating the short circuit current rating of the transfer switch based on overcurrent protective device type and settings. Label shall be installed on the exterior of the transfer switch.

3.2 CONNECTIONS

A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installation, including connections, and to assist in testing.

2. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
4. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.

    a. Check for electrical continuity of circuits and for short circuits.
    b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
    c. Verify that manual transfer warnings are properly placed.
    d. Perform manual transfer operation.

5. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.

    a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
    b. Simulate loss of phase-to-ground voltage for each phase of normal source.
    c. Verify time-delay settings.
    d. Verify pickup and dropout voltages by data readout or inspection of control settings.
    e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
    f. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

B. Coordinate tests with tests of generator and run them concurrently.

C. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

D. Remove and replace malfunctioning units and retest as specified above.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment as specified below. Refer to Division 01 Section "Demonstration and Training." Provide a minimum of four (4) hours of instruction scheduled seven (7) days in advance.

B. Coordinate this training with that for generator equipment.

END OF SECTION 263600

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SECTION 265100 - LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior luminaires and accessories.
2. Emergency lighting units and exit signs.
3. Luminaire supports.

B. Related Sections:

1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, digitally addressable lighting control systems, and multi-pole lighting relays and contactors.

1.2 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color-rendering index.

C. LED: Light Emitting Diode

D. LER: Luminaire efficacy rating.

E. Lumen: Measured output of lamp and luminaire, or both.

F. Luminaire: Complete lighting fixture, including ballast housing if provided.

G. Pole: Luminaire support structure, including tower used for large area illumination.

1.3 SUBMITTALS

A. For each type of luminaire, arranged in order of luminaire designation. Include complete product model number and product data sheets on features, accessories, finishes, and the following:

1. Physical description of luminaire including dimensions, as well as effective projected area for exterior luminaires.
2. Details of attaching luminaires and accessories.
3. Emergency lighting units including battery and charger.
4. Life, output (lumens, CCT, and CRI), and energy-efficiency data for lamps.
5. LED photometric report per latest IESNA LM-79-08 testing guidelines, including luminaire model number, manufacturer of LED chip array/board and driver, input wattage, and independent testing laboratory name, report number, and date tested.
6. Dimmer device data for all LED luminaires specified as dimming. Must be from approved manufacturer per luminaire manufacturer requirements, furnished and installed by contractor. Contractor responsible for dimmer control and luminaire compatibility.

7. Pole information including: Materials, dimensions, finishes, means of attaching luminaire to support, anchor bolts and templates, structural analysis and manufactured pole foundations.

B. Custom Luminaires: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. LED Chip Arrays/Boards: 3 for every 100 of each type and rating installed. Furnish at least one of each type.
2. LED Drivers: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
3. Diffusers, Lenses, Globes and Guards: 2 for every 100 of each type and rating installed. Furnish at least one of each type.
4. Glass and Plastic Lenses: 2 for every 100 of each type and rating installed. Furnish at least one of each type.
5. Globes and Guards: 1 for every 20 of each type and rating installed. Furnish at least one of each type.

1.5 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products, or by an independent agency complying with the IESNA Lighting Measurements Testing & Calculation Guides.

B. Comply with IEEE C2, “National Electrical Safety Code” and NFPA 70.

1.6 COORDINATION

A. Coordinate layout and installation of luminaires and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver luminaire and components to site. Store such that luminaires, finishes, lenses, and trims are protected. Install with protective films on and remove only after construction clean-up is complete.

B. Store poles on decay-resistant-treated skids at least 12 inches (300 mm) above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation. Prevent breakage and damage to finish.

1.8 WARRANTY

A. Warranty Period for LED chips/arrays and drivers: 5 years from date of substantial completion.

B. Warranty Period for Emergency Lighting Unit Batteries, and self-powered exit signs: 5 years from date of substation completion.

C. Warranty Period for Luminaires: 5 years from date of substantial completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Refer to Luminaire Schedule on the drawings.

2.2 GENERAL REQUIREMENTS FOR LUMINAIRES AND COMPONENTS

A. All luminaires shall carry a UL listing, unless otherwise noted on the Luminaire Schedule. Exterior luminaires shall carry a UL wet location listing as well as designated IP rating, unless otherwise noted on the Luminaire Schedule.

