PROJECT MANUAL FOR:

LOTTES HEALTH SCIENCE LIBRARY – RENOVATION FOR CONSOLIDATION
PROJECT NUMBER: CP211852

AND

LOTTES HEALTH SCIENCE LIBRARY – REPLACE GLAZING& ROOFING IN BARREL ROOF SYSTEMS
PROJECT NUMBER: CP230151

AT
UNIVERSITY OF MISSOURI - Columbia
Columbia, MISSOURI

FOR:
THE CURATORS OF THE UNIVERSITY OF MISSOURI

PREPARED BY:

Simon Oswald Associates, Inc.
DBA SOA Architecture
Brad Stegemann AIA / Nick Borgmeyer AIA
2801 Woodard Drive, Suite 103
Columbia, MO 65202
p. 573-443-1407

ISSUE FOR BIDDING

DATE: APRIL 14, 2023

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PROJECT MANUAL FOR:

Lottes Health Science Library - Renovation for Consolidation (#CP211852)

Lottes Health Science Library - Replace Glazing & Roofing in Barrel Roof Systems (#CP230151)

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Project Title **Lottes Health Science Library - Renovation for Consolidation #CP211852**
Lottes Health Science Library - Replace Glazing & Roofing in Barrel Roof Systems #CP230151

Design Professional of Record: Architect

The Architects seal on these contract documents has been affixed in accordance with the requirements of Chapter 327, RSMO. In affixing this seal, the Architect takes responsibility for the attached architectural specifications. The Architect hereby disclaims any and all responsibility for project specifications other than these, included in these project documents, they being the responsibility of the other design professionals, whose seals and statements appear herein.

Specification Section 02 0810 Universal/Hazardous Materials Removal and Disposal and Section 02 8233 Friable and Non-Friable Asbestos Removal, as well as Appendix A and Appendix B are technical documents that have been prepared by a qualified third-party hazardous materials testing lab. The specification was not prepared under the direct supervision of the architect and therefore is not included as part of the architect's certification.

The following drawings and specifications have been prepared by me or under my direct supervision:

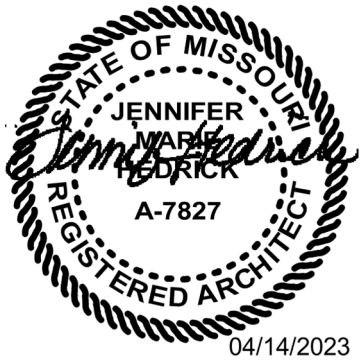
Drawings:	**Specifications:**
Lottes Health Science Library - Renovation for Consolidation #CP211852	02 4119 SELECTIVE DEMOLITION
G001 - COVER SHEET	03 3000 CAST-IN-PLACE CONCRETE
G002 - CODE SHEET (OVERALL & FIRST FLOOR)	05 1200 STRUCTURAL STEEL FRAMING
G003 - CODE SHEET (SECOND AND THIRD FLOOR)	05 3100 STEEL DECKING
G004 - SITE PREMIESES / CONSTRUCTION STAGING	05 5200 HANDRAILS AND RAILINGS
A001 - PARTITION TYPES, GENERAL SYMBOLS LEGEND, & ABBREVIATIONS	06 1000 ROUGH CARPENTRY
A101 - DEMOLITION FLOOR PLAN - LEVEL 01	06 4116 PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS
A102 - DEMOLITION REFLECTED CEILING PLAN - LEVEL 01	07 5419 POLYVINYL-CHLORIDE (PVC) ROOFING
A103 - DEMOLITION FLOOR PLAN - LEVEL 02	07 8100 APPLIED FIRE PROTECTION
A104 - DEMOLITION REFLECTED CEILING PLAN - LEVEL 02	07 8413 PENETRATION FIRESTOPPING
A105 - DEMOLITION FLOOR PLAN - LEVEL 03	07 8443 JOINT FIRESTOPPING
A106 - DEMOLITION REFLECTED CEILING PLAN - LEVEL 03	07 9200 JOINT SEALANTS
A201 - NEW WORK PLAN - FIRST FLOOR - DIMENSIONS	07 9513.13 INTERIOR EXPANSION JOINT COVER ASSEMBLIES
A202 - NEW WORK PLAN - FIRST FLOOR - TAGS & KEYNOTES	08 1213 HOLLOW METAL FRAMES
A203 - NEW WORK REFLECTED CEILING PLAN - FIRST FLOOR	08 1416 FLUSH WOOD DOORS
A204 - NEW WORK PLAN - SECOND FLOOR - DIMENSIONS	08 3113 ACCESS DOORS AND FRAMES
	08 4113 ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS
	08 4126.23 INTERIOR ALL-GLASS ENTRANCES
	08 4413 GLAZED ALUMINUM CURTAIN WALLS

A205 - NEW WORK PLAN - SECOND FLOOR - TAGS & KEYNOTES
A206 - NEW WORK REFLECTED CEILING PLAN - SECOND FLOOR
A207 - NEW WORK PLAN - THIRD FLOOR - DIMENSIONS
A208 - NEW WORK PLAN - THIRD FLOOR - TAGS & KEYNOTES
A209 - NEW WORK REFLECTED CEILING PLAN - THIRD FLOOR
A210 - NEW WORK ROOF PLAN
A401 - BUILDING SECTIONS
A501 - CASEWORK DETAILS & TYPICAL MOUNTING HEIGHTS
A502 - ENLARGED PLANS & INTERIOR ELEVATIONS
A503 - ENLARGED PLANS & INTERIOR ELEVATIONS
A601 - DETAIL SECTIONS
A602 - DETAIL SECTIONS
A701 - DOOR & FRAME SCHEDULES & ELEVATIONS
A702 - STOREFRONT & BUTT GLAZING ELEVATIONS
A703 - ROOM FINISH SCHEDULES
A704 - ROOM FINISH KEY
A711 - FIRST FLOOR PLAN - FINISHES
A712 - SECOND FLOOR PLAN - FINISHES
A713 - THIRD FLOOR PLAN – FINISHES

Lottes Health Science Library - Replace Glazing & Roofing in Barrel Roof Systems #CP230151

G001.2 - COVER SHEET
G002.2 - SITE PREMIESES / CONSTRUCTION STAGING
A101.2 - DEMOLITION ROOF PLAN
A201.2 - ROOF PLAN
A301.2 - ELEVATIONS & DETAILS
A401.2 - BUILDING SECTIONS
A601.2 - DETAILS

08 4523 FIBERGLASS-SANDWICH-PANEL ASSEMBLIES
08 7100 DOOR HARDWARE
08 8000 GLAZING
09 2116.23 GYPSUM BOARD SHAFT WALL ASSEMBLIES
09 2216 NON-STRUCTURAL METAL FRAMING
09 2900 GYPSUM BOARD
09 3013 CERAMIC TILING
09 5113 ACOUSTICAL PANEL CEILINGS
09 6513 RESILIENT BASE AND ACCESSORIES
09 6519 RESILIENT TILE FLOORING
09 6813 TILE CARPETING
09 8100 ACOUSTIC INSULATION AND JOINT SEALANT
09 8433 SOUND-ABSORBING WALL UNITS
09 8436 SOUND-ABSORBING CEILING UNITS
09 8453 SOUND BARRIER MULLION TRIM CAP
09 9123 INTERIOR PAINTING
10 1100 GLASS MARKERBOARDS
10 2613 FRP PANELS
10 2800 TOILET, BATH, AND LAUNDRY ACCESSORIES
10 4413 FIRE PROTECTION CABINETS
11 5213 PROJECTION SCREENS
12 2413 ROLLER WINDOW SHADES
12 3623.13 PLASTIC-LAMINATE-CLAD COUNTERTOPS
12 3661.16 SOLID SURFACING COUNTERTOPS, WINDOWSILLS AND WALL PANEL
13 9000 COVER SYSTEM FOR CONCEALMENT OF FIRE SPRINKLER SYSTEMS, PIPING, CONDUIT, WIRING AND CABLE



04/14/2023

Design Professional Name: Jennifer Marie Hedrick
State of Missouri License Number: A-7827

CERTIFICATION PAGE

Project Title **Lottes Health Science Library - Renovation for Consolidation #CP211852**
Lottes Health Science Library - Replace Glazing & Roofing in Barrel Roof Systems #CP230151

Design Professional of Record: Electrical Engineer

The Engineers seal on these contract documents has been affixed in accordance with the requirements of Chapter 327, RSMO. In affixing this seal, the engineer takes responsibility for the attached engineering specifications. The Engineer hereby disclaims any and all responsibility for project specifications other than these, included in these project documents, they being the responsibility of the other design professionals, whose seals and statements appear herein.

The following drawings and specifications have been prepared by me or under my direct supervision:

Drawings:	**Specifications:**
Lottes Health Science Library - Renovation for Consolidation #CP211852	26 0500 COMMON WORK RESULTS FOR ELECTRICAL
E000 - ELECTRICAL SYMBOLS AND ABBREVIATIONS	26 0519 CONDUCTORS AND CABLES
ED101 - POWER & SYSTEMS FIRST FLOOR DEMOLITION PLAN	26 0526 GROUNDING AND BONDING
ED102 - POWER & SYSTEMS SECOND FLOOR DEMOLITION PLAN	26 0529 HANGERS AND SUPPORTS
ED103 - POWER & SYSTEMS THIRD FLOOR DEMOLITION PLAN	26 0533 RACEWAYS
ED104 – ELECTRICAL ROOF – DEMOLITION PLAN	26 0534 BOXES, CABINETS AND ENCLOSURES
ED201 - LIGHTING FIRST FLOOR -DEMO	26 0536 CABLE TRAYS
ED202 - LIGHTING SECOND FLOOR -DEMO	26 0553 IDENTIFICATION FOR ELECTRICAL SYSTEMS
ED203 - LIGHTING THIRD FLOOR -DEMO	26 0573 POWER SYSTEM STUDIES
ED301 - FIRE ALARM FIRST FLOOR -DEMO	26 0600 ELECTRICAL DEMOLITION
ED302 - FIRE ALARM SECOND FLOOR -DEMO	26 0923 LIGHTING CONTROL DEVICES
ED303 - FIRE ALARM THIRD FLOOR -DEMO	26 2416 PANELBOARDS
ED600 – ELECTRICAL ENLARGED MECHANICAL ROOM DEMOLITION PLANS	26 2419 MOTOR CONTROL
E101 - POWER & SYSTEMS FIRST FLOOR NEW WORK	26 2726 WIRING DEVICES
E102 - POWER & SYSTEMS SECOND FLOOR NEW WORK	26 2813 FUSES
E103 - POWER & SYSTEMS THIRD FLOOR NEW WORK	26 2816 ENCLOSED SWITCHES
E104 - ELECTRICAL ROOF -NEW WORK PLAN	26 2923 VARIABLE FREQUENCY DRIVES
E201 - LIGHTING FIRST FLOOR -NEW WORK	26 5100 LIGHTING
E202 - LIGHTING SECOND FLOOR -NEW WORK	28 3111 DIGITAL ADDRESSABLE FIRE ALARM SYSTEM
E203 - LIGHTING THIRD FLOOR -NEW WORK	
E301 - FIRE ALARM FIRST FLOOR NEW WORK	
E302 - FIRE ALARM SECOND FLOOR -NEW WORK	
E303 - FIRE ALARM THIRD FLOOR -NEW WORK	
E400 - ONE-LINE DIAGRAM -DEMO	

E401 - ONE-LINE DIAGRAM -NEW WORK
E500 - ELECTRICAL SCHEDULES
E501 - ELECTRICAL SCHEDULES
E502 - PANEL SCHEDULES
E503 - PANEL SCHEDULES
E504 – LIGHTING CONTROL DETAILS
E505 – ELECTRICAL DETAILS
E506 – ELECTRICAL DETAILS
E600 - ELECTRICAL ENLARGED MECHANICAL ROOM NEW WORK PLANS

Design Professional Name: **Gary N. Fischer**
State of Missouri License Number: **PE - 2018021177**

CERTIFICATION PAGE

Project Title **Lottes Health Science Library - Renovation for Consolidation #CP211852**
Lottes Health Science Library - Replace Glazing & Roofing in Barrel Roof Systems #CP230151

Design Professional of Record: Mechanical, Plumbing, and Fire Protection Engineer

The Engineers seal on these contract documents has been affixed in accordance with the requirements of Chapter 327, RSMO. In affixing this seal, the engineer takes responsibility for the attached engineering specifications. The Engineer hereby disclaims any and all responsibility for project specifications other than these, included in these project documents, they being the responsibility of the other design professionals, whose seals and statements appear herein.

The following drawings and specifications have been prepared by me or under my direct supervision:

Drawings:	**Specifications:**
Lottes Health Science Library - Renovation for Consolidation #CP211852	21 0100 BASIC FIRE PROTECTION REQUIREMENTS
M000 - MECHANICAL SYMBOLS & ABBREVIATIONS	21 0500 COMMON WORK RESULTS FOR FIRE SUPPRESSION
MD101 - MECHANICAL FIRST FLOOR DEMOLITION PLAN	21 0553 IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT
MD102 - MECHANICAL SECOND FLOOR DEMOLITION PLAN	21 1313 WET-PIPE SPRINKLER SYSTEMS
MD103 - MECHANICAL THIRD FLOOR DEMOLITION PLAN	22 0100 BASIC PLUMBING REQUIREMENTS
MD104 - MECHANICAL ROOF DEMOLITION PLAN	22 0500 BASIC PLUMBING MATERIALS AND METHODS
MD201 - MECHANICAL ENLARGED MECHANICAL ROOM DEMOLITION PLANS	22 0523 VALVES
M101 - MECHANICAL FIRST FLOOR NEW DUCTWORK PLAN	22 0529 HANGER AND SUPPORTS
M102 - MECHANICAL SECOND FLOOR NEW DUCTWORK PLAN	22 0700 PLUMBING INSULATION
M103 - MECHANICAL THIRD FLOOR NEW DUCTWORK PLAN	22 1116 DOMESTIC WATER PIPING
M104 - MECHANICAL ROOF NEW WORK PLAN	22 1119 DOMESTIC WATER PIPING SPECIALTIES
M111 - MECHANICAL FIRST FLOOR NEW PIPING PLAN	22 1316 SANITARY WASTE AND VENT PIPING
M112 - MECHANICAL SECOND FLOOR NEW PIPING PLAN	22 1319 SANITARY WASTE PIPING SPECIALTIES
M113 - MECHANICAL THIRD FLOOR NEW PIPING PLAN	22 4300 PLUMBING FIXTURES
M201 - MECHANICAL ENLARGED MECHANICAL ROOM NEW WORK PLANS	23 0100 BASIC MECHANICAL REQUIREMENTS
M301 – SECTIONS	
M302 – SECTIONS	
M401 – MECHANICAL DIAGRAMS	
M501 - MECHANICAL DETAILS	
M502 - MECHANICAL DETAILS	
M503 - MECHANICAL DETAILS	
M601 - MECHANICAL SCHEDULES	
M602 - MECHANICAL SCHEDULES	
M603 - MECHANICAL SCHEDULES	
M701 - MECHANICAL CONTROLS	
M702 - MECHANICAL CONTROLS	
M703 - MECHANICAL CONTROLS	
M704 - MECHANICAL CONTROLS	

M705 – MECHANICAL CONTROLS
P000 - PLUMBING SYMBOLS AND ABBREVIATIONS
PD100 - PLUMBING UNDERGROUND DEMOLITION PLAN
PD101 - PLUMBING FIRST FLOOR DEMOLITION PLAN
PD102 - PLUMBING SECOND FLOOR DEMOLITION PLAN
PD103 - PLUMBING THIRD FLOOR DEMOLITION PLAN
P100 - PLUMBING UNDERGROUND PLAN
P101 - PLUMBING FIRST FLOOR WASTE AND VENT PLAN
P102 - PLUMBING SECOND FLOOR WASTE AND VENT PLAN
P103 - PLUMBING THIRD FLOOR WASTE AND VENT PLAN
P201 - PLUMBING WATER FIRST FLOOR PLAN NEW WORK
P202 - PLUMBING WATER SECOND FLOOR PLAN NEW WORK
P203 - PLUMBING WATER THIRD FLOOR PLAN NEW WORK
P401 - PLUMBING RISER DIAGRAMS
P402 - PLUMBING RISER DIAGRAMS
P403 - PLUMBING RISER DIAGRAMS
P501 - PLUMBING DETAILS & SCHEDULES
FP000 - FIRE PROTECTION SYMBOLS AND ABBREVIATIONS
FPD101 - FIRE PROTECTION FIRST FLOOR DEMOLITION PLAN
FPD102 - FIRE PROTECTION SECOND FLOOR DEMOLITION PLAN
FPD103 - FIRE PROTECTION THIRD FLOOR DEMOLITION PLAN
FP101 - FIRE PROTECTION FIRST FLOOR NEW WORK PLAN
FP102 - FIRE PROTECTION SECOND FLOOR NEW WORK PLAN
FP103 - FIRE PROTECTION THIRD FLOOR NEW WORK PLAN
FP501 - PLUMBING DETAILS

23 0500 BASIC MECHANICAL MATERIALS AND METHODS
23 0513 MOTORS
23 0523 VALVES
23 0529 HANGERS AND SUPPORTS
23 0700 MECHANICAL INSULATION
23 0900 CONTROL SYSTEMS
23 0990 TESTING, ADJUSTING, AND BALANCING
23 2113 HYDRONIC PIPING
23 2123 HYDRONIC PUMPS
23 3113 METAL DUCTS
23 3300 DUCT ACCESSORIES
23 3423 FANS AND VENTILATORS
23 3600 AIR TERMINAL UNITS
23 3713 DIFFUSERS, REGISTERS, AND GRILLES
23 7313 MODULAR PACKAGED AIR-HANDLING UNITS
23 8239 IN-ROOM TERMINAL EQUIPMENT

Design Professional Name: **RANDY JAMES DIEMER**
State of Missouri License Number: **PE-2017015702**

CERTIFICATION PAGE

Project Title **Lottes Health Science Library - Renovation for Consolidation #CP211852**
Lottes Health Science Library - Replace Glazing & Roofing in Barrel Roof Systems #CP230151

Design Professional of Record: Structural Engineer

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The following drawings and specifications have been prepared by me or under my direct supervision:

Drawings:	**Specifications:**
Lottes Health Science Library - Renovation for Consolidation #CP211852	03 3000 CAST-IN-PLACE CONCRETE
S100 - 2nd FLOOR FRAMING PLAN	05 1200 STRUCTURAL STEEL FRAMING
S101 - 3rd FLOOR FRAMING PLAN	05 3100 STEEL DECKING

Design Professional Name: **Gregory L. Linneman**
State of Missouri License Number: **P-2005001013**

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PLANNING DESIGN & CONSTRUCTION

900 E. Stadium, Ste. 130
Columbia, Missouri 65211
Telephone: (573) 882-6800

ADVERTISEMENT FOR BIDS

Sealed bids for:

CP211852 - LOTTES HEALTH SCIENCES LIBRARY – RENOVATION FOR CONSOLIDATION
CP230151 - LOTTES HEALTH SCIENCES LIBRARY – REPLACE GLAZING AND ROOFING IN BARREL ROOF SYSTEMS
UNIVERSITY OF MISSOURI
COLUMBIA, MISSOURI CONSTRUCTION ESTIMATE: $5,921,144 - $6,579,049

will be received by the Curators of the University of Missouri, Owner, at Campus Facilities, Planning, Design & Construction, Room L100 (Front Reception Desk), General Services Building, University of Missouri, Columbia, Missouri 65211, until 1:30 p.m., C.T., May 11, 2023 and then immediately opened and publicly read aloud.