B. Recessed Luminaires: Housing shall be constructed of steel or aluminum, free of burrs and sharp corners and edges, free of light leakage and accessible without use of tools. Components shall be formed and supported to prevent warping and sagging. Lamp and ballast compartments shall be accessible from below the ceiling.

1. Lensed troffers shall be provided with hinged door frames and positive spring-loaded latches, UV stabilized acrylic prismatic lenses with a minimum of 0.12 inch thickness, unless otherwise noted on the Luminaire Schedule.
2. Parabolic louvers shall be interlocking low-iridescent, specular anodized aluminum in construction. Number of cells shall be specified on Luminaire Schedule.
3. Direct/Indirect luminaire lamp chambers shall be made of one-piece perforated steel. Reflectors shall have a minimum reflectance of 90 percent. Both lamp chamber and reflector shall be painted after fabrication.
4. Volumetric luminaires shall have UV stabilized acrylic lens with optical pattern as designated on Luminaire Schedule. Reflectors shall have a minimum reflectance of 90 percent, painted after fabrication.
5. Where fire-rated ceilings are specified, luminaires should be provided with listed enclosures meeting requirements to maintain fire-rated system rating.

C. Suspended Luminaires: Canopies, power feeds, and mounting accessories shall be coordinated with architectural-designated ceiling type. Luminaires shall be installed plumb and level at luminaire height designated on Luminaire Schedule.

2.3 LIGHT EMITTING DIODE (LED) LUMINAIRE SYSTEMS

A. Light emitting diodes shall have a minimum color rendering index (CRI) of 80 for interior applications. Refer to plans for color temperature of the luminaires.

B. LED chips shall be wired so that operation of chip array is not prohibited by failure of one chip.

C. LED Driver:

1. Solid state driver with integral heat sink. Driver shall have overheat, short-circuit and overload protection, power factor 0.90 or above and maximum total harmonic distortion of 20 percent. Surge suppression device for all exterior luminaires.
2. Drivers shall have dimming capabilities as outlined in the luminaire schedule for each luminaire type.
3. Driver shall have a minimum of 50,000 hours rated life.

2.4 EXIT SIGNS

A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:

1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.
2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.

a. Battery: Sealed, maintenance-free, nickel-cadmium type.
b. Charger: Fully automatic, solid-state type with sealed transfer relay.
c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
f. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
g. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.5 EMERGENCY INVERTER – LED LUMINAIRES

A. Individual Unit: Self-contained, with automatic transfer to battery supply on loss of normal power, UL 924 listed for factory of field installation in indoor and damp locations.

B. Battery: Sealed, high temperature, maintenance free, nickel cadmium battery with capacity to provide 90 minutes of emergency operation at full lumen output, with 24-hour recharge time, seven (7) year minimum battery life expectancy.

C. Features: Integral battery charger with LED charging indicator light, test switch, electronic circuitry for use with LED drivers. Output of inverter shall be sinusoidal with solid-state low voltage disconnect circuit.

D. Inverter to be mounted remote and adjacent to luminaire shown on drawings. Inverter to be accessible from below ceiling through luminaire opening.

E. Charging indicator LED and test switch to be mounted in remote test/monitor plate provided with inverter OR integral to luminaire.

F. Inverter capable of operating a switched, dimmed, or unswitched luminaire up to 30 watts at full lumen output.

G. Warranty: Emergency inverter shall have a full five (5) year, non-prorated warranty.

2.6 LUMINAIRE SUPPORT COMPONENTS

A. Comply with Section 26 0529 "Hangers and Supports" for channel- and angle-iron supports, and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Twin-Stem Hangers: Two, 1/2-inch (13-mm) steel tubes with single canopy designed to mount a single luminaire. Finish same as luminaire.

D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).

E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage (2.68 mm).

F. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.

G. Hook Hangers: Integrated assembly matched to luminaire and line voltage and equipped with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Luminaires:

1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.
2. Install lamps in each luminaire.

B. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.

C. Remote Mounting of Ballasts: Distance between the ballast and luminaire shall not exceed that recommended by ballast manufacturer. Verify, with ballast manufacturers, maximum distance between ballast and luminaire.