Drawings, specifications, and other related contract information may be obtained at http://operations-webapps.missouri.edu/pdc/adsite/ad.html. Electronic bid sets are available at no cost and may be printed as desired by the plan holders. No paper copies will be issued. If paper copies are desired, it is the responsibility of the user to print the files or have them printed.

Questions regarding the scope of work should be directed to Nick Borgmeyer with Simon Oswald Associates at (573) 443-1407 or borgmeyer@soa-inc.com. Questions regarding commercial conditions should be directed to Jody Miller at (573) 884-8912 or jrmiller@missouri.edu.

A prebid meeting will be held at 1:30 p.m., C.T., April 25, 2023 in the General Services Bldg., Room 194B, followed by a site walk-through.

A Diversity Participation goal of 10% MBE, 10% Combined WBE, DBE, Veteran Owned Business and 3% SDVE has been established for this contract.

The Owner reserves the right to waive informalities in bids and to reject any and all bids.

Individuals with special needs as addressed by the Americans with Disabilities Act may contact (573) 882-6800.

Advertisement Date: April 14, 2023

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SECTION 1.A

BID FOR LUMP SUM CONTRACT

Date:_____

BID OF _____
(hereinafter called "Bidder") a corporation* organized and existing under laws of the State of _____
_____,
a partnership* consisting of _____,
an individual* trading as _____,
a joint venture* consisting of _____
_____.
*Insert Corporation(s), partnership or individual, as applicable.

TO: Curators of the University of Missouri
c/o Associate Vice Chancellor – Facilities
Room L100 General Service Building
Columbia, MO 65211

1. Bidder, in compliance with invitation for bids for construction work in accordance with Drawings and Specifications prepared by SOA Architecture, entitled "LOTTES HEALTH SCIENCE LIBRARY – RENOVATION FOR CONSOLIDATION" (project number CP211852) and "LOTTES HEALTH SCIENCE LIBRARY – REPLACE GLAZING & ROOFING IN BARREL ROOF SYSTEMS" (project number CP230151), dated April 14, 2023 having examined Contract Documents and site of proposed work, and being familiar with all conditions pertaining to construction of proposed project, including availability of materials and labor, hereby proposes to furnish all labor, materials and supplies to construct project in accordance with Contract Documents, within time set forth herein at prices stated below. Prices shall cover all expenses, including taxes not covered by the University of Missouri's tax exemption status, incurred in performing work required under Contract documents, of which this Bid is a part.

Bidder acknowledges receipt of following addenda:

Addendum No. _____Dated _____
Addendum No. _____Dated _____
Addendum No. _____Dated _____
Addendum No. _____Dated _____

2. In following Bid(s), amount(s) shall be written in both words and figures. In case of discrepancy between words and figures, words shall govern.

3. BID PRICING

a. Base Bid:
The Bidder agrees to furnish all labor, materials, tools, and equipment required for the renovation of Lottes HSL and limited roof and glazing replacement; all as indicated on the Drawings and described in these Specifications for sum of:

_____
_____DOLLARS ($_____).

b. Additive Alternate Bids (NOT APPLICALBE):

c. Unit Prices:

(1) For changing specified quantities of work from those indicated by Contract Drawings and Specifications, upon written instructions of Owner, the following Unit Prices shall prevail in accordance with General Conditions.

(2) The following Unit Prices include all labor, overhead and profit, materials, equipment, appliances, bailing, shoring, shoring removal, etc., to cover all work.

(3) The following Unit Prices are required where applicable to particular Base Bid and/or Alternate being submitted.

(4) Only a single Unit Price shall be given and it shall apply for either MORE or LESS work than that indicated on Drawings and called for in Specifications as indicated to be included in Base Bid and/or Alternates. In the event that more or less units than so indicated is actually furnished, Change Orders will be issued for increased or decreased amounts as approved by the Owner.

(5) Bidder understands that the Owner will not be liable for any Unit Price or any amount in excess of Base Bid and any Alternate(s) accepted at time of award of Contract, except as expressed in written Change Orders duly executed and delivered by Owner's Representative.

(6) Interior gypsum skim coat as defined in Division 9 and drawing

(a) Base Bid Quantity per Allowance (item d below) at $_____ /sq. ft.

(7) Metal roof deck replacement at the south atrium barrel vault roof as defined in Division 5 and drawing.

(a) Unit price at $_____ /sq. ft.

(8) Interior gypsum board ceiling replacement in the south atrium barrel vault as defined in Division 9 and drawing.

(a) Unit price at $_____ /sq. ft.

(9) Metal roof deck replacement at the north atrium barrel vault roof as defined in Division 5 and drawing.

(a) Unit price at $_____ /sq. ft.

(10) Interior gypsum board ceiling replacement in the north atrium barrel vault as defined in Division 9 and drawing.

(a) Unit price at $_____ /sq. ft.

(11) Replacement of timber nailers and blocking at the north and south barrel vault roofs as defined in Division 6 and drawings.

(a) Unit price at $_____ /board ft.

d. Allowance: allowance amount shall not include contractor's overhead and profit. The Contractor shall include overhead and profit on the allowance amount in his bid.

(1) Bidder shall include in the base bid sum an allowance of $_____ for 900 sq. ft. of skim coating of existing gypsum board partitions within the work area.

4. PROJECT COMPLETION

a. Contract Period - Contract period begins on the day the Contractor receives unsigned Contract, Performance Bond, Payment Bond, and "Instructions for Execution of Contract, Bonds, and Insurance Certificates." Bidder agrees to complete project within four-hundred seven (407) calendar days from receipt of aforementioned documents. Fifteen (15) calendar days have been allocated in construction schedule for receiving aforementioned documents from Bidder.

b. Commencement - Contractor agrees to commence work on this project after the "Notice to Proceed" is issued by the Owner. "Notice to Proceed" will be issued within seven (7) calendar days after Owner receives properly prepared and executed Contract documents listed in paragraph 4.a. above.

c. Liquidated Damages (NOT USED).

d. Special scheduling requirements:
(1) Lottes Health Sciences Library south atrium will be occupied on the first and second floors. Activities will be on going in the building and work affecting occupants must be coordinated with the Owner's Representative.

5. SUBCONTRACTOR LIST:

Bidder hereby certifies that the following subcontractors will be used in performance of Work:

NOTE: Failure to list subcontractors for each category of work identified on this form or listing more than one subcontractor for any category of work without designating the portion of work performed by each shall be grounds for rejection of bid. List name, city, and state of designated subcontractor, for each category of work listed in Bid For Lump Sum Contract. If work within a category will be performed by more than one subcontractor, Bidder shall provide name, city, and state of each subcontractor and specify exact portion of work to be performed by each. If acceptance/non-acceptance of Alternates will affect designation of a subcontractor, Bidder shall provide information, for each affected category, with this bid form. If Bidder intends to perform any designated subcontract work by using Bidder's own employees, then Bidder shall list their own name, city, and state. The bidder may petition the Owner to change a listed subcontractor only within 48 hours of the bid opening. See Information For Bidders Section 16 List of Subcontractors for requirements.

Work to be performed	Subcontractor Name, City, State
Roofing	
HVAC	
Electrical	
Plumbing	

6. SUPPLIER DIVERSITY PARTICIPATION GOALS

a. The Contractor shall have as a goal, subcontracting with Minority Business Enterprise (MBE) of ten percent 10%), with Service Disabled Veteran Owned Business (SDVE) of three percent (3%); and with Women Business Enterprise (WBE), Disadvantage Business Enterprise (DBE), and/or Veteran Owned Business of ten percent (10%) of awarded contract price for work to be performed.

b. Requests for waiver of this goal shall be submitted on the attached Application For Waiver form. A determination by the Director of Facilities Planning & Development, UM, that a good faith effort has not been made by Contractor to achieve above stated goal may result in rejection of bid.

c. The Undersigned proposes to perform work with following Supplier Diversity participation level:

MBE PERCENTAGE PARTICIPATION: _____ percent (_____%)
SDVE PERCENTAGE PARTICIPATION: _____ percent (____%)
WBE, DBE, and/or VETERAN PERCENTAGE PARTICIPATION:_____percent(____%)

d. A Supplier Diversity Compliance Evaluation form shall be submitted with this bid for each diverse subcontractor to be used on this project.

7. BIDDER'S ACKNOWLEDGMENTS

a. Bidder declares that he has had an opportunity to examine the site of the work and he has examined Contract Documents therefore; that he has carefully prepared his bid upon the basis thereof; that he has carefully examined and checked bid, materials, equipment and labor required thereunder, cost thereof, and his figures therefore. Bidder hereby states that amount, or amounts, set forth in bid is, or are, correct and that no mistake or error has occurred in bid or in Bidder's computations upon which this bid is based. Bidder agrees that he will make no claim for reformation, modifications, revisions or correction of bid after scheduled closing time for receipt of bids.

b. Bidder agrees that bid shall not be withdrawn for a period of sixty (60) days after scheduled closing time for receipt of bids.

c. Bidder understands that Owner reserves right to reject any or all bids and to waive any informalities in bidding.

d. Accompanying the bid is a bid bond, or a certified check or a cashier's check payable without condition to "The Curators of the University of Missouri" which is an amount at least equal to five percent (5%) of amount of largest possible total bid herein submitted, including consideration of Alternates.

e. Accompanying the bid is a Bidder's Statement of Qualifications. Failure of Bidder to submit the Bidder's Statement of Qualifications with the bid may cause the bid to be rejected. Owner does not maintain Bidder's Statements of Qualifications on file.

f. It is understood and agreed that bid security of two (2) lowest and responsive Bidders will be retained until Contract has been executed and an acceptable Performance Bond and Payment Bond has been furnished. It is understood and agreed that if the bid is accepted and the undersigned fails to execute the Contract and furnish acceptable Performance/Payment Bond as required by Contract Documents, accompanying bid security will be realized upon or retained by Owner. Otherwise, the bid security will be returned to the undersigned.

8. BIDDER'S CERTIFICATE

Bidder hereby certifies:

a. His bid is genuine and is not made in interest of or on behalf of any undisclosed person, firm or corporation, and is not submitted in conformity with any agreement or rules of any group, association or corporation.

b. He has not directly or indirectly induced or solicited any other bidder to put in a false or sham bid.

c. He has not solicited or induced any person, firm or corporation to refrain from bidding.

d. He has not sought by collusion or otherwise to obtain for himself any advantage over any other Bidder or over Owner.

e. He will not discriminate against any employee or applicant for employment because of race, color, religion, sex or national origin in connection with performance of work.

f. By virtue of policy of the Board of Curators, and by virtue of statutory authority, a preference will be given to materials, products, supplies, provisions and all other articles produced, manufactured, mined or grown within the State of Missouri. By virtue of policy of the Board of Curators, preference will also be given to all Missouri firms, corporations, or individuals, all as more fully set forth in "Information For Bidders."

9. BIDDER'S SIGNATURE

Note: All signatures shall be original; not copies, photocopies, stamped, etc.

Authorized Signature	Date
Printed Name	Title
Company Name	
Mailing Address	
City, State, Zip	
Phone No.	Federal Employer ID No.
Fax No.	E-Mail Address
Circle one: Individual Partnership Corporation Joint Venture	
If a corporation, incorporated under the laws of the State of_____	
Licensed to do business in the State of Missouri? ____yes _____no	

(Each Bidder shall complete bid form by manually signing on the proper signature line above and supplying required information called for in connection with the signature. Information is necessary for proper preparation of the Contract, Performance Bond and Payment Bond. Each Bidder shall supply information called for in accompanying "Bidder's Statement of Qualifications.")

END OF SECTION

UNIVERSITY OF MISSOURI
BIDDER'S STATEMENT OF QUALIFICATIONS

Submit with Bid for Lump Sum Contract in separate envelope appropriately labeled. Attach additional sheet if necessary.

1. Company Name_____

   Phone# _____ Fax #:_____

   Address _____

2. Number of years in business _____. If not under present firm name, list previous firm names and types of organization.

3. List contracts on hand (complete the following schedule, include telephone number).

Project & Address	Owner/Owner's Representative	Phone Number	Architect	Amount of your Contract	Percent Completed

4. General character of work performed by your company personnel.

5. List important projects completed in the last five (5) years on a type similar to the work now bid for, including approximate cost and telephone number.

Project & Address	Owner/Owner's Representative	Phone Number	Architect	Amount of your Contract	Percent Completed

6. Other experience qualifying you for the work now bid.

7. No default has been made in any contract complete or incomplete except as noted below:
   (a) Number of contracts on which default was made _____
   (b) Description of defaulted contracts and reason therefor

8. (a) Have you or your company participated in any contract subject to an equal opportunity clause similar to that described in the General Conditions?
   Yes _____ No ____

   (b) Have you filed all required compliance reports?
   Yes _____ No ____

(c) Is fifty percent or more of your company owned by a minority?
Yes _____ No ____

(d) Is fifty percent or more of your company owned by a woman?
Yes _____ No ____

(e) Is fifty percent or more of your company owned by a service disabled veteran?
Yes _____ No ____

(f) Is fifty percent or more of your company owned by a veteran?
Yes _____ No ____

(g) Is your company a Disadvantaged Business Enterprise?
Yes _____ No ____

9. Have you or your company been suspended or debarred from working at any University of Missouri campus?
Yes _____ No ____ (If the answer is "yes", give details.)

_____

_____

10. Have any administrative or legal proceedings been started against you or your company alleging violation of any wage and hour regulations or laws?
Yes _____ No ____ (If the answer is "yes", give details.)

_____

_____

11. Workers Compensation Experience Modification Rates (last 3 yrs): ____/____/____

Incidence Rates (last 3 years): _____/____/_____

12. List banking references.

_____

_____

13. (a) Do you have a current confidential financial statement on file with Owner?
Yes _____ No ____ (If not, and if desired, Bidder may submit such statement with bid, in a separate sealed and labeled envelope.)

(b) If not, upon request will you file a detailed confidential financial statement within three (3) days?
Yes _____ No ____

Dated at _____ this _____ day of _____ 20____

_____
Name of Organization

_____
Signature

_____
Printed Name

_____
Title of Person Signing

END OF SECTION

UNIVERSITY OF MISSOURI
BIDDER'S STATEMENT OF QUALIFICATIONS FOR ASBESTOS ABATEMENT

Submit with Bid for Lump Sum Contract in separate envelope appropriately labeled. Attach additional sheet if necessary.

1. Company Name_____ Phone# _____

   Address _____

2. State of Missouri Registration number_____

3. Number of years in business _____. If not under present firm name, list previous firm names and types of organization.

   _____

   _____

4. List contracts on hand (complete the following schedule, include telephone number).

Project & Address	Owner/Owner's Representative	Phone Number	Architect	Amount of your Contract	Percent Completed

5. General character of work performed by your company personnel.

   _____

6. List important projects completed in the last five (5) years on a type similar to the work now bid for, including approximate cost and telephone number.

Project & Address	Owner/Owner's Representative	Phone Number	Architect	Amount of your Contract	Percent Completed

7. Other experience qualifying you for the work now bid.

   _____

   _____

8. No default has been made in any contract complete or incomplete except as noted below:
   (a) Number of contracts on which default was made _____
   (b) Description of defaulted contracts and reason therefor

   _____

   _____

9. (a) Have you or your company participated in any contract subject to an equal opportunity clause similar to that described in the General Conditions?
   Yes _____ No ____

   (b) Have you filed all required compliance reports?
   Yes _____ No ____

(c) Is fifty percent or more of your company owned by a minority?
Yes _____ No ____

(d) Is fifty percent or more of your company owned by a woman?
Yes _____ No ____

(e) Is fifty percent or more of your company owned by a service disabled veteran?
Yes _____ No ____

(f) Is fifty percent or more of your company owned by a veteran?
Yes _____ No ____

(g) Is your company a Disadvantaged Business Enterprise?
Yes _____ No ____

10. Have you or your company been suspended or debarred from working at any University of Missouri campus?
Yes _____ No ____ (If the answer is "yes", give details.)

_____

_____

11. Have any administrative or legal proceedings been started against you or your company alleging violation of any wage and hour regulations or laws?
Yes _____ No ____ (If the answer is "yes", give details.)

_____

_____

12. Workers Compensation Experience Modification Rates (last 3 yrs): ____/____/____

Incidence Rates (last 3 years): _____/____/_____

13. List banking references.

_____

_____

14. (a) Do you have a current confidential financial statement on file with Owner?
Yes _____ No ____ (If not, and if desired, Bidder may submit such statement with bid, in a separate sealed and labeled envelope.)

(b) If not, upon request will you file a detailed confidential financial statement within three (3) days?
Yes _____ No ____

Dated at _____ this _____ day of _____ 20____

_____
Name of Organization

_____
Signature

_____
Printed Name

_____
Title of Person Signing

END OF SECTION

SUPPLIER DIVERSITY COMPLIANCE EVALUATION FORM

This form shall be completed by Bidders and submitted with the Bidder's Statement of Qualifications form for each diverse firm who will function as a subcontractor on the contract.

The undersigned submits the following data with respect to this firm's assurance to meet the goal for Supplier Diversity participation.

I. Project:

_____

II. Name of General Contractor:_____

III. Name of Diverse Firm:_____

Address:_____

Phone No.:_____ Fax No.:_____

Status (check one) MBE _____ WBE _____ Veteran_____ Service Disabled Veteran_____ DBE_____

IV. Describe the subcontract work to be performed. (List Base Bid work and any Alternate work separately):

Base Bid:_____

_____

_____

_____

_____

V. Dollar amount of contract to be subcontracted to the Diverse firm:

Base Bid:_____

Alternate(s), (Identify separately):_____

_____

_____

_____

_____

VI. Is the proposed subcontractor listed in the Directory of M/W/DBE Vendors, Directory of Serviced Disabled Veterans and/or the Directory of Veterans maintained by the State of Missouri?

Yes _____ No _____

Is the proposed subcontractor certified as a diverse supplier by any of the following: federal government agencies, state agencies, State of Missouri city or county government agencies, Minority and/or WBE certifying agencies?

Yes _____ No _____ If yes, please provide details and attach a copy of the certification.

_____

_____

_____

_____

Does the proposed subcontractor have a signed document from their attorney certifying the Supplier as a Diverse and meeting the 51% owned and committed requirement?

Yes _____ No _____ If yes, please attach letter.

Signature: _____

Name: _____

Title: _____

Date: _____

APPLICATION FOR WAIVER

This form shall be completed and submitted with the Bidder's Statement of Qualifications. Firms wishing to be considered for award are required to demonstrate that a good faith effort has been made to include diverse suppliers. This form will be used to evaluate the extent to which a good faith effort has been made. The undersigned submits the following data with respect to the firm's efforts to meet the goal for Supplier Diversity Participation.

1. List pre-bid conferences your firm attended where Supplier Diversity requirements were discussed.

2. Identify advertising efforts undertaken by your firm which were intended to recruit potential diverse subcontractors for various aspects of this project. Provide names of newspapers, dates of advertisements and copies of ads that were run.

3. Note specific efforts to contact in writing those diverse suppliers capable of and likely to participate as subcontractors for this project.

4. Describe steps taken by your firm to divide work into areas in which diverse suppliers/contractors would be capable of performing.

5. What efforts were taken to negotiate with prospective diverse suppliers/contractors for specific sub-bids? Include the names, addresses, and telephone numbers of diverse suppliers/contractors contacted, a description of the information given to diverse suppliers/contractors regarding plans and specifications for the assigned work, and a statement as to why additional agreements were not made with diverse suppliers/contractors.

6. List reasons for rejecting a diverse supplier/contractor which has been contacted.

8. Describe the follow-up contacts with diverse suppliers/contractors made by your firm after the initial solicitation.

_____

_____

_____

9. Describe the efforts made by your firm to provide interested diverse suppliers/contractors with sufficiently detailed information about the plans, specifications and requirements of the contract.

_____

_____

_____

10. Describe your firm's efforts to locate diverse suppliers/contractors.

_____

_____

_____

Based on the above stated good faith efforts made to include supplier diversity, the bidder hereby requests that the original supplier diversity percentage goal be waived and that the percentage goal for this project be set at _____ percent.

The undersigned hereby certifies, having read the answers contained in the foregoing Application for Waiver, that they are true and correct to the best of his/her knowledge, information and belief.

Signature_____

Name_____

Title_____

Company_____

Date_____

AFFIDAVIT

"The undersigned swears that the foregoing statements are true and correct and include all material information necessary to identify and explain the operation of _____ _____(name of firm) as well as the ownership thereof. Further, the undersigned agrees to provide through the prime contractor or directly to the Contracting Officer current, complete and accurate information regarding actual work performed on the project, the payment therefore and any proposed changes, if any, of the project, the foregoing arrangements and to permit the audit and examination of books, records and files of the named firm. Any material misrepresentation will be grounds for terminating any contract which may be awarded and for initiating action under federal or state laws concerning false statements."

Note - If, after filing this information and before the work of this firm is completed on the contract covered by this regulation, there is any significant change in the information submitted, you must inform the Director of Facilities Planning and Development of the change either through the prime contractor or directly.

Signature _____

Name _____

Title _____

Date _____

Corporate Seal (where appropriate)

Date _____

State of _____

County of _____

On this _____ day of _____, 19_,

before me appeared (name) _____ to me personally known, who, being duly sworn, did execute the foregoing affidavit, and did state that he or she was properly authorized by (name of firm)

_____

_____to execute the affidavit and did so as his or her own free act and deed.

(Seal)

Notary Public _____

Commission expires _____

AFFIDAVIT FOR AFFIRMATIVE ACTION

State of Missouri)
) ss.
County of)

_____ first being duly sworn on his/her oath states: that he/she is the (sole proprietor, partner, or officer) of _____ _____ a (sole proprietorship, partnership, corporation), and as such (sole proprietor, partner, or officer) is duly authorized to make this affidavit on behalf of said (sole proprietorship, partnership, corporation); that under the contract known as "_____" Project No. _____ less than 50 persons in the aggregate will be employed and therefore, the applicable Affirmative Action requirements as set forth in the "Nondiscrimination in Employment Equal Opportunity," Supplemental Special Conditions, and Article 13 in the General Conditions do not apply.

_____

Subscribed and sworn before me this _____ day of _____, 19_____.

My commission expires _____, 19_____.

CERTIFYING SUPPLIER DIVERSITYAGENCIES

Diverse firms are defined in General Conditions Articles 1.1.7 and those businesses must be certified as disadvantaged by an approved agency. The Bidder is responsible for obtaining information regarding the certification status of a firm. A list of certified firms may be obtained by contacting the agencies listed below. Any firm listed as disadvantaged by any of the following agencies will be classified as a diverse firm by the Owner.

St. Louis Development Corporation
1520 Market St., Ste. 2000
St. Louis, MO 63103
P: 314.982.1400
W: www.stlouis-mo.gov/sldc/

Bi-State Development
211 N. Broadway, Ste. 700
St. Louis, MO 63102
P: 314.982.1400
W: www.metrostlouis.dbesystem.com

St. Louis Minority Business Council
211 N. Broadway, Ste. 1300
St. Louis, MO 63102
P: 314.231.5555
W: www.slmbc.org

U.S. Small Business Administration - St. Louis, MO
8(a) Contractors, Minority Small Business
1222 Spruce Street, Suite 10.103
St. Louis, MO 63101
P: 314.539.6600
W: www.sba.gov

Lambert St. Louis International Airport
Business Diversity Development Office
11495 Navaid
Bridgeton, MO 63044
P: 314-426-8111
W: www.flystl.com/business/business-diversity-development-1/directories

City of Kansas City, Missouri
Human Relations Department, MBE/WBE Division
4th Floor, City Hall
414 E. 12th Street
Kansas City, MO 64106
P: 816.513.1836
W: kcmohrd.mwdbe.com/?TN=kcmohrd

Mid-States Minority Supplier Development Council
505 N. 7th Street, Ste. 1820
St. Louis, MO 63101
P: 314.278.5616
W: midstatesdc.org

U.S. Small Business Administration - Kansas City, MO
8(a) Contractors, Minority Small Business
1000 Walnut, Suite 500
Kansas City, MO 64106
P: 816.426.4900
W: kcmohrd.mwdbe.com/?TN=kcmohrd

Missouri Department of Transportation
Division of Construction
1617 Missouri Blvd.
P.O. Box 270
Jefferson City, MO 65102
P: 573.526.2978
W: www.modot.org/mrcc-directory

Illinois Department of Transportation
MBE/WBE Certification Section
2300 Dirksen Parkway
Springfield, IL 62764
217/782-5490; 217/785-1524 (Fax)
W: webapps.dot.illinois.gov/UCP/ExternalSearch

State of Missouri OA
Office of Equal Opportunity
301 W. High St. HSC Rm 870-B
Jefferson City, MO 65101
P: 877.259.2963
W: oa.mo.gov/sites/default/files/sdvelisting.pdf
W: oeo.mo.gov/

Minority Newspapers

Dos Mundos Bilingual Newspaper
902A Southwest Blvd.
Kansas City, MO 64108
816-221-4747
www.dosmundos.com

Kansas City Hispanic News
2918 Southwest Blvd.
Kansas City, MO 64108
816/472-5246
www.kchispanicnews.com

The Kansas City Globe
615 E. 29th Street
Kansas City, MO 64109
816-531-5253
www.thekcglobe.com/about_us.php

St. Louis American
4144 Lindell
St. Louis, MO 63108
314-533-8000
www.stlamerican.com

St. Louis Chinese American News
1766 Burns Ave, Suite 201
St. Louis, MO 63132
314-432-3858
www.scannews.com

St. Louis Business Journal
815 Olive St., Suite 100
St. Louis, MO 63101
314-421-6200
www.bizjournal.com/stlouis

Kansas City Business Journal
1100 Main Street, Suite 210
Kansas City, MO 64105
816-421-5900
www.bizjournals.com/kansascity

AFFIDAVIT OF SUPPLIER DIVERSITY PARTICIPATION

The apparent low Bidder shall complete and submit this form within 48 hours of bid opening for each Diverse firm that will participate on the contract.

1. Diverse Firm:_____

   Contact Name: _____

   Address:_____

   Phone No.:_____ E-Mail:_____

   Status (check one) MBE ☐ WBE ☐ Veteran ☐ Service Disabled Veteran ☐ DBE ☐
   If MBE, Certified as (circle one): 1) Black American 2) Hispanic American 3) Native American 4) Asian American

2. Is the proposed diverse firm certified by an approved agency [see IFB article 15]? Yes ☐ No ☐

   Agency: _____[attach copy of certification authorization from agency]

   Certification Number:_____

3. Diverse firm scope work and bid/contract dollar amount of participation (List Base Bid and Alternate work separately). The final Dollar amount will be determined at substantial completion:

	Scope of Work	Bid/Contract Amount	Final Dollar Amount
Base Bid			
Alternate #1			
Alternate #2			
Alternate #3			
Alternate #4			
Alternate #5			
Alternate #6			

The undersigned certifies that the information contained herein (i.e. Scope of Work and Bid/Contract Amount) is true and correct to the best of their knowledge, information and belief.

General Contractor:_____ Diverse Firm: _____

Signature: _____ Signature: _____

Name: _____ Name: _____

Title: _____ Title: _____

Date: _____ Date: _____

The undersigned certifies that the information contained herein (i.e. Scope of Work and Final Dollar Amount) is true and correct to the best of their knowledge, information and belief. If the Final Dollar Amount is different than the Bid/Contract Amount, then attach justification for the difference.

.

Contractor: _____ Diverse Firm: _____

Signature: _____ Signature: _____

Name: _____ Name: _____

Title: _____ Title: _____

Date: _____ Date:_____

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University of Missouri

INFORMATION FOR BIDDERS

Page No.

1. Contract Documents

1.1 Drawings, specifications, and other contract documents, pursuant to work which is to be done, may be obtained shown in the Advertisement for Bids and Special Conditions.

2. Bidder Obligations

2.1 Before submitting bids each bidder shall carefully examine the drawings and specifications and related contract documents, visit site of work and fully inform themselves as to all existing conditions, facilities, restrictions and other matters which can affect the work or the cost thereof.

2.2 Each bidder shall include in their bid the cost of all work and materials required to complete the contract in a first-class manner as hereinafter specified.

2.3 Failure or omission of any bidder to receive or examine any form, instrument, addendum, or other document, or to visit the site and acquaint themselves with existing conditions, shall in no way relieve them from any obligation with respect to their bid or contract, and no extra compensation will be allowed by reason of any thing or matter concerning which bidder should have fully informed themselves prior to bidding.

2.4 Submission of bids shall be deemed acceptance of the above obligations and each and every obligation required to be performed by all of the contract documents in the event the bid is accepted.

3. Interpretation of Documents

3.1 If any prospective bidder is in doubt as to the true meaning of any part of the drawings and specifications or contract documents, they shall submit a written request to the Architect for an interpretation.

3.2 Requests for such interpretations shall be delivered to the Architect at least one (1) week prior to time for receipt of bids.

3.3 Bids shall be based only on interpretations issued in the form of addenda mailed to each person who is on the Architect's record as having received a set of the contract documents.

4. Bids

4.1 Bids shall be received separately or in combination as shown in and required by the Bid for Lump Sum contract. Bids will be completed so as to include insertion of amounts for alternate bids, unit prices and cost accounting data.

4.2 Bidders shall apportion each base bid between various phases of the work, as stipulated in the Bid for Lump Sum contract. All work shall be done as defined in the specifications and as indicated on the drawings.

4.3 Bids shall be presented in sealed envelopes which shall be plainly marked "Bids for (indicate name of project from cover sheet)", and mailed or delivered to the building and room number specified in the Advertisement for Bids. Bidders shall be responsible for actual delivery of bids during business hours, and it shall not be sufficient to show that a bid was mailed in time to be received before scheduled closing time for receipt of bids, nor shall it be sufficient to show that a bid was somewhere in a university facility.

4.4 The bidder's price shall include all federal sales, excise, and similar taxes, which may be lawfully assessed in connection with their performance of work and purchase of materials to be incorporated in the work. City & State taxes shall not be included as defined within Article 3.16 of the General Conditions for Construction Contract included in the contract documents.

4.5 Bids shall be submitted on a single bid form, furnished by the Owner or Architect. Do not remove the bid form from the specifications.

4.6 No bidder shall stipulate in their bid any conditions not contained in the bid form.

4.7 The Owner reserves the right to waive informalities in bids and to reject any or all bids.

5. Modification and Withdrawal of Bids

5.1 The bidder may withdraw their bid at any time before the scheduled closing time for receipt of bids, but no bidder may withdraw their bid after the scheduled closing time for receipt of bids.

5.2 Only telegrams, letters and other written requests for modifications or correction of previously submitted bids, contained in a sealed envelope which is plainly marked "Modification of Bid on (name of project on cover sheet)," which are addressed in the same manner as bids, and are received by Owner before the scheduled closing time for receipt of bids will be accepted and bids corrected in accordance with such written requests.

6. Signing of Bids

6.1 Bids which are signed for a partnership shall be **manually** signed in the firm name by at least one partner, or in the firm name by Attorney-in-Fact. If signed by Attorney-in-Fact there should be attached to the bid, a Power of Attorney evidencing authority to sign the bid dated the same date as the bid and executed by all partners of the firm.

6.2 Bids that are signed for a corporation shall have the correct corporate name thereon and the signature of an authorized officer of the corporation manually written below corporate name. Title of office held by the person signing for the corporation shall appear below the signature of the officer.

6.3 Bids that are signed by an individual doing business under a firm name, shall be manually signed in the name of the individual doing business under the proper firm name and style.

6.4 Bids that are signed under joint venture shall be manually signed by officers of the firms having authority to sign for their firm.

7. Bid Security

7.1 Each bid shall be accompanied by a bid bond, certified check, or cashier's check, acceptable to and payable without condition to The Curators of the University of Missouri, in an amount at least equal to five percent (5%) of bidder's bid including additive alternates.

7.2 Bid security is required as a guarantee that bidder will enter into a written contract and furnish a performance bond within the time and in form as specified in these specifications; and if successful bidder fails to do so, the bid security will be realized upon or retained by the Owner. The apparent low bidder shall notify the Owner in writing within 48 hours (2 work days) of the bid opening of any circumstance that may affect the bid security including, but not limited to, a bidding error. This notification will not guarantee release of the bidder's security and/or the bidder from the Bidder's Obligations.

7.3 If a bid bond is given as a bid security, the amount of the bond may be stated as an amount equal to at least five percent (5%) of the bid, including additive alternates, described in the bid. The bid bond shall be executed by the bidder and a responsible surety licensed in the State of Missouri with a Best's rating of no less than A-/XI.

7.4 It is specifically understood that the bid security is a guarantee and shall not be considered as liquidated damages for failure of bidder to execute and deliver their contract and performance bond, nor limit or fix bidder's liability to Owner for any damages sustained because of failure to execute and deliver the required contract and performance bond.

7.5 Bid security of the two (2) lowest and responsive Bidders will be retained by the Owner until a contract has been executed and an acceptable bond has been furnished, as required hereby, when such bid security will be returned. Surety bid bonds of all other bidders will be destroyed and all other alternative forms of bid bonds will be returned to them within ten (10) days after Owner has determined the two (2) lowest and responsive bids.

8. Bidder's Statement of Qualifications

8.1 Each bidder submitting a bid shall present evidence of their experience, qualifications, financial responsibility and ability to carry out the terms of the contract by completing and submitting with their bid the schedule of information set forth in the form furnished in the bid form.

8.2 Such information, a single copy required in a separate sealed envelope, will be treated as confidential information by the Owner, within the meaning of Missouri Statue 610.010.

8.3 Bids not accompanied with current Bidder's Statement of Qualifications may be rejected.

9. Award of Contract

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

9.2 In awarding the contract, the Owner may take into consideration the bidder's, and their subcontractor's, ability to handle promptly the additional work, skill, facilities, capacity, experience, ability, responsibility, previous work, financial standing of bidder, and the bidder's ability to provide the required bonds and insurance; quality, efficiency and construction of equipment proposed to be furnished; period of time within which equipment is proposed to be furnished and delivered; success in achieving the specified Supplier Diversity goal, or demonstrating a good faith effort as described in Article 15; necessity of prompt and efficient completion of work herein described, and the bidder's status as suspended or debarred. Inability of any bidder to meet the requirements mentioned above may be cause for rejection of their bid.

10. Contract Execution

10.1 The Contractor shall submit within fifteen (15) days from receipt of notice, the documents required in Article 9 of the General Conditions for Construction Contract included in the contract documents.

10.2 No bids will be considered binding upon the Owner until the documents listed above have been furnished. Failure of Contractor to execute and submit these documents within the time period specified will be treated, at the option of the

Owner, as a breach of the bidder's bid security under Article 7 and the Owner shall be under no further obligation to Bidder.

11. Contract Security

11.1 When the Contract sum exceeds $50,000, the Contractor shall procure and furnish a Performance bond and a Payment bond in the form prepared by Owner. Each bond shall be in the amount equal to one hundred percent (100%) of the contract sum, as well as adjustments to the Contract Sum. The Performance Bond shall secure and guarantee Contractor's faithful performance of this Contract, including but not limited to Contractor's obligation to correct defects after final payment has been made as required by the Contract Documents. The Payment Bond shall secure and guarantee payment of all persons performing labor on the Project under this Contract and furnishing materials in connection with this Contract. These Bonds shall be in effect through the duration of the Contract plus the Guaranty Period as required by the Contract Documents.

11.2 The bonds required hereunder shall be meet all requirements of Article 11 of the General Conditions for Construction Contract included in the contract documents.

11.3 If the surety of any bond furnished by Contractor is declared bankrupt or becomes insolvent or its right to conduct business in the State of Missouri is terminated, or it ceases to meet the requirements of this Article 11, Contractor shall within ten (10) days substitute another bond and surety, both of which must be acceptable to Owner. If Contractor fails to make such substitution, Owner may procure such required bonds on behalf of Contractor at Contractor's expense.

12. Time of Completion

12.1 Contractors shall agree to commence work within five (5) days of the date "Notice to Proceed" is received from the Owner, and the entire work shall be completed by the completion date specified or within the number of consecutive calendar days stated in the Special Conditions. The duration of the construction period, when specified in consecutive calendar days, shall begin when the contractor receives notice requesting the documents required in Article 9 of the General Conditions for Construction Contract included in the contract documents.

13. Number of Contract Documents

13.1 The Owner will furnish the Contractor a copy of the executed contract and performance bond.

13.2 The Owner will furnish the Contractor the number of copies of complete sets of drawings and specifications for the work, as well as, clarification and change order drawings pertaining to change orders required during construction as set forth in the Special Conditions.

14. Missouri Products and Missouri Firms

14.1 The Curators of the University of Missouri have adopted a policy which is binding upon all employees and departments of the University of Missouri, and which by contract, shall be binding upon independent contractors and subcontractors with the University of Missouri whereby all other things being equal, and when the same can be secured without additional cost over foreign products, or products of other states, a preference shall be granted in all construction, repair and purchase contracts, to all products, commodities, materials, supplies and articles mined, grown, produced and manufactured in marketable quantity and quality in the State of Missouri, and to all firms, corporations or individuals doing business as Missouri firms, corporations or individuals. Each bidder submitting a bid agrees to comply with, and be bound by the foregoing policy.