D. Lay-in Ceiling Luminaire Supports: Use grid as a support element.

1. Install ceiling support system rods or wires**,** independent of the ceiling suspension devices, for each luminaire. Locate not more than 6 inches (150 mm) from luminaire corners.
2. Support Clips: Fasten to luminaires and to ceiling grid members at or near each luminaire corner with clips that are UL listed for the application.
3. Luminaires of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support luminaires independently with at least two 3/4-inch (20-mm) metal channels spanning and secured to ceiling tees.
4. Install at least one independent support rod or wire from structure to a tab on luminaire. Wire or rod shall have breaking strength of the weight of luminaire at a safety factor of 3.

E. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers.
3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.
4. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.

F. When installing luminaires, the contractor shall use the luminaire manufacturer's mounting hardware and follow all manufacturer's installation direction.

G. All recessed downlights must be installed so that the bottom of the throat is even with the finished ceiling plane. The overlapping flange must then fit flush to the ceiling plane/throat. No light leak must be visible. All miscellaneous hardware above the ceiling plane to accomplish the above shall be included in the base bid.

H. All recessed downlights shall have self-flanged reflectors unless otherwise noted.

I. When luminaires are installed in continuous rows of 2 or more, luminaires shall be approved for use as wireway.

J. Alignment: Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on the pole.

K. Embedded Poles: Set poles to depth below finished grade indicated on Drawings, but not less than one-sixth of pole height, installed plumb with double nuts for adjustment. Grout around pole anchor base.

L. Raise and set poles using web fabric slings (not chain or cable), or non-chafing ropes.

M. Bollards and Ground-Mount Luminaires: Align units for optimum directional alignment of light distribution. Install on concrete base with top 4 inches (100 mm) above finished grade or surface at bollard location. Cast conduit into base, shape base to match shape of bollard base. Finish by troweling and rubbing smooth.

N. Ground metal and non-metallic poles and support structures according to Section 26 0526 "Grounding and Bonding."

3.2 IDENTIFICATION

A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Section 26 0553 "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

B. Verify that self-luminous exit signs are installed according to their listing and the requirements in NFPA 101.

C. Illumination Observations: Verify normal operation of luminaires after installing luminaires and energizing circuits with normal power source.

D. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.4 ADJUSTING AND CLEANING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting aimable luminaires to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Some of this work may be required after dark.

B. Align luminaires and clean lenses and diffusers at completion of work. Clean paint splatters, dirt, and debris from installed luminaires. Touch up luminaire and pole finishes as necessary.

C. Inspect each installed luminaire for damage. Replace damaged luminaires and components.

END OF SECTION 265100

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SECTION 283111 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Fire Alarm and Detection Systems.

B. Related Sections include the following:

1. Division 20 Section "Seismic Protection" for products and installation requirements necessary for compliance with seismic criteria.

1.3 DEFINITIONS

A. LED: Light-emitting diode.

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

1.4 PERFORMANCE REQUIREMENTS

A. The fire alarm design documents and this specification section describe the minimum required features, material quality and operational requirements of the fire alarm system. These documents do not depict every connection to be made and wire to be installed. The Vendor and Contractor are solely responsible for determining all wiring, programming, interconnections and additional equipment required to create a complete and fully functional fire alarm system, based on the equipment and performance characteristics described within these documents.

B. Provide all components, devices, hardware, software, programming, peripheral devices, extension components, conduit, wiring, etc., required to extend the existing fire alarm system with the new fire alarm system. Required components include, but are not limited to, initiating devices and circuits, signaling devices and circuits, monitoring devices and circuits, batteries, auxiliary devices and control circuits for other building systems such as elevator recall and dampers. Extend the existing fire alarm in a manner that the existing fire alarm system’s functionality and annunciation is equivalent to the existing conditions unless otherwise noted. Upon completion of construction, the complete fire alarm system shall function as a single system, able to be reset from any single reset location point, and annunciated at any annunciator location.

C. Device layouts and limited equipment have been shown on the construction documents. Additional equipment, wiring, components, etc required to create a complete and fully functional system has not been shown, and is the responsibility of the Contractor. Shop drawing submittals shall indicate all requirements to create said fire alarm system.

1.5 SUBMITTALS

A. General Submittal Requirements:

1. Failure to comply with all of the requirements within specification 26 0500 and within this specification section will result in the submitted shop drawing being rejected without review. All listed requirements must be submitted within a single submittal package.
2. Shop Drawings shall be prepared by persons with the following qualifications:

    a. Trained and certified by manufacturer in fire-alarm system design.
    b. NICET-certified fire-alarm technician, Level III minimum.
    c. Licensed or certified by authorities having jurisdiction.