15. SUPPLIER DIVERSITY

15.1 Award of Contract

The Supplier Diversity participation goal for this project is stated on the Bid for Lump Sum Contract Form, and the Owner will take into consideration the bidder's success in achieving the Supplier Diversity participation goal in awarding the contract. Inability of any bidder to meet this requirement may be cause for rejection of their bid.

The University will grant a three (3) point bonus preference to a Missouri based, certified Service Disabled Veteran Enterprise (SDVE) bidder as defined in Article 1 – (Supplier Diversity Definitions) of the General Conditions of the Contract for Construction included in the contract documents. The three percent (3%) goal can be met, and the bonus points obtained, by a qualified SDVE vendor and/or through the use of qualified SDVE subcontractors or suppliers that provide at least three percent (3%) of the total contract value. The submitted bid form must include a minimum of 3% SDVE participation to obtain the three (3) point bonus.

15.2 List of Supplier Diversity Firms

15.2.1 The bidder shall submit as part of their bid a list of diverse firms performing as contractor, subcontractors, and/or suppliers. The list shall specify the single designated diverse firm name and address. If acceptance or non-acceptance of alternates will affect the designation of a subcontractor, provide information for each affected category.

15.2.2 Failure to include a complete list of diverse firms may be grounds for rejection of the bid.

15.2.3 The list of diverse firms shall be submitted in addition to any other listing of subcontractors required in the Bid for Lump Sum Contract Form.

15.3 Supplier Diversity Percentage Goal

The bidder shall have a minimum goal of subcontracting with diverse contractors, subcontractors, and suppliers, the percent of contract price stated in the Supplier Diversity goal paragraph of the Bid for Lump Sum Contract Form.

.

15.4 Supplier Diversity Percent Goal Computation

15.4.1 The total dollar value of the work granted to the diverse firms by the successful bidder is counted towards the applicable goal of the entire contract, unless otherwise noted below.

15.4.2 The bidder may count toward the Supplier Diversity goal only expenditures to diverse firms that perform a commercially useful function in the work of a contract. A diverse firm is considered to perform 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 involved. A bidder that is a certified diverse firm may count as 100% of the contract towards the Supplier Diversity goal. For projects with separate MBE, SDVE, and WBE/Veteran

/DBE goals, a MBE firm bidding as the prime bidder is expected to obtain the required SDVE, and WBE/Veteran/ DBE participation; a WBE or Veteran or DBE firm bidding as the prime bidder is expected to obtain the required MBE and SDVE participation and a SDVE firm bidding as the prime bidder is expected to obtain the required MBE, and WBE/Veteran/ DBE participation.

15.4.3 When a MBE, WBE, Veteran Business Enterprise, DBE, or SDVE performs work as a participant in a joint venture, only the portion of the total dollar value of the contract equal to the distinct, clearly defined portion of the work of the contract that the MBE, WBE, Veteran Business Enterprise, DBE, or SDVE performs with its own forces shall count toward the MBE, WBE, Veteran Business Enterprise, DBE, or SDVE individual contract percentages.

15.4.4 The bidder may count toward its Supplier Diversity goal expenditures for materials and supplies obtained from diverse suppliers and manufacturers, provided the diverse firm assumes the actual and contractual responsibility for the provision of the materials and supplies.

15.4.4.1 The bidder may count its entire expenditure to a diverse manufacturer. A manufacturer shall be defined as an individual or firm that produces goods from raw materials or substantially alters them before resale.

15.4.4.2 The bidder may count its entire expenditure to diverse suppliers that are not manufacturers provided the diverse supplier performs a commercially useful function as defined above in the supply process.

15.4.4.3 The bidder may count 25% of its entire expenditures to diverse firms that do not meet the definition of a subcontractor, a manufacturer, nor a supplier. Such diverse firms may arrange for, expedite, or procure portions of the work but are not actively engaged in the business of performing, manufacturing, or supplying that work.

15.4.5 The bidder may count toward the Supplier Diversity goal that portion of the total dollar value of the work awarded to a certified joint venture equal to the percentage of the ownership and control of the diverse partner in the joint venture.

15.5 Certification by Bidder of Diverse Firms

15.5.1 The bidder shall submit with its bid the information requested in the "Supplier Diversity Compliance Evaluation Form" for every diverse firm the bidder intends to award work to on the contract.

15.5.2 Diverse firms are defined in Article 1 – (Supplier Diversity Definitions) of the General Conditions of the Contract for Construction included in the contract documents, and as those businesses certified as disadvantaged by an approved agency. The bidder is responsible for obtaining information regarding the certification status of a firm. A list of certified firms may be obtained by contacting the agencies listed in the proposal form document “Supplier Diversity Certifying Agencies”. Any firm listed as disadvantaged by any of the identified agencies will be classified as a diverse firm by the Owner.

15.5.3 Bidders are urged to encourage their prospective diverse contractors, subcontractors, joint venture participants, team partners, and suppliers who are not currently certified to obtain certification from one of the approved agencies.

15.6 Supplier Diversity Participation Waiver

15.6.1 The bidder is required to make a good faith effort to locate and contract with diverse firms. If a bidder has made a good faith effort to secure the required diverse firms and has failed, the bidder shall submit with the bid, the information requested in "Application for Supplier Diversity Participation Waiver." The Contracting Officer will review the bidder's actions as set forth in the bidder's "Application for Waiver" and any other factors deemed relevant by the Contracting Officer to determine if a good faith effort has been made to meet the applicable percentage goal. If the bidder is judged not to have made a good faith effort, the bid may be rejected. Bidder's who demonstrate that they have made a good faith effort to include Supplier Diversity participation may be awarded the contract regardless of the percent of Supplier Diversity participation, provided the bid is otherwise acceptable and is determined to be the best bid.

15.6.2 To determine good faith effort of the bidder, the Contracting Officer may evaluate factors including, but not limited to, the following:

15.6.2.1 The bidder’s attendance at pre-proposal meetings scheduled to inform bidders and diverse firms of contracting and subcontracting opportunities and responsibilities associated with Supplier Diversity participation.

15.6.2.2 The bidder’s advertisements in general circulation trade association, and diverse (minority) focused media concerning subcontracting opportunities.

15.6.2.3 The bidder’s written notice to specific diverse firms that their services were being solicited in sufficient time to allow for their effective participation.

15.6.2.4 The bidder’s follow-up attempts to the initial solicitation(s) to determine with certainty whether diverse firms were interested.

15.6.2.5 The bidder’s efforts to divide the work into packages suitable for subcontracting to diverse firms.

15.6.2.6 The bidder’s efforts to provide interested diverse firms with sufficiently detailed information about the drawings, specific actions and requirements of the contract, and clear scopes of work for the firms to bid on.

15.6.2.7 The bidder’s efforts to solicit for specific sub-bids from diverse firms in good faith. Documentation should include names, addresses, and telephone numbers of firms contacted a description of all information provided the diverse firms, and an explanation as to why agreements were not reached.

15.6.2.8 The bidder's efforts to locate diverse firms not on the directory list and assist diverse firms in becoming certified as such.

15.6.2.9 The bidder's initiatives to encourage and develop participation by diverse firms.

15.6.2.10 The bidder's efforts to help diverse firms overcome legal or other barriers impeding the participation of diverse firms in the construction contract.

15.6.2.11 The availability of diverse firms and the adequacy of the bidder's efforts to increase the participation of such business provided by the persons and organizations consulted by the bidder.

15.7 Submittal of Forms

15.7.1 The bidder will include the Supplier Diversity Compliance Evaluation Form(s), or the Application for Waiver and other form(s) as required above in the envelope containing the "Bidder's Statement of Qualifications", see Article 8.

15.8 Additional Bid/Proposer Information

15.8.1 The Contracting Officer reserves the right to request additional information regarding Supplier Diversity participation and supporting documentation from the apparent low bidder. The bidder shall respond in writing to the Contracting Officer within 24 hours (1 work day) of a request.

15.8.2 The Contracting Officer reserves the right to request additional information after the bidder has responded to prior 24 hour requests. This information may include follow up and/or clarification of the information previously submitted.

15.8.3 The Owner reserves the right to consider additional diverse subcontractor and supplier participation submitted by the bidder after bids are opened under the provisions within these contract documents that describe the Owner's right to accept or reject subcontractors including, but not limited to, Article 16 below. The Owner may elect to waive the good faith effort requirement if such additional participation achieves the Supplier Diversity goal.

15.8.4 The Bidder shall provide the Owner information related to the Supplier Diversity participation included in the bidder's proposal, including, but is not limited to, the complete Application for Waiver, evidence of diverse certification of participating firms, dollar amount of participation of diverse firms, information supporting a good faith effort as described in Article 15.6 above, and a list of all diverse firms that submitted bids to the Bidder with the diverse firm's price and the name and the price of the firm awarded the scope of work bid by the diverse firm.

16. List of Subcontractors

16.1 If a list of subcontractors is required on the Bid for Lump Sum Contract Form, the bidders shall list the name, city and state of the firm(s) which will accomplish that portion of the contract requested in the space provided. This list is separate from both the list of diverse firms required in Article 15.2, and the complete list of subcontractors required in Article 10.1 of this document. Should the bidder choose to perform any of the listed portions of the work with its own forces, the bidder shall enter its own name, city and state in the space provided. If acceptance or non-acceptance of alternates will affect the designation of a subcontractor, the bidder shall provide that information on the bid form.

16.2 Failure of the bidder to supply the list of subcontractors required or the listing of more than one subcontractor for any category without designating the portion of the work to be performed by each, shall be grounds for the rejection of the bid. The bidder can petition the Owner to change a listed subcontractor within 48 hours of the bid opening. The Owner reserves the right to make the final determination on a petition to change a subcontractor. The Owner will consider factors such as clerical and mathematical bidding errors, listed subcontractor's inability to perform the work for the bid used, etc. Any request to change a listed subcontractor shall include at a minimum, contractor's bid sheet showing tabulation of the bid; all subcontractor bids with documentation of the time they were received by the contractor; and a letter from the listed subcontractor on their letterhead stating why they cannot perform the work if applicable. The Owner reserves the right to ask for additional information.

16.3 Upon award of the contract, the requirements of Article 10 of this document and Article 5 of the General Conditions of the Contract for Construction included in the contract documents will apply.

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University of Missouri

General Conditions

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December 2021 Edition

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TABLE OF ARTICLES

ARTICLE 1
GENERAL PROVISIONS

1.1 Basic Definitions
As used in the Contract Documents, the following terms shall have the meanings and refer to the parties designated in these definitions.

1.1.1 Owner
The Curators of the University of Missouri. The Owner may act through its Board of Curators or any duly authorized committee or representative thereof.

1.1.2 Contracting Officer
The Contracting Officer is the duly authorized representative of the Owner with the authority to execute contracts. Communications to the Contracting Officer shall be forwarded via the Owner's Representative.

1.1.3 Owner's Representative
The Owner's Representative is authorized by the Owner as the administrator of the Contract and will represent the Owner during the progress of the Work. Communications from the Architect to the Contractor and from the Contractor to the Architect shall be through the Owner's Representative, unless otherwise indicated in the Contract Documents.

1.1.4 Architect
When the term "Architect" is used herein, it shall refer to the Architect or the Engineer specified and defined in the Contract for Construction or its duly authorized representative. Communications to the Architect shall be forwarded to the address shown in the Contract for Construction.

1.1.5 Owner's Authorized Agent
When the term "Owner's Authorized Agent" is used herein, it shall refer to an employee or agency acting on the behalf of the Owner's Representative to perform duties related to code inspections, testing, operational systems check, certification or accreditation inspections, or other specialized work.

1.1.6 Contractor
The Contractor is the person or entity with whom the Owner has entered into the Contract for Construction. The term "Contractor" means the Contractor or the Contractor's authorized representative.

1.1.7 Subcontractor and Lower-tier Subcontractor
A Subcontractor is a person or organization who has a contract with the Contractor to perform any of the Work. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or its authorized representative. The term "Subcontractor" also is applicable to those furnishing materials to be incorporated in the Work whether work performed is at the Owner's site or off site, or both. A lower-tier Subcontractor is a person or organization who has a contract with a Subcontractor or another lower-tier Subcontractor to perform any of the Work at the site. Nothing contained in the Contract Documents shall create contractual relationships between the Owner or the Architect and any Subcontractor or lower-tier Subcontractor of any tier.

1.1.8 Supplier Diversity Definitions
Businesses that fall into the Supplier Diversity classification shall mean an approved certified business concern which is at least fifty-one percent (51%) owned and controlled by one (1) or more diverse suppliers as described below.

.1 Minority Business Enterprises (MBE)

Minority Business Enterprise [MBE] shall mean an approved certified business concern which is at least fifty-one percent (51%) owned and controlled by one (1) or more minorities as defined below or, in the case of any publicly-owned business, in which at least fifty-one percent (51%) of the stock of which is owned by one (1) or more minorities as defined below, and whose management and daily business operations are controlled by one (1) or more minorities as defined herein.

- **.1.1** "African Americans", which includes persons having origins in any of the black racial groups of Africa.
- **.1.2** "Hispanic Americans", which includes persons of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture or origin, regardless of race.
- **.1.3** "Native Americans", which includes persons of American Indian, Eskimo, Aleut, or Native Hawaiian origin.
- **.1.4** "Asian-Pacific Americans", which includes persons whose origins are from Japan, China, Taiwan, Korea, Vietnam, Laos, Cambodia, the Philippines, Samoa, Guam, the U.S. Trust Territories of the Pacific, or the Northern Marinas.
- **.1.5** "Asian-Indian Americans", which includes persons whose origins are from India, Pakistan, or Bangladesh.

.2 Women Business Enterprise (WBE)

Women Business Enterprise [WBE] shall mean an approved certified business concern which is at least fifty-one percent (51%) owned and controlled by one (1) or more women or, in the case of any publicly owned business, in which at least fifty-one percent (51%) of the stock of which is owned by one (1) or more women, and whose management and daily business operations are controlled by one (1) or more women.

.3 Veteran Owned Business

Veteran Owned Business shall mean an approved certified business concern which is at least fifty-one percent (51%) owned and controlled by one (1) or more Veterans or, in the case of any publicly owned business, in which at least fifty-one percent (51%) of the stock of which is owned by one (1) or more Veterans, and whose management and daily business operations are controlled by one (1) or more Veterans. Veterans must be certified by the appropriate federal agency responsible for veterans' affairs.

.4 Service-Disabled Veteran Enterprise (SDVE)
Service-Disabled Veteran Enterprise (SDVE) shall mean a business certified by the State of Missouri Office of Administration as a Service-Disabled Veteran Enterprise, which is at least fifty-one percent (51%) owned and controlled by one (1) or more Serviced-Disabled Veterans or, in the case of any publicly-owned business, in which at least fifty-one percent (51%) of the stock of which is owned by one (1) or more Service-Disabled Veterans, and whose management and daily business operations are controlled by one (1) or more Serviced-Disabled Veterans.

.5 Disadvantaged Business Enterprise (DBE)
A Disadvantaged Business Enterprise (DBE) is a for-profit small business concern where a socially and economically disadvantaged individual owns at least 51% interest and also controls management and daily business operations. These firms can and also be referred to as Small Disadvantaged Businesses (SDB). Eligibility requirements for certification are stated in 49 CFR (Code of Federal Regulations), part 26, Subpart D.

U.S. citizens that are African Americans, Hispanics, Native Americans, Asian-Pacific and Subcontinent Asian Americans, and women are presumed to be socially and economically disadvantaged. Also recognized as DBE's are Historically Black Colleges and Universities (HBCU) and small businesses located in Federal HUB Zones.
To be regarded as economically disadvantaged, an individual must have a personal net worth that does not exceed $1.32 million. To be seen as a small business, a firm must meet Small Business Administration (SBA) size criteria (500 employees or less) and have average annual gross receipts not to exceed $22.41 million. To be considered a DBE/SDB, a small business owned and controlled by socially and/or economically disadvantaged individuals must receive DBE certification from one of the recognized Missouri state agencies to be recognized in this classification.

1.1.9 Work
Work shall mean supervision, labor, equipment, tools, material, supplies, incidentals operations and activities required by the Contract Documents or reasonably inferable by Contractor therefrom as necessary 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.

1.1.10 Approved
The terms "approved", "equal to", "directed", "required", "ordered", "designated", "acceptable", "compliant", "satisfactory", and similar words or phrases will be understood to have reference to action on the part of the Architect and/or the Owner's Representative.

1.1.11 Contract Documents
The Contract Documents consist of (1) the executed Contract for Construction, (2) these General Conditions of the Contract for Construction, (3) any Supplemental Conditions or Special Conditions identified in the Contract for Construction, (4) the Specifications identified in the Contract for Construction, (5) the Drawings identified in the Contract for Construction, (6) Addenda issued prior to the receipt of bids, (7) Contractor's bid addressed to Owner, including Contractor's completed Qualification Statement, (8) Contractor's Performance Bond and Contractor's Payment Bond, (9) Notice to Proceed, (10) and any other exhibits and/or post bid adjustments identified in the Contract for Construction, (11) Advertisement for Bid, (12) Information for Bidders, and (13) Change Orders issued after execution of the Contract. All other documents and technical reports and information are not Contract Documents, including without limitation, Shop Drawings, and Submittals.

1.1.12 Contract
The Contract Documents form the Contract and are the exclusive statement of agreement between the parties. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior representations or agreements, either written or oral. The Contract Documents shall not be construed to create a contractual relationship of any kind between the Owner and a Subcontractor or any lower-tier Subcontractor.

1.1.13 Change Order
The Contract may be amended or modified without invalidating the Contract, only by a Change Order, subject to the limitations in Article 7 and elsewhere in the Contract Documents. A Change Order is a written instrument signed by the Owner and the Contractor stating their agreement to a change in the Work, the amount of the adjustment to the Contract Sum, if any, and the extent of the adjustment to the Contract Time, if any. Agreement to any Change Order shall constitute a final settlement of all matters relating to the change in the work which is the subject of the Change Order, including, but not limited to, all direct and indirect costs associated with such change and any and all adjustments of the Contract sum, time and schedule.

1.1.14 Substantial Completion
The terms "Substantial Completion" or "substantially complete" as used herein shall be construed to mean the completion of the entire Work, including all submittals required under the Contract Documents, except minor items which in the opinion of the Architect, and/or the Owner's Representative will not interfere with the complete and satisfactory use of the facilities for the purposes intended.

1.1.15 Final Completion
The date when all punch list items are completed, including all closeout submittals and approval by the Architect is given to the Owner in writing.

1.1.16 Supplemental and Special Conditions
The terms "Supplemental Conditions" or "Special Conditions" shall mean the part of the Contract Documents

which amend, supplement, delete from, or add to these General Conditions.

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

1.1.18 Knowledge.
The terms “knowledge,” “recognize” and “discover” their respective derivatives and similar terms in the Contract Documents, as used in reference to the Contractor, shall be interpreted to mean that which the Contractor knows or should know, recognizes, or should recognize and discovers or should discover in exercising the care, skill, and diligence of a diligent and prudent contractor familiar with the work. Analogously, the expression “reasonably inferable” and similar terms in the Contract Documents shall be interpreted to mean reasonably inferable by a diligent and prudent contractor familiar with the work.

1.1.19 Punch List
“Punch List” means the list of items, prepared in connection with the inspection(s) of the Project by the Owner’s Representative or Architect in connection with Substantial Completion of the Work or a portion of the Work, which the Owner’s Representative or Architect has designated as remaining to be performed, completed, or corrected before the Work will be accepted by the Owner.

1.1.20 Public Works Contracting Minimum Wage
The public works contracting minimum wage shall be equal to one hundred twenty percent of the average hourly wage in a particular locality, as determined by the Missouri economic research and information center within the department of economic development, or any successor agency.

1.1.21 Force Majeure
An event or circumstance that could not have been reasonably anticipated and is out of the control of both the Owner and the Contractor.

1.2 Specifications and Drawings
1.2.1 The Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equipment, construction system, standards and workmanship and performance of related services for the Work identified in the Contract for Construction. Specifications are separated into titled divisions for convenience of reference only. Organization of the Specifications into divisions, sections and articles, and arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade. Such separation will not operate to make the Owner or the Architect an arbiter of labor disputes or work agreements.

1.2.2 The drawings herein referred to, consist of drawings prepared by the Architect and are enumerated in the Contract Documents.

1.2.3 Drawings are intended to show general arrangements, design, and dimensions of work and are partly diagrammatic. Dimensions shall not be determined by scale or rule. If figured dimensions are lacking, they shall be supplied by the Architect on the Contractor's written request to the Owner's Representative.

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

1.2.5 In the event of inconsistencies within or between parts of the Contract Documents, or between the Contract Documents and applicable standards, codes and ordinances, the Contractor shall (1) provide the better quality or greater quantity of Work or (2) comply with the more stringent requirement; either or both in accordance with the Owner’s Representative’s interpretation. On the Drawings, given dimensions shall take precedence over scaled measurements and large-scale drawings over small scale drawings. Before ordering any materials or doing any Work, the Contractor and each Subcontractor shall verify measurements at the Work site and shall be responsible for the correctness of such measurements. Any difference which may be found shall be submitted to the Owner’s Representative and Architect for resolution before proceeding with the Work. If a minor change in the Work is found necessary due to actual field conditions, the Contractor shall submit detailed drawings of such departure for the approval by the Owner’s Representative and Architect before making the change.

1.2.6 Data in the Contract Documents concerning lot size, ground elevations, present obstructions on or near the site, locations and depths of sewers, conduits, pipes, wires, etc., position of sidewalks, curbs, pavements, etc., and nature of ground and subsurface conditions have been obtained from sources the Architect believes reliable, but the Architect and Owner do not represent or warrant that this information is accurate or complete. The Contractor shall verify such data to the extent possible through normal construction procedures, including but not limited to contacting utility owners and by prospecting.

1.2.7 Only work included in the Contract Documents is authorized, and the Contractor shall do no work other than that described therein.

1.2.8 Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become familiar with local conditions under which the Work is to be

performed and correlated personal observations with requirements of the Contract Documents. Contractor represents that it has performed its own investigation and examination of the Work site and its surroundings and satisfied itself before entering into this Contract as to:

.1 conditions bearing upon transportation, disposal, handling, and storage of materials;

.2 the availability of labor, materials, equipment, water, electrical power, utilities and roads;

.3 uncertainties of weather, river stages, flooding and similar characteristics of the site;

.4 conditions bearing upon security and protection of material, equipment, and Work in progress;

.5 the form and nature of the Work site, including the surface and sub-surface conditions;

.6 the extent and nature of Work and materials necessary for the execution of the Work and the remedying of any defects therein; and

.7 the means of access to the site and the accommodations it may require and, in general, shall be deemed to have obtained all information as to risks, contingencies and other circumstances.

.8 the ability to complete work without disruption to normal campus activities, except as specifically allowed in the contract documents.

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.

1.2.9 Drawings, specifications, and copies thereof furnished by the Owner are and shall remain the Owner's property. They are not to be used on another project and, with the exception of one contract set for each party to the Contract, shall be returned to the Owner's Representative on request, at the completion of the Work.

1.3 Required Provisions Deemed Inserted

Each and every provision of law and clause required by law to be inserted in this Contract shall be deemed to be inserted herein, and the Contract shall be read and enforced as though it were included herein; and if through mistake or otherwise any such provision is not inserted, or is not correctly inserted, then upon the written application of either party the Contract shall forthwith be physically amended to make such insertion or correction.

ARTICLE 2
OWNER

2.1 Information and Services Required of Owner

2.1.1 Permits and fees are the responsibility of the Contractor under the Contract Documents, unless specifically stated in the contract documents that the Owner will secure and pay for specific necessary approvals, easements, assessments, and charges required for construction, use or occupancy of permanent structures, or for permanent changes in existing facilities.

2.1.2 When requested in writing by the Contractor, information or services under the Owner's control, which are reasonably necessary to perform the Work, will be furnished by the Owner with reasonable promptness to avoid delay in the orderly progress of the Work.

2.2 Owner's Right to Stop the Work

2.2.1 If the Contractor fails to correct Work which is not in strict accordance with the requirements of the Contract Documents or fails to carry out Work in strict accordance with the Contract Documents, the Owner's Representative may order the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of the Owner to stop the Work will not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity. Owner's lifting of Stop Work Order shall not prejudice Owner's right to enforce any provision of this Contract.

2.3 Owner's Right to Carry Out the Work

2.3.1 If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a seven (7) day period after receipt of a written notice from the Owner to correct such default or neglect, the Owner may, without prejudice to other remedies the Owner may have, correct such default or neglect. In such case, an appropriate Change Order shall be issued deducting from payments then or thereafter due the Contractor the cost of correcting such deficiencies, including compensation for the Architect's additional services and expenses made necessary by such default or neglect. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to Owner. However, such notice shall be waived in the event of an emergency with the potential for property damage or the endangerment of students, faculty, staff, the public or construction personnel, at the sole discretion of the Owner.

2.3.2 In the event the Contractor has not satisfactorily completed all items on the Punch List within thirty (30) days of its receipt, the Owner reserves the right to complete the Punch List without further notice to the Contractor or its surety. In such case, Owner shall be entitled to deduct from payments then or thereafter due the Contractor the cost of completing the Punch List items, including compensation for the Architect's additional services. If payments then or

thereafter due Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to Owner.

2.4 Extent of Owner Rights

2.4.1 The rights stated in this Article 2 and elsewhere in the Contract Documents are cumulative and not in limitation of any rights of the Owner (1) granted in the Contract Documents, (2) at law or (3) in equity.

2.4.2 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.

ARTICLE 3
CONTRACTOR

3.1 Contractor's Warranty

3.1.1 The Contractor warrants all equipment and materials furnished, and work performed, under this Contract, against defective materials and workmanship for a period of twelve months after acceptance as provided in this Contract, unless a longer period is specified, regardless of whether the same were furnished or performed by the Contractor or any Subcontractors of any tier. Upon written notice from the Owner of any breech of warranty during the applicable warranty period due to defective material or workmanship, the affected part or parts thereof shall be repaired or replaced by the Contractor at no cost to the Owner. Should the Contractor fail or refuse to make the necessary repairs, replacements, and tests when requested by the Owner, the Owner may perform, or cause the necessary work and tests to be performed, at the Contractor's expense, or exercise the Owner's rights under Article 14.

3.1.2 Should one or more defects mentioned above appear within the specified period, the Owner shall have the right to continue to use or operate the defective part or apparatus until the Contractor makes repairs or replacements or until such time as it can be taken out of service without loss or inconvenience to the Owner.

3.1.3 The above warranties are not intended as a limitation but are in addition to all other express warranties set forth in this Contract and such other warranties as are implied by law, custom, and usage of trade. The Contractor, and its surety or sureties, if any, shall be liable for the satisfaction and full performance of the warranties set forth herein.

3.1.4 Neither the final payment nor any provision in the Contract Documents nor partial or entire occupancy of the premises by the Owner, nor expiration of warranty stated herein, will constitute an acceptance of Work not done in accordance with the Contract Documents or relieve the Contractor of liability in respect to any responsibility for non-conforming work. The Contractor shall immediately remedy any defects in the Work and pay for any damage to other Work resulting therefrom upon written notice from the Owner. Should the Contractor fail or refuse to remedy the non-conforming work, the Owner may perform, or cause to be performed the work necessary to bring the work into conformance with the Contract Documents at the Contractor's expense.

3.1.5 The Contractor agrees to defend, indemnify, and save harmless The Curators of the University of Missouri, their Officers, Agents, Employees and Volunteers, from and against all loss or expense from any injury or damages to property of others suffered or incurred on account of any breech of the aforesaid obligations and covenants. The Contractor agrees to investigate, handle, respond to and provide defense for and defend against any such liability, claims, and demands at the sole expense of the Contractor, or at the option of the University, agrees to pay to or reimburse the University for the defense costs incurred by the University in connection with any such liability claims, or demands. The parties hereto understand and agree that the University is relying on and does not waive or intend to waive by any provision of this Contract, any monetary limitations or any other rights, immunities, and protections provided by the State of Missouri, as from time to time amended, or otherwise available to the University, or its officers, employees, agents or volunteers.

3.2 Compliance with Laws, Regulations, Permits, Codes, and Inspections

3.2.1 The Contractor shall, without additional expense to the Owner, comply with all applicable laws, ordinances, rules, permit requirements, codes, statutes, and regulations (collectively referred to as “Laws”).

3.2.2 Since the Owner is an instrumentality of the State of Missouri, municipal, or political subdivision, ordinances, zoning ordinances, and other like ordinances are not applicable to construction on the Owner's property, and the Contractor will not be required to submit plans and specifications to any municipal or political subdivision authority to obtain construction permits or any other licenses or permits from or submit to, inspection by any municipality or political subdivision relating to the construction on the Owner's property, unless required by the Owner in these Contract Documents or otherwise in writing.

3.2.3 All fees, permits, inspections, or licenses required by municipality or political subdivision for operation on property not belonging to the Owner, shall be obtained by and paid for by the Contractor. The Contractor, of its own expense, is responsible to ensure that all inspections required by said permits or licenses on property, easements, or utilities not belonging to the Owner are conducted as required therein. All connection charges, assessments or transportation fees as may be imposed by any utility company or others are

included in the Contract Sum and shall be the Contractor's responsibility, as stated in 2.1.1 above.

3.2.4 If the Contractor has knowledge that any Contract Documents are at variance with any Laws, including Americans with Disabilities Act – Standards for Accessible Design, ordinances, rules, regulations, or codes applying to the Work, Contractor shall promptly notify the Architect and the Owner's Representative, in writing, and any necessary changes will be adjusted as provided in the Contract Documents. However, it is not the Contractor's primary responsibility to ascertain that the Contract Documents are in accordance with applicable Laws, unless such Laws bear upon performance of the Work.

3.3 Anti-Kickback

3.3.1 No member or delegate to Congress, or resident commissioner, shall be admitted to any share or part of this Contract or to any benefit that may arise therefrom, but this provision shall not be construed to extend to this Contract if made with a corporation for its general benefit.

3.3.2 No official of the Owner who is authorized in such capacity and on behalf of the Owner to negotiate, make, accept or approve, or to take part in negotiating, making, accepting, or approving any architectural, engineering, inspection, construction, or material supply contract or any Subcontract of any tier in connection with the construction of the Work shall have a financial interest in this Contract or in any part thereof, any material supply contract, Subcontract of any tier, insurance contract, or any other contract pertaining to the Work.

3.4 Supervision and Construction Procedures

3.4.1 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for and have control over construction means, methods, techniques, sequences, and procedures and for coordinating all portions of the Work under the Contract. The Contractor shall supply sufficient and competent supervision and personnel, and sufficient material, plant, and equipment to prosecute the Work with diligence to ensure completion thereof within the time specified in the Contract Documents, and shall pay when due any laborer, Subcontractor of any tier, or supplier.

3.4.2 The Contractor, if an individual, shall give the Work an adequate amount of personal supervision, and if a partnership or corporation or joint venture the Work shall be given an adequate amount of personal supervision by a partner or executive officer, as determined by the Owner's Representative.

3.4.3 The Contractor and each of its Subcontractors of any tier shall submit to the Owner such schedules of quantities and costs, progress schedules in accordance with 3.17.2 of this document, payrolls, reports, estimates, records, and other data as the Owner may request concerning Work performed or to be performed under the Contract.

3.4.4 The Contractor shall be represented at the site by a competent superintendent from the beginning of the Work until its final acceptance, whenever contract work is being performed, unless otherwise permitted in writing by the Owner's Representative. The superintendent for the Contractor shall exercise general supervision over the Work and such superintendent shall have decision making authority of the Contractor. Communications given to the superintendent shall be binding as if given to the Contractor. The superintendent shall not be changed by the contractor without approval from the Owner's Representative.

3.4.5 The Contractor shall establish and maintain a permanent benchmark to which access may be had during progress of the Work, and Contractor shall establish all lines and levels, and shall be responsible for the correctness of such. Contractor shall be fully responsible for all layout work for the proper location of Work in strict accordance with the Contract Documents.

3.4.6 The Contractor shall establish and be responsible for wall and partition locations. If applicable, separate contractors shall be entitled to rely upon these locations and for setting their sleeves, openings, or chases.

3.4.7 The Contractor's scheduled outage/tie-in plan, time, and date for any utilities is subject to approval by the Owner's Representative. Communication with the appropriate entity and planning for any scheduled outage/tie-in of utilities shall be the responsibility of the Contractor. Failure of Contractor to comply with the provisions of this Paragraph shall cause Contractor to forfeit any right to an adjustment of the Contract Sum or Contract Time for any postponement, rescheduling or other delays ordered by Owner in connection with such Work. The Contractor shall follow the following procedures for all utility outages/tie-ins or disruption of any building system:

.1 All shutting of valves, switches, etc., shall be by the Owner's personnel.

.2 Contractor shall submit its preliminary outage/tie-in schedule with its baseline schedule.

.3 The Contractor shall request an outage/tie-in meeting at least two weeks before the outage/tie-in is required.

.4 The Owner's Representative will schedule an outage/tie-in meeting at least one week prior to the outage/tie-in.

3.4.8 The Contractor shall coordinate all Work so there shall be no prolonged interruption of existing utilities, systems, and equipment of Owner. Any existing plumbing, heating, ventilating, air conditioning, or electrical disconnection necessary, which affect portions of this construction or building or any other building, must be scheduled with the Owner's Representative to avoid any

disruption of operation within the building under construction or other buildings or utilities. In no case shall utilities be left disconnected at the end of a workday or over a weekend. Any interruption of utilities, either intentionally or accidentally, shall not relieve the Contractor from repairing and restoring the utility to normal service. Repairs and restoration shall be made before the workers responsible for the repair and restoration leave the job.

3.4.9 The Contractor shall be responsible for repair of damage to property on or off the project occurring during construction of project, and all such repairs shall be made to meet code requirements or to the satisfaction of the Owner's Representative if code is not applicable.

3.4.10 The Contractor shall be responsible for all shoring required to protect its work or adjacent property and shall pay for any damage caused by failure to shore or by improper shoring or by failure to give proper notice. Shoring shall be removed only after completion of permanent supports.

3.4.11 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 students, faculty, 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.

3.4.12 During the performance of the 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 shall give proper and understandable warning to all persons of danger of entry onto land, structure, or equipment, within the limits of the Contractor's work area.

3.4.13 The Contractor shall pump, bail, or otherwise keep any general excavations free of water. The Contractor shall keep all areas free of water before, during and after concrete placement. The Contractor shall be responsible for protection, including weather protection, and proper maintenance of all equipment and materials installed, or to be installed by him.

3.4.14 The Contractor shall be responsible for care of the Work and must protect same from damage of defacement until acceptance by the Owner. All damaged or defaced Work shall be repaired or replaced to the Owner's satisfaction, without cost to the Owner.

3.4.15 When requested by the Owner's Representative, the Contractor, at no extra charge, shall provide scaffolds or ladders in place as may be required by the Architect or the Owner for examination or inspection of Work in progress or completed.

3.4.16 The Contractor shall be responsible to the Owner for acts and omissions of the Contractor's employees, Subcontractors of any tier and their agents and employees, and any entity or other persons performing portions of the Work.

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

3.4.18 The Contractor shall be responsible for inspection of portions of the Work already performed under this Contract to determine that such portions are compliant and in proper condition to receive subsequent Work.

3.5 Use of Site

3.5.1 The Contractor shall limit operations and storage of material to the area within the Work limit lines shown on Drawings, except as necessary to connect to exiting utilities, shall not encroach on neighboring property, and shall exercise caution to prevent damage to existing structures.

3.5.2 Only materials and equipment, which are to be used directly in the Work, shall be brought to and stored on the Work site by the Contractor. After equipment is no longer required for the Work, it shall be promptly removed from the Work site. Protection of construction materials and equipment stored at the Work site from weather, theft, damage and all other adversity is solely the responsibility of the Contractor.

3.5.3 No project signs shall be erected without the written approval of the Owner's Representative.

3.5.4 The Contractor shall ensure that the Work is at all times performed in a manner that affords reasonable access, both vehicular and pedestrian, to the site of the Work and all adjacent areas. Particular attention shall be paid to access for emergency vehicles, including fire trucks. Wherever there is the possibility of interfering with normal emergency vehicle operations, Contractor shall obtain permission from both campus and municipal emergency response entities prior to limiting any access. The Work shall be performed, to the fullest extent reasonably possible, in such a manner that public areas adjacent to the site of the Work shall be free from all debris, building materials and equipment likely to cause hazardous conditions. Without limitation of any other provision of the Contract Documents, Contractor shall not interfere with the occupancy or beneficial use of (1) any areas and buildings adjacent to the site of the Work or (2) the Work in the event of partial occupancy. Contractor shall assume full responsibility for any damage to the property

comprising the Work or to the owner or occupant of any adjacent land or areas resulting from the performance of the Work.

3.5.5 The Contractor shall not permit any workers to use any existing facilities at the Work site, including, without limitation, lavatories, toilets, entrances, and parking areas other than those designated by Owner. The Contractor, Subcontractors of any tier, suppliers and employees shall comply with instructions or regulations of the Owner's Representative governing access to, operation of, and conduct while in or on the premises and shall perform all Work required under the Contract Documents in such a manner as not to unreasonably interrupt or interfere with the conduct of Owner's operations. Any request for Work, a suspension of Work or any other request or directive received by the Contractor from occupants of existing buildings shall be referred to the Owner's Representative for determination.

3.5.6 The Contractor and the Subcontractor of any tier shall have its' name, acceptable abbreviation or recognizable logo and the name of the city and state of the mailing address of the principal office of the company, on each motor vehicle and motorized self-propelled piece of equipment which is used in connection with the project. The signs are required on such vehicles during the time the Contractor is working on the project.