B. Product Data: For each type of product indicated on drawings and required to complete installation if not indicated on drawings. Indicate part numbers being ordered for each equipment or component variation required. If device or equipment is shown on construction documents, indicate corresponding fire alarm symbol at the top of each product data sheet.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Include CAD floor plans indicating the complete layout of the entire system, including auxiliary equipment, wiring and device addresses.

    a. A legend shall be provided to indicate which fire alarm symbols correspond with construction document fire alarm symbols, if different.

2. Include a complete fire alarm riser diagram indicating the wiring sequence of devices and their connections to the control equipment. Include a color code schedule for the wiring.
3. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
4. Include battery-size calculations including total available capacity, used capacity and future capacity available.
5. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
6. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.
7. Manufacturer wiring requirements, such as size, type and manufacturer.
8. Photocopy of NICET certification of person overseeing the preparation of fire alarm drawings, shop drawings, installation and testing.
9. Stamp and signature of Professional Engineer overseeing fire alarm design shall be required on drawings as required to comply with local or state regulations.

D. Installation and maintenance manuals per Section 26 0500.

E. Field quality-control reports.

F. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
3. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:

    a. Frequency of testing of installed components.
    b. Frequency of inspection of installed components.
    c. Requirements and recommendations related to results of maintenance.
    d. Manufacturer's user training manuals.

4. Provide shop drawings as reviewed by the Architect/Engineer and Authority Having Jurisdiction.
5. Provide hardcopy and electronically reproducible CAD floor plans indicating location of fire alarm devices, wiring and associated addresses.

G. Software and Firmware Operational Documentation:

1. Device address list.

H. Project Record Documents:

1. Submit record documents per Section 26 0500.
2. Provide a CAD drawing of each building area depicting each device location and address. Labeling of devices on drawings shall be consistent with labeling in the field. Scale CAD drawings no smaller than 1/16 inch = 1 foot-0 inch.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

B. Installer Qualifications: A factory authorized, licensed electrical or security contractor with minimum 5 years experience in the design, installation and maintenance of fire systems by fire alarm system manufacturer specified and selected. Installation shall be by personnel certified by NICET as fire-alarm Level II technician.

C. Source Limitations for Fire-Alarm System and Components: Obtain system from single source from single manufacturer.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

1.7 SYSTEM DESCRIPTION

A. UL-certified automatic and manual addressable fire alarm system consisting of multiplexed signal transmission, dedicated to fire-alarm service only. Compliant with NFPA 72.

1.8 SEQUENCING AND SCHEDULING

A. 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 two days in advance of proposed interruption of service.
2. Do not proceed with interruption of service without Owner's written permission.

B. Existing Fire-Alarm Equipment: Maintain existing equipment fully operational until new equipment has been tested and accepted. As new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service and label existing fire-alarm equipment "NOT IN SERVICE" until removed from the building.

C. Equipment Removal: After acceptance of new fire-alarm system, remove existing disconnected equipment and wiring.

1.9 WARRANTY

A. Provide one (1) year warranty for all labor and materials from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Provide products compatible with existing devices installed within facility. Devices installed in finished areas should match existing devices.

2.2 SIGNALING LINE CIRCUIT DEVICES

A. Smoke Detectors:

1. Comply with UL 268.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
3. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base in locations shown on drawings with all mounting hardware provided. Provide terminals in the fixed base for connection to building wiring.
4. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
5. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status.

6. Photoelectric Smoke Detector: Detector shall use the photoelectric (light-scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density.
7. Detector shall be directly connected to a SLC loop. Each 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.
8. Dual status LEDs shall be provided on each smoke detector to indicate the detector is operational and in regular communication with the control panel, or in an alarm condition.
9. Each detector shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel.

B. Heat Detectors:

1. Comply with UL 521.
2. Heat Detector, Combination Type: Actuated by either a fixed temperature of 165 degrees F.
3. Mounting: Twist-lock base interchangeable with smoke-detector bases. Provide two-piece head/base design.
4. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
5. Device shall connect directly to a SLC loop.
6. Dual status LEDs shall be provided on each smoke detector to indicate the detector is operational and in regular communication with the control panel, or in an alarm condition.
7. Each detector shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel.