3.6 Review of Contract Documents and Field Conditions by Contractor

3.6.1 The Contractor shall carefully study and compare the Contract Documents with each other and with information furnished by the Architect and Owner and shall at once report in writing to the Architect and Owner's Representative any errors, inconsistencies or omissions discovered. If the Contractor performs any construction activity which it knows or should have known involves a recognized error, inconsistency, or omission in the Contract Documents without such written notice to the Architect and Owner's Representative, the Contractor shall assume appropriate responsibility for such performance and shall bear an appropriate amount of the attributable costs for correction.

3.6.2 The Contractor shall take field measurements and verify field conditions and shall carefully compare such field measurements and conditions and other information known to the Contractor with the Contract Documents before commencing activities. Errors, inconsistencies, or omissions discovered shall be reported in writing to the Architect and Owner's Representative within twenty-four (24) hours. During the progress of work, Contractor shall verify all field measurements prior to fabrication of building components or equipment and proceed with the fabrication to meet field conditions. Contractor shall consult all Contract Documents to determine the exact location of all work and verify spatial relationships of all work. Any question concerning said location or spatial relationships shall be submitted to the Owner's Representative. Specific locations for equipment, pipelines, ductwork and other such items of work, where not dimensioned on plans, shall be determined in consultation with Owner's Representative and Architect. Contractor shall be responsible for the proper fitting of the Work in place.

3.6.3 The Contractor shall provide, at the proper time, such material as required for support of the Work. If openings or chases are required, whether shown on Drawings or not, the Contractor shall see they are properly constructed. If required openings or chases are omitted, the Contractor shall cut them at the Contractors own expense, but only as directed by the Architect, through the Owner Representative.

3.6.4 Should the Contract Documents fail to particularly describe materials or goods to be used, it shall be the duty of the Contractor to inquire of the Architect and the Owner's Representative what is to be used and to supply it at the Contractor's expense, or else thereafter replace it to the Owner's Representative's satisfaction. At a minimum, the Contractor shall provide the quality of materials as generally specified throughout the Contract Documents.

3.7 Cleaning and Removal

3.7.1 The Contractor shall keep the Work site and surrounding areas free from accumulation of waste materials, rubbish, debris, and dirt resulting from the Work and shall clean the Work site and surrounding areas as requested by the Architect and the Owner's Representative, including mowing of grass greater than 6 inches high. The Contractor shall be responsible for the cost of clean up and removal of debris from premises. The building and premises shall be kept clean, safe, in a workmanlike manner, and in compliance with OSHA standards and code at all times. At completion of the Work, the Contractor shall remove from and about the Work site tools, construction equipment, machinery, fencing, and surplus materials. Further, at the completion of the work, all dirt, stains, and smudges shall be removed from every part of the building, all glass in doors and windows shall be washed, and entire Work shall be left broom clean in a finished state ready for occupancy. The Contractor shall advise his Subcontractors of any tier of this provision, and the Contractor shall be fully responsible for leaving the premises in a finished state ready for use to the satisfaction of the Owner's Representative. If the Contractor fails to comply with the provisions of this paragraph, the Owner may do so, and the cost thereof shall be charged to the Contractor.

3.8 Cutting and Patching

3.8.1 The Contractor shall be responsible for cutting, fitting, or patching required to complete the Work or to make its parts fit together properly.

3.8.2 The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or separate contractors by cutting, patching, or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter

such construction by the Owner or a separate contractor except with written consent of the Owner and of such separate contractor; such consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold from the Owner or a separate contractor the Contractor's consent to cutting or otherwise altering the Work.

3.8.3 If the Work involves renovation and/or alteration of existing improvements, Contractor acknowledges that cutting and patching of the Work is essential for the Work to be successfully completed. Contractor shall perform any cutting, altering, patching, and/or fitting of the Work necessary for the Work and the existing improvements to be fully integrated and to present the visual appearance of an entire, completed, and unified project. In performing any Work which requires cutting or patching, Contractor shall use its best efforts to protect and preserve the visual appearance and aesthetics of the Work to the reasonable satisfaction of both the Owner's Representative and Architect.

3.9 Indemnification

3.9.1 To the fullest extent permitted by law, the Contractor shall defend, indemnify, and hold harmless the Owner, the Architect, Architect's consultants, and the agents, employees, representatives, insurers and re-insurers of any of the foregoing (hereafter collectively referred to as the "Indemnitees") from and against claims, damages (including loss of use of the Work itself), punitive damages, penalties and civil fines unless expressly prohibited by law, losses and expenses, including, but not limited to, attorneys' fees, arising out of or resulting from performance of the Work to the extent caused in whole or in part by negligent acts or omissions or other fault of Contractor, a Subcontractor of any tier, or anyone directly or indirectly employed by them or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss, or expense is caused in part by the negligent acts or omissions or other fault of a party indemnified hereunder. The Contractor's obligations hereunder are in addition to and shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity that the Owner may possess. If one or more of the Indemnitees demand performance by the Contractor of obligations under this paragraph or other provisions of the Contract Documents and if Contractor refuses to assume or perform, or delays in assuming or performing Contractor's obligations, Contractor shall pay each Indemnitee who has made such demand its respective attorneys' fees, costs, and other expenses incurred in enforcing this provision. The defense and indemnity required herein shall be a binding obligation upon Contractor whether or not an Indemnitee has made such demand. Even if a defense is successful to a claim or demand for which Contractor is obligated to indemnify the Indemnitees from under this Paragraph, Contractor shall remain liable for all costs of defense.

3.9.2 The indemnity obligations of Contractor under this Section 3.9 shall survive termination of this Contract or final payment thereunder. In the event of any claim or demand made against any party which is entitled to be indemnified hereunder, the Owner may in its sole discretion reserve, return or apply any monies due or to become due the Contractor under the Contract for the purpose of resolving such claims; provided, however, that the Owner may release such funds if the Contractor provides the Owner with reasonable assurance of protection of the Owner's interests. The Owner shall in its sole discretion determine if such assurances are reasonable. Owner reserves the right to control the defense and settlement of any claim, action or proceeding which Contractor has an obligation to indemnify the Indemnitees against under Paragraph 3.9.1.

3.9.3 In claims against any person or entity indemnified under this Section 3.9 by an employee of the Contractor, a Subcontractor of any tier, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, the indemnification obligation under this Section 3.9 shall not be limited by a limitation on amount or type of damages, compensation or benefits payable by or for the Contractor or a Subcontractor of any tier under workers' or workmen's compensation acts, disability benefit acts or other employee benefit acts.

3.9.4 The obligations of the Contractor under Paragraph 3.9.1 shall not extend to the liability of the Architect, his agents or employees, arising out of the preparation and approval of maps, drawings, opinions, reports, surveys, Change Orders, designs, or Specifications.

3.10 Patents

3.10.1 The Contractor shall hold and save harmless the Owner and its officers, agents, servants, and employees from liability of any nature or kind, including cost and expense, for, or on account of, any patented or otherwise protected invention, process, article, or appliance manufactured or used in the performance of the Contract, including its use by the Owner, unless otherwise specifically stipulated in the Contract Documents.

3.10.2 If the Contractor uses any design, device, or material covered by letters patent or copyright, he 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 Sum include, and the Contractor shall pay all royalties, license fees or costs arising from the use of such design, device, or material in any way involved in the Work. The Contractor and/or sureties shall indemnify and save harmless the Owner from any and all claims for infringement by reason of the use of such patented or copyrighted design, device, or material 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 obligated to pay by reason of

such infringement at any time during the prosecution of the Work or after completion of the Work.

3.11 Delegated Design

3.11.1 If the Contract Documents specify the Contractor is responsible for the design of any work as part of the project, then the Contractor shall procure all design services and certifications necessary to complete the Work as specified, from a design professional licensed in the State of Missouri. The signature and seal of that design professional shall appear on all drawings, calculations, specifications, certifications, shop drawings, and other submittals related to the Work. The design professional shall maintain insurance as required per Article 11.

3.12 Materials, Labor, and Workmanship

3.12.1 Materials and equipment incorporated into the Work shall strictly conform to the Contract Documents and representations and approved Samples provided by Contractor and shall be of the most suitable grade of their respective kinds for their respective uses and shall be fit and sufficient for the purpose intended, merchantable, of good new material and workmanship, and free from defect. Workmanship shall be in accordance with the highest standard in the industry and free from defect in strict accordance with the Contract Documents.

3.12.2 Materials and fixtures shall be new and of latest design unless otherwise specified and shall provide the most efficient operating and maintenance costs to the Owner. All Work shall be performed by competent workers and shall be of best quality.

3.12.3 The Contractor shall carefully examine the Contract Documents and shall be responsible for the proper fitting of his material, equipment, and apparatus into the building.

3.12.4 The Contractor shall base his bid only on the Contract Documents.

3.12.5 Materials and workmanship shall be subject to inspection, examination, and testing by the Architect and the Owner's Representative at any and all times during manufacture, installation, and construction of any of them, at places where such manufacture, installation, or construction is performed.

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

3.12.7 Unless otherwise specifically noted, the Contractor shall provide and pay for supervision, labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for the proper execution and completion of the Work.

3.12.8 Substitutions

3.12.8.1 A substitution is a Contractor proposal of an alternate product or method in lieu of what has been specified or shown in the Contract Documents, which is not an "or equal" as set forth in Section 3.12.1.

3.12.8.2 Contractor may make a proposal to the Architect and the Owner's Representative to use substitute products or methods as set forth herein, but the Architect's and the Owner's Representative's decision concerning acceptance of a substitute shall be final. The Contractor must do so in writing and setting forth the following:

.1 Full explanation of the proposed substitution and submittal of all supporting data including technical information, catalog cuts, warranties, test results, installation instructions, operating procedures, and other like information necessary for a complete evaluation of the substitution.

.2 Reasons the substitution is advantageous and necessary, including the benefits to the Owner and the Work in the event the substitution is acceptable.

.3 The adjustment, if any, in the Contract Sum, in the event the substitution is acceptable.

.4 The adjustment, if any, in the time of completion of the Contract and the construction schedule in the event the substitution is acceptable.

.5 An affidavit stating that (a) the proposed substitution conforms to and meets all of the Contract Document requirements and is code compliant, except as specifically disclosed and set forth in the affidavit and (b) the Contractor accepts the warranty and correction obligations in connection with the proposed substitution as if originally specified by the Architect. Proposals for substitutions shall be submitted to the Architect and Owner's Representative in sufficient time to allow the Architect and Owner's Representative no less than ten (10) working days for review. No substitution will be considered or allowed without the Contractor's submittal of complete substantiating data and information as stated herein.

3.12.8.3 Substitutions may be rejected without explanation at the Owner's sole discretion and will be considered only under one or more of the following conditions:

.1 Required for compliance with interpretation of code requirements or insurance regulations then existing;

.2 Unavailability of specified products, through no fault of the Contractor;

.3 Material delivered fails to comply with the Contract Documents;

.4 Subsequent information discloses inability of specified products to perform properly or to fit in designated space;

.5 Manufacturer/fabricator refuses to certify or guarantee performance of specified product as required; or

.6 When in the judgment of the Owner or the Architect, a substitution would be substantially to the Owner's best interests, in terms of cost, time, or other considerations.

3.12.8.4 Whether or not any proposed substitution is accepted by the Owner or the Architect, the Contractor shall reimburse the Owner for any fees charged by the Architect or other consultants for evaluating each proposed substitution.

3.13 Approved Equal

3.13.1 Whenever in the Contract Documents any article, appliance, device, or material is designated by the name of a manufacturer, vendor, or by any proprietary or trade name, the words "or approved equal," shall automatically follow and shall be implied unless specifically indicated otherwise. The 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's Representative and the Architect they are equal in design, appearance, spare parts availability, strength, durability, usefulness, serviceability, operation cost, maintenance cost, and convenience for the purpose intended. Any general listings of approved manufacturers in any Contract Document shall be for informational purposes only and it shall be the Contractor's sole responsibility to ensure that any proposed "or equal" complies with the requirements of the Contract Documents and is code compliant.

3.13.2 The Contractor shall submit to Architect and Owner's Representative a written and full description of the proposed "or equal" including all supporting data, including technical information, catalog cuts, warranties, test results, installation instructions, operating procedures, and similar information demonstrating that the proposed "or equal" strictly complies with the Contract Documents. The Architect or Owner's Representative shall take appropriate action with respect to the submission of a proposed "or equal" item. If Contractor fails to submit proposed "or equals" as set forth herein, it shall waive any right to supply such items. The Contract Sum and Contract Time shall not be adjusted as a result of any failure by Contractor to submit proposed "or equals" as provided for herein. All documents submitted in connection with preparing an "or equal" shall be clearly and obviously marked as a proposed "or equal" submission.

3.13.3 No approvals or action taken by the Architect or Owner's Representative shall relieve Contractor from its obligation to ensure that an "or equal" article, appliance, devise, or material strictly complies with the requirements of the Contract Documents. Contractor shall not propose "or equal" items in connection with Shop Drawings or other Submittals, and Contractor acknowledges and agrees that no approvals or action taken by the Architect or Owner's Representative with respect to Shop Drawings or other Submittals shall constitute approval of any "or equal" item or relieve Contractor from its sole and exclusive responsibility. Any changes required in the details and dimensions indicated in the Contract Documents for the incorporation or installation of any "or equal" item supplied by the Contractor shall be properly made and approved by the Architect at the expense of the Contractor. No 'or equal' items will be permitted for components of or extensions to existing systems when, in the opinion of the Architect, the named manufacturer must be provided in order to ensure compatibility with the existing systems, including, but not limited to, mechanical systems, electrical systems, fire alarms, smoke detectors, etc. No action will be taken by the Architect with respect to proposed "or equal" items prior to receipt of bids, unless otherwise noted in the Special Conditions.

3.14 Shop Drawings, Product Data, Samples, and Coordination Drawings/BIM Models

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

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

3.14.3 Samples are physical samples which illustrate materials, equipment or workmanship and establish standards by which the Work will be judged.

3.14.4 Coordination Drawings are drawings for the integration of the Work, including work first shown in detail on shop drawings or product data. Coordination drawings show sequencing and relationship of separate units of work which must interface in a restricted manner to fit in the space provided, or function as indicated. Coordination Drawings are the responsibility of the contractor and are submitted for informational purposes. The Special Conditions will state whether coordination drawings are required. BIM models may be used for coordination in lieu of coordination drawings at the contractor's discretion, unless required in the Special Conditions. The final coordination drawings/BIM Model will not change the contract documents, unless approved by a fully executed change order describing the specific modifications that are being made to the contract documents.

3.14.5 Shop Drawings, Coordination Drawings/BIM Models, Product Data, Samples and similar submittals (collectively referred to as "Submittals") are not Contract Documents. The purpose of their submittal is to demonstrate for those portions of the Work for which submittals are

required the way the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents.

3.14.6 The Contractor shall schedule submittal of Shop Drawings and Product Data to the Architect so that no delays will result in delivery of materials and equipment, advising the Architect of priority for checking of Shop Drawings and Product Data, but a minimum of two weeks shall be provided for this purpose. Because time is of the essence in this contract, unless noted otherwise in the Special Conditions or Technical Specifications, all submittals, shop drawings and samples must be submitted as required to maintain the contractor's plan for proceeding but must be submitted within 90 days of the Notice to Proceed. If Contractor believes that this milestone is unreasonable for any submittal, Contractor shall request an extension of this milestone, within 60 days of Notice to Proceed, for each submittal that cannot meet the milestone. The request shall contain a reasonable explanation as to why the 90-day milestone is unrealistic, and shall specify a date on which the submittal will be provided, for approval by the Owner's Representative. Failure of the Contractor to comply with this section may result in delays in the submittal approval process and/or charges for expediting approval, both of which will be the responsibility of the Contractor.

3.14.7 The Contractor, at its own expense, shall submit Samples required by the Contract Documents with reasonable promptness as to cause no delay in the Work or the activities of separate contractors and no later than twenty (20) days before materials are required to be ordered for scheduled delivery to the Work site. Samples shall be labeled to designate material or products represented, grade, place of origin, name of producer, name of Contractor and the name and number of the Owner's project. Quantities of Samples shall be twice the number required for testing so that Architect can return one set of the Samples. Materials delivered before receipt of Architect's approval may be rejected by Architect and in such event, Contractor shall immediately remove all such materials from the Work site. When requested by Architect or Owner's Representative, samples of finished masonry and field applied paints and finishes shall be located as directed and shall include sample panels built at the site of approximately twenty (20) square feet each.

3.14.8 The Contractor shall perform no portion of the Work requiring submittal and review of Shop Drawings, Product Data, Samples, or similar submittals until the respective submittal has been approved by the Architect. Such Work shall be in accordance with approved submittals.

3.14.9 By approving and submitting Shop Drawings, Product Data, Samples and similar submittals, the Contractor represents such Submittals strictly comply with the requirements of the Contract Documents and that the Contractor has determined and verified field measurements and field construction criteria related thereto, that materials are fit for their intended use and that the fabrication, shipping, handling, storage, assembly and installation of all materials, systems and equipment are in accordance with best practices in the industry and are in strict compliance with any applicable requirements of the Contract Documents. Contractor shall also coordinate each Submittal with other Submittals.

3.14.10 Contractor shall be responsible for the correctness and accuracy of the dimensions, measurements and other information contained in the Submittals.

3.14.11 Each Submittal will bear a stamp or specific indication that the Submittal complies with the Contract Documents and Contractor has satisfied its obligations under the Contract Documents with respect to Contractor's review and approval of that Submittal. Each Submittal shall bear the signature of the representative of Contractor who approved the Submittal, together with the Contractor's name, Owner's name, number of the Project, and the item name and specification section number.

3.14.12 The Contractor shall not be relieved of responsibility for deviations from requirements of the Contract Documents by the Architect's approval of Shop Drawings, Product Data, Samples, or similar submittals. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples, or similar submittals by the Architect's approval thereof. Specifically, but not by way of limitation, Contractor acknowledges that Architect's approval of Shop Drawings shall not relieve Contractor for responsibility for errors and omissions in the Shop Drawings since Contractor is responsible for the correctness of dimensions, details and the design of adequate connections and details contained in the Shop Drawings.

3.14.13 The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples or similar submittals, to revisions other than those requested by the Architect on previous Submittals.

3.14.14 The Contractor represents and warrants that all Shop Drawings shall be prepared by persons and entities possessing expertise and experience in the trade for which the Shop Drawing is prepared and, if required by the Architect or applicable Laws, by a licensed engineer or other design professional.

3.15 Record Drawings

3.15.1 The Contractor shall maintain a set of Record Drawings on site in good condition and shall use colored pencils to mark up said set with "record information" in a legible manner to show: (1) bidding addendums, (2) executed change orders, (3)deviations from the Drawings made during construction; (4) details in the Work not previously shown; (5) changes to existing conditions or existing conditions found to differ from those shown on any existing drawings; (6) the actual installed position of equipment, piping, conduits, light switches, electric fixtures, circuiting, ducts, dampers, access

panels, control valves, drains, openings, and stub-outs; and (7) such other information as either Owner or Architect may reasonably request. The prints for Record Drawing use will be a set of "blue line" prints provided by Architect to Contractor at the start of construction. Upon Substantial Completion of the Work, Contractor shall deliver all Record Drawings to Owner and Architect for approval. If not approved, Contractor shall make the revisions requested by Architect or Owner's Representative. Final payment and any retainage shall not be due and owing to Contractor until the final Record Drawings marked by Contractor as required above are delivered to Owner.

3.16 Operating Instructions and Service Manuals

3.16.1 The Contractor shall submit four (4) volumes of operating instructions and service manuals to the Architect before completing 50% of the adjusted contract amount. Payments beyond 50% of the adjusted contract amount may be withheld until all operating instructions and service manuals are received. The operating instructions and service manuals shall contain:

.1 Start-up and Shutdown 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 include model number, capacities, flow rate, and name-plate data.

.4 Service Instructions: The Contractor shall be required to provide the following information for all pieces of equipment.

(a) Recommended spare parts including catalog number and name of local suppliers or factory representative.

(b) Belt sizes, types, and lengths.

(c) Wiring diagrams.

.5 Manufacturer's Certificate of Warranty: Manufacturer's certificates of warranty shall be obtained for all major equipment. Warranty shall be obtained for at least one year from the date of Substantial Completion. Where longer period is required by the Contract Documents, the longer period shall govern.

.6 Parts catalogs: For each piece of equipment furnished, a parts catalog or similar document shall be provided which identifies the components by number for replacement ordering.

3.16.2 Submission

.1 Manuals shall be bound into volumes of standard 8 1/2" x 11" hard binders. Large drawings too bulky to be folded into 8 1/2" x 11" shall be separately bound or folded and in brown envelopes, cross-referenced and indexed with the manuals.

.2 The manuals shall identify the Owner's project name, project number, and include the name and address of the Contractor and major Subcontractors of any tier who were involved with the activity described in that particular manual.

3.17 Taxes

3.17.1 The Contractor shall pay all applicable sales, consumer, use, and similar taxes for the Work which are legally enacted when the bids are received, whether or not yet effective or scheduled to go into effect. However, certain purchases by the Contractor of materials incorporated in or consumed in the Work are exempt from certain sales tax pursuant to RSMo § 144.062. The Contractor shall be issued a Project Tax Exemption Certificate for this Work to obtain the benefits of RSMo § 144.062.

3.17.2 The Contractor shall furnish this certificate to all subcontractors, and any person or entity purchasing materials for the Work shall present such certificate to all material suppliers as authorization to purchase, on behalf of the Owner, all tangible personal property and materials to be incorporated into or consumed in the Work and no other on a tax-exempt basis. Such suppliers shall provide to the purchasing party invoices bearing the name of the exempt entity and the project identification number. Nothing in this section shall be deemed to exempt from any sales or similar tax the purchase of any construction machinery, equipment or tools used in construction, repairing or remodeling facilities for the Owner. All invoices for all personal property and materials purchased under a Project Tax Exemption Certificate shall be retained by the Contractor for a period of five years and shall be subject to audit by the Director of Revenue.

3.17.3 Any excess resalable tangible personal property or materials which were purchased for the project under this Project Tax Exemption Certificate but which were not incorporated into or consumed in the Work shall either be returned to the supplier for credit or the appropriate sales or use tax on such excess property or materials shall be reported on a return and paid by such purchasing party not later than the due date of the purchasing party's Missouri sales or use tax return following the month in which it was determined that the materials were not used in the Work.

3.17.4 If it is determined that sales tax is owed by the Contractor on property and materials due to the failure of the Owner to revise the certificate expiration date to cover the applicable date of purchase, Owner shall be liable for the tax owed.

3.17.5 The Owner shall not be responsible for any tax liability due to Contractor's neglect to make timely orders, payments, etc. or Contractor's misuse of the Project Tax Exemption Certificate. Contractor represents that the Project Tax Exemption Certificate shall be used in accordance with RSMo § 144.062 and the terms of the Project Tax Exemption

Certificate. Contractor shall indemnify the Owner for any loss or expense, including but not limited to, reasonable attorneys' fees, arising out of Contractor's use of the Project Tax Exemption Certificate.

3.18 Contractor's Construction Schedules

3.18.1 The Contractor, within fifteen (15) days after the issuance of the Notice to Proceed, shall prepare and submit for the Owner's and Architect's information Contractor's construction schedule for the Work and shall set forth interim dates for completion of various components of the Work and Work Milestone Dates as defined herein. The schedule shall not exceed time limits current under the Contract Documents, shall be revised on a monthly basis or as requested by the Owner's Representative as required by the conditions of the Work, and shall provide for expeditious and practicable execution of the Work. The Contractor shall conform to the most recent schedule.

3.18.2 The construction schedule shall be in a detailed format satisfactory to the Owner's Representative and the Architect and in accordance with the detailed schedule requirements set forth in this document and the Special Conditions. If the Owner's Representative or Architect has a reasonable objection to the schedule submitted by Contractor, the construction schedule shall be promptly revised by the Contractor. The Contractor shall monitor the progress of the Work for conformance with the requirements of the construction schedule and shall promptly advise the Owner of any delays or potential delays.

3.18.3 As time is of the essence to this contract, the University expects that the Contractor will take all necessary steps to ensure that the project construction schedule shall be prepared in accordance with the specific requirements of the Special Conditions to this contract. At a minimum, contractor shall comply with the following:

.1 The schedule shall be prepared using Primavera P3, Oracle P6, Microsoft Project or other software acceptable to the Owner's Representative.

.2 The schedule shall be prepared and maintained in CPM format, in accordance with Construction CPM Scheduling, published by the Associated General Contractors of American (AGC).

.3 Prior to submittal to the Owner's Representative for review, Contractor shall obtain full buy-in to the schedule from all major subcontractors, in writing if so, requested by Owner's Representative.

.4 Schedule shall be updated, in accordance with Construction CPM Scheduling, published by the AGC, on a monthly basis at minimum, prior to, and submitted with, the monthly pay application or as requested by the Owner's Representative.

.5 Along with the update the Contractor shall submit a narrative report addressing all changes, delays and impacts, including weather to the schedule during the last month, and explain how the end date has been impacted by same.

.6 The submission of the updated schedule certifies that all delays and impacts that have occurred on or to the project during the previous month have been factored into the update and are fully integrated into the schedule and the projected completion date.

Failure to comply with any of these requirements will be considered a material breach of this contract. See Special Conditions for detailed scheduling requirements.

3.18. 4 In the event the Owner's Representative or Architect determines that the performance of the Work, as of a Milestone Date, has not progressed or reached the level of completion required by the Contract Documents, the Owner shall have the right to order the Contractor to take corrective measures necessary to expedite the progress of construction, including, without limitation, (1) working additional shifts or overtime, (2) supplying additional manpower, equipment, facilities, (3) expediting delivery of materials, and (4) other similar measures (hereinafter referred to collectively as Extraordinary Measures). Such Extraordinary Measures shall continue until the progress of the Work complies with the stage of completion required by the Contract Documents. The Owner's right to require Extraordinary Measures is solely for the purpose of ensuring the Contractor's compliance with the construction schedule. The Contractor shall not be entitled to an adjustment in the Contract Sum concerning Extraordinary Measures required by the Owner under or pursuant to this Paragraph 3.17.3. The Owner may exercise the rights furnished the Owner under or pursuant to this Paragraph 3.17.3 as frequently as the Owner deems necessary to ensure that the Contractor's performance of the Work will comply with any Milestone Date or completion date set forth in the Contract Documents.

ARTICLE 4
ADMINISTRATION OF THE CONTRACT

4.1 Rights of the Owner

4.1.1 The Owner's Representative will administer the Construction Contract. The Architect will assist the Owner's Representative with the administration of the Contract as indicated in these Contract Documents.

4.1.2 If, in the judgment of the Owner's Representative, it becomes necessary to accelerate the work, the Contractor, when directed by the Owner's Representative in writing, shall cease work at any point and transfer its workers to such point or points and execute such portions of the work as may be required to enable others to hasten and properly engage and carry out the work, all as directed by the Owner's Representative. The additional cost of accelerating the work, if any, will be borne by the Owner, unless the Contractor's work progress is behind schedule as shown on the most recent progress schedule.

4.1.3 If the Contractor refuses, for any reason, to proceed with what the Owner believes to be contract work, the Owner may issue a Construction Directive, directing the Contractor to proceed. Contractor shall be obligated to promptly proceed with this work. If Contractor feels that it is entitled to additional compensation for this work, it may file a claim for additional compensation and/or time, in accordance with 4.4 of this Document.

4.1.4 The Owner's Representative, may, by written notice, require a Contractor to remove from involvement with the Work, any of Contractor's personnel or the personnel of its Subcontractors of any tier whom the Owner's Representative may deem abusive, incompetent, careless, or a hindrance to proper and timely execution of the Work. The Contractor shall comply with such notice promptly, but without detriment to the Work or its progress.

4.1.5 The Owner's Representative will schedule Work status meetings that shall be attended by representatives of the Contractor and appropriate Subcontractors of any tier. Material suppliers shall attend status meetings if required by the Owner's Representative. These meetings shall include preconstruction meetings.

4.1.6 The Owner does not allow smoking on university property.

4.2 Rights of the Architect

4.2.1 The Architect will interpret requirements of the Contract Documents with respect to the quality, quantity, and other technical requirements of the Work itself within a reasonable time after written request of the Contractor. Contractor shall provide Owner's Representative a copy of such written request.

4.3 Review of the Work

4.3.1 The Architect, the Owner's Representative, and the Owner's Authorized Agent shall, at all times, have access to the Work; and the Contractor shall provide proper and safe facilities for such access.

4.3.2 The Owner's Representative shall have authority to reject Work that does not strictly comply with the requirements of the Contract Documents. Whenever the Owner's Representative considers it necessary or advisable for implementation of the intent of the Contract Documents, Owner's Representative shall have the authority to require additional inspection or testing of the Work, whether or not such Work is fabricated, installed, or completed.

4.3.3 The fact that the Architect or the Owner's Representative observed, or failed to observe, faulty Work, or Work done which is not in accordance with the Contract Documents, regardless of whether or not the Owner has released final payment, shall not relieve the Contractor from responsibility for all damages and additional costs of the Owner as a result of defective or faulty Work.

4.4 Claims

4.4.1 A Claim is a demand or assertion by Contractor seeking, as a matter of right, adjustment or interpretation of Contract terms, payment of money, extension of time or any other relief with respect to the terms of the Contract. The term "Claim(s)" also includes demands and assertions of Contractor arising out of or relating to the Contract Documents, including Claims based upon breach of contract, mistake, misrepresentation, or other cause for Contract Modification or recision. Claims must be made by written notice. Contractor shall have the responsibility to substantiate Claims.

4.4.2 Claims by Contractor must be made promptly, and no later than within fourteen (14) days after occurrence of the event giving rise to such Claim. Claims must be made by written notice. Such notice shall include a detailed statement setting forth all reasons for the Claim and the amount of additional money and additional time claimed by Contractor. The notice of Claims shall also strictly comply with all other provisions of the Contract Documents. Contractor shall not be entitled to rely upon any grounds or basis for additional money on additional time not specifically set forth in the notice of Claim. All Claims not made in the manner provided herein shall be deemed waived and of no effect. Contractor shall furnish the Owner and Architect such timely written notice of any Claim provided for herein, including, without limitation, those in connection with alleged concealed or unknown conditions, and shall cooperate with the Owner and Architect in any effort to mitigate the alleged or potential damages, delay or other adverse consequences arising out of the condition which is the cause of such a Claim.

4.4.3 Pending final resolution of a Claim, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments that are not in dispute in accordance with the Contract Documents.

4.5 Claims for Concealed or Unknown Conditions

4.5.1 If conditions are encountered at the site which are (1) subsurface or otherwise concealed physical conditions which differ materially from those indicated in the Contract Documents, or (2) unknown physical conditions of an unusual nature, which differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, then notice by the Contractor shall be given to the Owner's Representative promptly before conditions are disturbed, and in no event later than three (3) days after first observance of the conditions. The Owner's Representative will promptly investigate such conditions. If such conditions differ materially, as provided for above and cause an increase or decrease in the Contractor's cost, or time, required for performance of the Work, an equitable adjustment in the Contract sum or Contract Time, or both, shall be made, subject to the provisions and restrictions set for herein. If the Owner's Representative determines that the

conditions at the site are not materially different from those indicated in the Contract Documents, and that no change in the terms of the Contract is justified, the Owner's Representative will so notify the Contractor in writing. If the Contractor disputes the finding of the Owner's Representative that no change in the terms of the Contract terms is justified, Contractor shall proceed with the Work, taking whatever steps are necessary to overcome or correct such conditions so that Contractor can proceed in a timely manner. The Contractor may have the right to file a Claim in accordance with the Contract Documents.

4.5.2 It is expressly agreed that no adjustment in the Contract Time or Contract Sum shall be permitted, however, in connection with a concealed or unknown condition which does not differ materially from those conditions disclosed or which reasonably should have been disclosed by the Contractor's (1) prior inspections, tests, reviews and preconstruction investigations for the Project, or (2) inspections, tests, reviews and preconstruction inspections which the Contractor had the opportunity to make or should have performed in connection with the Project.

4.6 Claim for Additional Cost

4.6.1 If the Contractor makes a Claim for an increase in the Contract Sum, written notice as provided herein shall be given before proceeding to execute the Work. In addition to all other requirements for notice of a Claim, said notice shall detail and itemize the amount of all Claims and shall contain sufficient data to permit evaluation of same by Owner.

4.7 Claims for Additional Time

4.7.1 If the Contractor makes a Claim for an increase in the Contract Time, written notice as provided herein shall be given. In addition to other requirements for notice of a Claim, Contractor shall include an estimate of the probable effect of delay upon the progress of the Work, utilizing a CPM Time Impact Schedule Analysis, (TIA) as defined in the AGC Scheduling Manual. In the case of a continuing delay, only one Claim is necessary.

.1 Time extensions will be considered for excusable delays only. That is, delays that are beyond the control and/or contractual responsibility of the Contractor.

4.7.2 If weather days are the basis for a Claim for additional time, such Claim shall be documented by the Contractor by data acceptable to the Owner's Representative substantiating that weather conditions for the period of time in question, had an adverse effect on the critical path of the scheduled construction. Weather days shall be defined as days on which critical path work cannot proceed due to weather conditions (including but not limited to rain, snow, etc.), in excess of the number of days shown on the Anticipated Weather Day schedule in the Special Conditions. To be considered a weather day, at least four working hours must be lost due to the weather conditions on a critical path scope item for that day.-Weather days and Anticipated weather days listed in the Special Conditions shall only apply to Monday through Friday. A weather day claim cannot be made for Saturdays, Sundays, New Year's Day, Martin Luther King Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the day after Thanksgiving Day and Christmas Day, unless that specific day was approved in writing for work by the Owner's Representative.

.1 The Contractor must have fulfilled its contract obligations with respect to temporary facilities and protection of its work, and worker protection for hot and cold weather per OSHA guidelines.

.2 If the contract obligations have been satisfied, the Owner will review requests for non-compensable time extensions for critical path activities as follows:

.2.1 If the Contractor cannot work on a critical path activity due to adverse weather, after implementing all reasonable temporary weather protection, the Contractor will so notify the Owner's Representative. Each week, the Contractor will notify the Owner's Representative of the number of adverse weather days that it believes it has experienced in the previous week. As provided in the contract, until such time as the weather days acknowledged by the Owner's Representative exceed the number of days of adverse weather contemplated in the Special Conditions, no request for extension of the contract completion time will be considered.

.2.2 If the Contractor has accumulated in excess of the number of adverse weather days contemplated in the Special Conditions due to the stoppage of work on critical path activities due to adverse weather, the Owner will consider a time extension request from the Contractor that is submitted in accordance with the contract requirements. The Owner will provide a change order extending the time for contract completion or direct an acceleration of the work in accordance with the contract terms and conditions to recover the time lost due to adverse weather in excess of the number of adverse weather working days contemplated in the Special Conditions.

4.7.3 A Force Majeure event or circumstance shall not be the basis of a claim by the Contractor seeking an adjustment in the Contract amount for costs or expenses of any type. With the exception of weather delays which are administered under this Article 4, and not withstanding other requirements of the Contract, all Force Majeure events resulting in a delay

to the critical path of the project shall be administered as provided in Article 8.

4.7.4 The Owner will consider and evaluate requests for time extensions due to changes or other events beyond the control of the Contractor on a monthly basis only, with the submission of the Contractor's updated schedule, in conjunction with the monthly application for payment.

4.8 Resolution of Claims and Disputes

4.8.1 The Owner's Representative will review Claims and take one or more of the following preliminary actions within ten days of receipt of a Claim: (1) request additional supporting data from the Contractor, (2) reject the Claim in whole or in part, (3) approve the Claim, or (4) suggest a compromise.

4.8.2 If a Claim has not been resolved, the Contractor shall, within ten days after the Owner's Representative's preliminary response, take one or more of the following actions: (1) submit additional supporting data requested, (2) modify the initial Claim, or (3) notify the Owner's Representative that the initial Claim stands.

4.8.3 If a Claim has not been resolved after consideration of the foregoing and of further information presented by the Contractor, the Contractor has the right to seek administrative review as set forth in Section 4.9. However, Owner's Representative's decisions on matters relating to aesthetics will be final.

4.9 Administrative Review

4.9.1 Claims not resolved pursuant to the procedures set forth in the Contract Documents except with respect to Owner's Representative's decision on matters relating to aesthetic effect, and except for claims which have been waived by the making or acceptance of final payment, or the Contractor's acceptance of payments in full for changes in work may be submitted to administrative review as provided in this section. All requests for administrative review shall be made in writing.

4.9.2 Upon written request from the Contractor, the Owner's Review Administrator authorized by the Campus Contracting Officer will convene a review meeting between the Contractor and Owner's Representative's within fifteen (15) days of receipt of such written request. The Contractor and Owner's Representative will be allowed to present written documentation with respect to the claim(s) before or during the meeting. The Contractor and Owner's Representative will be allowed to present the testimony of any knowledgeable person regarding the claim at the review meeting. The Owner's Review Administrator will issue a written summary of the review meeting and decision to resolve the Claim within fifteen (15) days. If the Contractor is in agreement with the decision the Contractor shall notify the Owner's Review Administrator in writing within five (5) days, and appropriate documentation will be signed by the parties to resolve the Claim.

4.9.3 If the Contractor is not in agreement with the proposal of the Owner's Review Administrator as to the resolution of the claim, the Contractor may file a written appeal with the UM System Contracting Officer, [in care of the Director of Facilities Planning and Development, University of Missouri, 109 Old Alumni Centers, University of Missouri, Columbia, Missouri 65211] within fifteen (15) days after receipt of the Owner's Review Administrator's proposal. The UM System Contracting Officer will call a meeting of the Contractor, the Owner's Representative, and the Owner's Review Administrator by written notice, within thirty (30) days after receipt of the Contractor's written appeal. The Owner's Review Administrator shall provide the UM System Contracting Officer with a copy of the written decision and summary of the review meeting, the Contractor's corrections or comments regarding the summary of the review meeting, and any written documentation presented by the Contractor and the Owner's Representative at the initial review meeting. The parties may present further documentation and/or present the testimony of any knowledgeable person regarding the claim at the meeting called by the UM System Contracting Officer.