2.3 ADDRESSABLE INTERFACE DEVICES

A. Addressable Relays:

1. Addressable relay module available for control of auxiliary devices, rated for the electrical load being controlled. Contractor shall provide additional slave relay(s) as required to achieve desired function.
2. Addressable relays shall connect directly to a SLC loop and receive power from a separate 24VDC circuit. Addressable relay shall supply 24VDC power to the device(s) being controlled, unless otherwise indicated on the drawings.

B. Addressable Monitor Modules:

1. Addressable monitor module available for monitoring of auxiliary devices. It shall interface initiating devices with the fire alarm control panel.
2. Addressable monitor modules shall connect directly to a SLC loop and receive power from a separate 24VDC circuit.
3. The addressable monitor module shall provide the required power to operate the monitored device(s).
4. At the Contractor’s option, an integral relay capable of providing a direct signal auxiliary device may be provided within the monitor module.

2.4 WIRING

A. All fire alarm wiring and cables shall be furnished and installed by the Contractor.

B. Initiating circuits shall be Class A.

C. Pathway Survivability: Level 1.

D. Install no more than 50 addressable devices on each signaling-line circuit.

E. Wiring shall be in accordance with local, state and national codes. Number and size of conductors shall be as recommended by the fire alarm system manufacturer.

F. All wiring and cables shall be UL listed and labeled as complying with NFPA 70 Article 760.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Comply with NFPA 70, NFPA 72, local and state codes and manufacturer recommendations for installation of fire-alarm equipment.

B. Connection to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.

1. Connecting new equipment to existing control panel in existing part of the building.
2. Provide all items, wiring, devices, components, programming, etc., to modify, supplement and expand the existing fire alarm system as necessary to extend existing fire alarm system. New components shall be capable of merging with existing configuration without degrading the performance of either system.
3. After acceptance of the new fire alarm system, remove existing, disconnected fire alarm equipment and restore damaged surfaces.

C. Devices specified to be surface mounted shall be mounted on a manufacturer provided backbox, painted to match the color of the device. The backbox shall be the same size and shape of the device, and must not have visible knockouts.

D. Signaling Line Circuit Devices:

1. General:

a. Ceiling mounted devices shall be located where shown on the floor plans or reflected ceiling plans. Where a conflict arises with architectural elements or other items that will not allow installation in shown location, the Contractor shall adjust location of device such that the new location meets all NFPA 72 requirements and applicable building codes.
b. Coordinate the location of all ceiling devices with luminaires, sprinkler heads, piping, diffusers, grilles and other obstructions to maintain a neat and operable operation. Mounting locations and spacing must in accordance with NFPA 72.

c. Center ceiling mounted devices within each ceiling tile where installed in a grid type ceiling. Devices installed within hard ceilings shall be arranged in a neat and uniform pattern.
d. Provide a means of isolating addressable devices connected to the SLC so that connection to no more than 50 devices would be lost by single fault on a pathway, per NFPA-72 chapter 23.6.
e. Provide a means of isolating addressable devices connected to the SLC so that connection to the devices in no more than one zone would be lost by a single fault on a pathway, per NFPA-72 chapter 23.6.

2. Smoke Detectors:

a. Detector heads shall not be installed until after the final construction cleaning, unless required by the Authority Having Jurisdiction. If detector heads must be installed prior to final cleaning, they may not be installed until they can be connected to a fully functional fire alarm control panel.
b. All smoke detectors must be installed in an accessible location, including detectors at the top of elevator shafts. Provide access panels as required. Coordinate with General Contractor.
c. Smoke detectors must be located at least 3 feet-0 inches from each supply air diffuser and return grille.
d. Smoke detectors shall be installed at least 12 inches from any part of a lighting fixture.

3. Heat Detectors:

a. Detector heads shall not be installed until after the final construction cleaning, unless required by the Authority Having Jurisdiction. If detector heads must be installed prior to final cleaning, they may not be installed until they can be connected to a fully functional fire alarm control panel.
b. All heat detectors must be installed in an accessible location.
c. Provide heat detectors within 2 feet-0 inches of each sprinkler head within elevator pit, elevator shaft and elevator equipment room. Final quantity of sprinkler heads and respective locations must be coordinated with Fire Protection Contractor.
d. Heat detectors shall be installed at least 12 inches from any part of a lighting fixture.
e. All heat detectors must be installed in an accessible location, including and detectors at the top of elevator shafts. Provide access panels as required. Coordinate with General Contractor.

E. Addressable Interface Devices:

1. Addressable Relays:

a. Mount each addressable relay within an enclosure located in an accessible serviceable area as near as possible to the device(s) being controlled unless otherwise specifically noted. Provide all required mounting hardware, and label each enclosure to indicate relay function. Provide remote indicator to allow inspection of the device status from a floor standing location if device is not visible from a floor standing position.

2. Addressable Monitor Modules:

   a. Mount each addressable monitor module within an enclosure located in an accessible serviceable area as near as possible to the device(s) being controlled unless otherwise specifically noted. Provide all required mounting hardware, and label each enclosure to indicate device being monitored. Provide remote indicator to allow inspection of the device status from a floor standing location if device is not visible from a floor standing position.

3.2 WIRING

A. Fire alarm wiring shall be provided by the Contractor in accordance with the manufacturer's recommendations and in compliance with the National Fire Codes.

B. Connect all components together for a completely functional ready to operate system as shown on the drawings, as specified herein and as directed by the manufacturer.

C. Install all fire alarm wiring in conduit.

   1. Wiring not associated with fire alarm detection, alarm or auxiliary fire protection functions shall not be routed in fire alarm conduits.

D. Wiring shall be installed in conduit from devices to the accessible ceiling. Exposed plenum-rated cable (Type THHN/THWN-2) shall be used above the accessible ceiling, supported every four (4) feet. Maintain 12-inches of clearance from all lighting ballasts. Fire alarm wiring shall be routed independently of other systems and may not share common bridal rings or cable trays (where applicable).

E. Fire alarm wiring splices shall be avoided to the extent possible. If needed, splices may only be made in accessible junction boxes, compliant with NFPA 70.

F. Signal line circuits connecting devices shall not span floors.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

B. Paint all junction boxes associated with the fire alarm system red. Identify SLC and NAC circuit on junction box cover.

C. Color Coding: Color code fire alarm conductors differently from the normal building power wiring. Differentiate the following circuit types by using different conductor colors with an overall red jacket.

   1. Alarm Circuits.
   2. Supervisory Circuits.
   3. Initiating Circuits.
   4. Notification Circuits.
   5. Door Release.

6. Central Station.
7. DC Power Supply.
8. Power Branch Circuits.

3.4 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100 and manufacturer written requirements. Install a ground wire from main service ground to fire alarm control unit.

B. For audio circuits, minimize the following to the greatest extent possible: ground loops, common mode returns, noise pickup, cross talk and other impairments.

3.5 SEQUENCES OF OPERATION

A. General:

1. Refer to the Fire Alarm Operation Matrix within the drawings for basic requirements and system input/output relationships.

B. Elevator Recall Sequence:

1. Elevator recall sequences shall meet all of the requirements listed within ASME/ANSI A17.1 (latest version) and NFPA 72 (latest version).
2. Refer to the Sequence of Operations on the drawings.

C. Elevator Shutdown Sequence:

1. Elevator shutdown shall meet all of the requirements listed within ASME/ANSI A17.1 (latest version) and NFPA 72 (latest version).
2. Utilizing an addressable relay, an alarming heat detector within the elevator hoistway or machine room shall send a signal to shunt trip the main elevator circuit breaker, disconnecting power to the elevators.

3.6 FIELD QUALITY CONTROL

A. Field tests shall be witnessed by Owner’s representative and authorities having jurisdiction.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Test fire alarm system in accordance with NFPA 72 Chapter 14, local Fire Marshal requirements and local building codes.
2. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.

D. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

E. Fire-alarm system will be considered defective if it does not pass tests and inspections.

F. Contractor and Owner shall coordinate actual room numbers to be used within facility. Final room numbers should be used for fire alarm system programming and record documents.

3.7 SYSTEM TRAINING

A. Authorized manufacturer representative shall provide the following minimum on-site training to instruct the Owner's representative as required for operating the system. Hands-on demonstrations of the operation of all system components and the entire system including program changes and functions shall be provided.

1. System Operators: One day.
2. Graphical User Interface Operation and Editing: One day.

B. The contractor and/or the system manufacturer's representatives shall provide a typewritten "Sequence of Operation."

END OF SECTION 283111