4.9.4 The UM System Contracting Officer will issue a written decision to resolve the claim within fifteen (15) days after the meeting. If the Contractor is in agreement with the UM System Contracting Officer's proposal, the Contractor shall notify the UM System Contracting Officer in writing within five (5) days, and the Contractor and the Owner shall sign appropriate documents. The issuance of the UM System Contracting Officer's written proposal shall conclude the administrative review process even if the Contractor is not in agreement. However, proposals and any opinions expressed in such proposals issued under this section will not be binding on the Contractor nor will the decisions or any opinions expressed be admissible in any legal actions arising from the Claim and will not be deemed to remove any right or remedy of the Contractor as may otherwise exist by virtue of Contract Documents or law. Contractor and Owner agree that the Missouri Circuit Court for the County where the Work is located shall have exclusive jurisdiction to determine all issues between them. Contractor agrees not to file any complaint, petition, lawsuit or legal proceeding against Owner except with such Missouri Circuit Court.

ARTICLE 5
SUBCONTRACTORS

5.1 Award of Subcontracts

5.1.1 Pursuant to Article 9, the Contractor shall furnish the Owner and the Architect, in writing, with the name, and trade for each Subcontractor and the names of all persons or entities proposed as manufacturers of products, materials and equipment identified in the Contract Documents and where applicable, the name of the installing contractor. The

Owner's Representative will reply to the Contractor in writing if the Owner has reasonable objection to any such proposed person or entity. The Contractor shall not contract with a proposed person or entity to whom the Owner has made reasonable and timely objection.

5.1.2 The Contractor may request to change a subcontractor. Any such request shall be made in writing to the Owner's Representative. The Contractor shall not change a Subcontractor, person, or entity previously disclosed if the Owner makes reasonable objection to such change.

5.1.3 The Contractor shall be responsible to the Owner for acts, defaults, and omissions of its Subcontractors of any tier.

5.2 Subcontractual Relations

5.2.1 By appropriate agreement, written where legally required for validity, the Contractor shall require each Subcontractor of any tier, to the extent of the Work to be performed by the Subcontractor of any tier, to be bound to the Contractor by terms of the Contract Documents and to assume toward the Contractor all the obligations and responsibilities which the Contractor, by these Documents, assumes toward the Owner and the Architect. Each subcontract agreement of any tier shall preserve and protect the rights of the Owner and the Architect under the Contract Documents with respect to the Work to be performed by the Subcontractor of any tier so that subcontracting thereof will not prejudice such rights and shall allow to the Subcontractor of any tier, unless specifically provided otherwise in the subcontract agreement, the benefit of all rights, remedies, and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with its sub-subcontractors. The Contractor shall make available to each proposed Subcontractor of any tier, prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor of any tier shall be bound Subcontractors of any tier shall similarly make copies of applicable portions of such documents available to their respective proposed Subcontractors of any tier.

5.2.2 All agreements between the Contractor and a Subcontractor or supplier shall contain provisions whereby Subcontractor or supplier waives all rights against the Owner, contractor, Owner's representative, Architect and all other additional insureds for all losses and damages caused by, arising out of, or resulting from any of the perils covered by property or builders risk insurance coverage required of the Contractor in the Contract Documents. If Contractor fails to include said provisions in all subcontracts, Contractor shall indemnify, defend and hold all the above entities harmless in the event of any legal action by Subcontractor or supplier. If insureds on any such policies require separate waiver forms to be signed by any Subcontractors of any tier or suppliers, Contractor shall obtain the same.

5.3 Contingent Assignment of Subcontract

5.3.1 No assignment by the Contractor of any amount or any part of the Contract or of the funds to be received thereunder will be recognized unless such assignment has had the written approval of the Owner, and the surety has been given due notice of such assignment and has furnished written consent hereto. 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 the contract and to claims and to 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 6
SEPARATE CONTRACTS AND COOPERATION

6.1 The Owner reserves the right to let other contracts in connection with the Work.

6.2 It shall be the duty of each Contractor to whom Work may be awarded, as well as all Subcontractors of any tier employed by them, to communicate immediately with each other in order to schedule Work, locate storage facilities, etc., in a manner that will permit all Contractors to work in harmony in order that Work may be completed in the manner and within the time specified in the Contract Documents.

6.3 No Contractor shall delay another Contractor by neglecting to perform his work at the proper time. Each Contractor shall be required to coordinate his work with other Contractors to afford others reasonable opportunity for execution of their work. Any costs caused by defective, non-compliant, or ill- timed work, including actual damages and liquidated damages for delay, if applicable, shall be borne by the Contractor responsible therefor.

6.4 Each Contractor shall be responsible for damage to Owner's or other Contractor's property done by him or persons in his employ, through his or their fault or negligence. If any Contractor shall cause damage to any other Contractor, the Contractor causing such damage shall upon notice of any claim, settle with such Contractor.

6.5 The Contractor shall not claim from the Owner money damages or extra compensation under this Contract when delayed in initiating or completing his performance hereunder, when the delay is caused by labor disputes, acts of God, or the failure of any other Contractor to complete his performance under any Contract with the Owner, where any such cause is beyond the Owner's reasonable control.

6.6 Progress schedule of the Contractor for the Work shall be submitted to other Contractors as necessary to permit coordinating their progress schedules.

6.7 If Contractors or Subcontractors of any tier refuse to cooperate with the instructions and reasonable requests of other contractors performing work for the Owner under separate contract, in the overall coordinating of the Work, the Owner's Representative may take such appropriate action and issue such instructions as in his judgement may be required to avoid unnecessary and unwarranted delay.

ARTICLE 7
CHANGES IN THE WORK

7.1 CHANGE ORDERS

7.1.1 A change order is a written instrument prepared by the Owner and signed by the Owner and Contractor formalizing their agreement on the following:

.1 a change in the Work

.2 the amount of an adjustment, if any, in the Contract amount

.3 an adjustment, if any, in the Contract time

7.1.2 The Owner may at any time, order additions, deletions, or revisions in the Work by a Change Order or a Construction Change Directive. Such Change Order or Construction Change Directive shall not invalidate the Contract and requires no notice to the surety. Upon receipt of any such document, or written authorization from the Owner's Representative directing the Contractor to proceed pending receipt of the document, Contractor shall promptly proceed with the Work involved in accordance with the terms set forth therein.

7.1.3 Until such time as the change order is formalized and signed by both the Owner and the Contractor it shall be considered a Change Order Request.

7.1.4 The amount of adjustment in the contract price for authorized Change Orders will be agreed upon before such Change Orders becomes effective and will be determined as follows:

.1 By a lump sum proposal from the Contractor and the Subcontractors of any tier, including overhead and profit.

.2 By a time and material basis with or without a specified maximum. The Contractor shall submit to the Owner's Representative itemized time and material sheets depicting labor, materials, equipment utilized in completing the Work on a daily basis for the Owner's Representative approval. If this pricing option is utilized, the Contractor may be required to submit weekly reports summarizing costs to date on time and material change orders not yet finalized.

.3 By unit prices contained in the Contractor's original bid and incorporated in the Construction Contract or subsequently agreed upon. Such unit prices contained in the Contractor's original proposal are understood to include the Contractor's overhead and profit. If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are so changed in a proposed Change Order that application of such unit prices to quantities of the Work proposed will cause substantial inequity to the Owner or to the Contractor, the applicable unit prices shall be equitably adjusted.

7.1.5 The Contractor shall submit all fully documented change order requests with corresponding back-up documentation within the time requested by the Owner but no later than fourteen (14) working days following 1.) the Owner's request for change order pricing in the case of a lump sum; or 2.) the completion of unit price or time and material work.

7.1.6 The Contractor shall submit change order requests in sufficient detail to allow evaluation by the Owner. Such requests shall be fully itemized by units of labor, material and equipment and overhead and profit. Such breakdowns shall be itemized as follows:

.1 Labor: The Contractor's proposal shall include breakdowns by labor, by trade, indicating number of hours and cost per hour for each Subcontractor as applicable. Such breakdowns shall only include employees in the direct employ of Contractor or Subcontractors in the performance of the Work. Such employees shall only include laborers at the site, mechanics, craftsmen and foremen. Payroll cost shall include base rate salaries and wages plus the cost of fringe benefits required by agreement or custom and social security contributions, unemployment, payroll taxes and workers' or workmen's compensation insurance and other customary and legally required taxes paid by the Contractor or Subcontractors. Any item or expense outside of these categories is not allowed. The expense of performing Work after regular working hours, on Saturdays, Sundays or legal holidays shall not be included in the above, unless approved in writing and in advance by Owner.

.2 Material, supplies, consumables and equipment to be incorporated into the Work at actual invoice cost to the Contractor or Subcontractors; breakdowns showing all material, installed equipment and consumables fully itemized with number of units installed and cost per unit extended. Any singular item or items in aggregate greater than one thousand dollars ($1,000) in cost shall be supported with supplier invoices at the request of the Owner's Representative. Normal hand tools are not compensable.

.3 Equipment: Breakdown for required equipment shall itemize (at a minimum) delivery / pick-up charge, hourly

rate and hours used. Operator hours and rate shall not be included in the equipment breakdown. Contractor must use the most cost-effective equipment available in the area and should not exceed the rates listed in the Rental Rate Blue Book for Construction Equipment (Blue Book). Contractor shall submit documentation for the Blue Book to support the rate being requested.

7.2 Construction Change Directive

7.2.1 A construction change directive is a written order prepared and signed by the Owner, issued with supporting documents prepared by the Architect (if applicable), directing a change in the Work prior to agreement on adjustment of the Contract amount or Contract time, or both. A Construction Change Directive shall be used in the absence of complete agreement between the Owner and Contractor on the terms of a change order. If the Construction Change Directive allows an adjustment of the contract amount or time, such adjustment amount shall be based on one of the following methods:

.1 A lump sum agreement, properly itemized and supported by substantiating documents of sufficient detail to allow evaluation.

.2 By unit prices contained in the Contractor's original proposal and incorporated in the Construction Contract or subsequently agreed upon.

.3 A method agreed to by both the Owner and the contractor with a mutually agreeable fee for overhead and profit.

.4 In the absence of an agreement between the Owner and the Contractor on the method of establishing an adjustment of the contract amount, the Owner, with the assistance of the architect, shall determine the adjustment amount on the basis of expenditures by the Contractor for labor, materials, equipment, and other costs consistent with other provisions of the Contract. The contractor shall keep and submit to the Owner an itemized accounting of all cost components, either expended or saved, while performing the Work covered under the Construction Change Directive.

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

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

7.3 Overhead and Profit

7.3.1 Overhead and Profit on Change Orders shall be applied as follows:

.1 The overhead and profit charged by the Contractor and Subcontractors shall be considered to include, but not limited to, job site office and clerical expense, normal hand tools, incidental job supervision, field supervision, payroll costs and other compensation for project manager, officers, executives, principals, general managers, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expediters, time-keepers, and other personnel employed whether at the site or in principal or a branch office for general superintendent and administration of the Work.

.2 The percentages for overhead and profit charged on Change Orders shall be negotiated and may vary according to the nature, extent, and complexity of the Work involved but in no case shall exceed the following:

15% To the Contractor or the Subcontractor of any tier for Work performed with their respective forces or materials purchased

5% To the Contractor on Work performed by other than his forces

5% To first tier Subcontractor on Work performed by his Subcontractor

.3 The Contractor will be allowed to add 2% for the cost of bonding and insurance to their cost of work. This 2% shall be allowed on the total cost of the added work, including overhead and profit.

.4 Not more than three mark-ups, not to exceed individual maximums shown above, shall be allowed regardless of the number of tier subcontractors. Overhead and profit shall be shown separately for each subcontractor of any tier and the Contractor.

.5 On proposals covering both increases and decreases in the amount of the Contract, the application of overhead and profit shall be on the net change in direct cost for the Contractor or Subcontractor of any tier performing the Work.

.6 The percentages for overhead and profit credit to the Owner on Change Orders that are strictly decreases in the quantity of work or materials shall be negotiated and may vary according to the nature, extent, and complexity of the Work involved, but shall not be less than the following:

Overhead and Profit

7.5% Credit to the Owner from the Contractor or Subcontractor of any tier for Work performed with their respective forces or materials purchased

2.5% Credit to the Owner from the Contractor on Work performed by other than his forces

2.5% Credit to the Owner from the first tier Subcontractor on Work performed by his Subcontractor of any tier

7.4 Extended General Conditions

7.4.1 The Contractor acknowledges that the percentage mark-up allowed on change orders for overhead and profit cover the Contractor's cost of administering and executing the Work, inclusive of change orders that increase the contract time. Contractor further acknowledges that no compensation beyond the specified mark-up percentages for extended overhead shall be due or payable as a result of an increase in the Contract Time.

7.4.2 The Owner may reimburse the Contractor for extended overhead if an extension of the Contract Time is granted by the Owner, in accordance with Article 4.7.1 and the Owner determines that the extension of the Contract Time creates an inequitable condition for the Contractor. If these conditions are determined by the Owner to exist, the Contractor may be reimbursed by unit prices contained in the Contractor's original bid and incorporated in the Construction Contract or by unit prices subsequently agreed upon.

7.4.3 If unit prices are subsequently agreed upon, the Contractor's compensation shall be limited as follows:

.1 For the portion of the direct payroll cost of the Contractor's project manager expended in completing the Work and the direct payroll cost of other onsite administrative staff not included in Article 7.3.1. Direct payroll cost shall include base rate salaries and wages plus the cost of fringe benefits required by agreement or custom and social security contributions, unemployment, payroll taxes and workers' or workmen's compensation insurance and other customary and legally required taxes paid by the Contractor;

.2 Cost of Contractor's temporary office, including temporary office utilities expense;

.3 Cost of temporary utilities required in the performance of the work;

.4 Profit not to exceed 5% of the total extended overhead direct costs;

7.4.4 All costs not falling into one of these categories and costs of the Contractors staff not employed onsite are not allowed.

7.5 Emergency Work

7.5.1 If, during the course of the Work, the Owner has need to engage the Contractor in emergency work, whether related to the Work or not, the Contractor shall immediately proceed with the emergency work as directed by the Owner under the applicable provisions of the contract. In so doing, Contractor agrees that all provisions of the contract remain in full force and effect and the schedule for the Work is not impacted in any way unless explicitly agreed to in writing by the Owner.

ARTICLE 8
TIME

8.1 Progress and Completion

8.1.1 Contractor acknowledges and agrees that time is of the essence of this Contract

8.1.2 Contract Time is the period of time set forth in the Contract for Construction required for Substantial Completion and Final Completion of the entire Work or portions of the Work as defined in the Contract Documents. Time limits stated in the Contract Documents are of the essence of the Contract. The Contract Time may only be changed by a Change Order. By executing the Contract, the Contractor confirms that the Contract Time is a sufficient period for performing the Work in its entirety.

8.1.3 The Contractor shall not knowingly, except by agreement or instruction of the Owner in writing, prematurely commence operations on the site or elsewhere prior to the effective date of insurance and bonds required by Article 11 to be furnished by the Contractor.

8.1.4 The Contractor shall proceed expeditiously and diligently with adequate forces and shall achieve Substantial Completion and Final Completion within the time specified in the Contract Documents.

8.2 Delay in Completion

8.2.1 The Contractor shall be liable for all of the Owner's damages for delay in achieving Substantial Completion and/or Final Completion of the entire Work or portions of Work as set forth in the Contract Documents within the Contract Time unless liquidated damages are specifically provided for in the Contract Documents. If liquidated damages are specifically provided for in the Contract for Construction, Contractor shall be liable for such liquidated damages as set forth in Paragraph 8.3

8.2.2 All time limits stated in the Contract are of the essence of the Contract. However, if the Contractor is delayed at any time in the progress of the Work by any act or neglect of the Owner or by the Owner's Representative, by changes ordered in the Work, Force Majeure including but not limited to war, armed conflict, riot, civil commotion or disorder, act of terrorism or sabotage; epidemic, pandemic, outbreaks of infectious disease or any other public health crisis, including quarantine or other employee restrictions, compliance with any law or governmental order, rule, regulation or direction, curfew restriction, act of God or natural disaster such as earthquake, volcanic activity, landslide, tidal wave, tsunami, flood, damage or destruction by lightning, drought; explosion, fire, destruction of machines, equipment, prolonged break-down of transport, telecommunication or electric current; general labor disturbance such as but not limited to boycott, strike and lock-out, occupation of factories and premises, or any other causes beyond the Contractor's reasonable control which the Owner's Representative determines may justify

delay then, upon submission of the Time Impact Schedule Analysis (TIA) justifying the delay called out in Section 4.7 of these General Conditions, the Contract Time may be extended for a reasonable time to the extent such delay will prevent Contractor from achieving Substantial Completion and/or Final Completion within the Contract Time and if performance of the Work is not, was not or would not have been delayed by any other cause for which the Contractor is not entitled to an extension of the Contract Time under the Contract Documents. It shall be a condition precedent to any adjustment of the Contract Time that Contractor provide the Owner's Representative with written notice of the cause of delay within seven (7) days from the occurrence of the event or condition which caused the claimed delay. If a Force Majeure is approved by the Owner as the basis for a delay claim, an adjustment in the contract time to the extent the Force Majeure impacts the schedule is the only remedy. No increase in the contract sum for any reason shall be allowed due to a Force Majeure.

8.2.3 The Contractor further acknowledges and agrees that adjustments in the Contract Time will be permitted for a delay only to the extent such delay (1) is not caused, or could not have been anticipated, by the Contractor, (2) could not be limited or avoided by the Contractor's timely notice to the Owner of the delay, (3) prevents Contractor from completing its Work by the Contract Time, and (4) is of a duration not less than one (1) day. Delays attributable to and within the control of a Subcontractor or supplier shall not justify an extension of the Contract Time.

8.2.4 Notwithstanding anything to the contrary in the Contract Documents, except as otherwise noted in these General Conditions, an extension in the Contract Time, to the extent permitted under this Article, shall be the sole remedy of the Contractor for any (1) delay in the commencement, prosecution or completion of the Work, (2) hindrance or obstruction in the performance of the Work, (3) loss of productivity, or (4) other claims due to or caused by any events beyond the control of both the Owner and Contractor defined herein as Force Majeure. In no event shall the Contractor be entitled to any compensation or recovery of any damages or any portion of damages resulting from delays caused by or within the control of Contractor or by acts or omissions of Contractor or its Subcontractors of any tier or delays beyond the control of both Owner and Contractor. If the Contractor contends that delay, hindrance, obstruction or other adverse condition results from acts or omissions of the Owner, the Owner's Representative or the Architect, Contractor shall provide written notice to the Owner within seven (7) calendar days of the event giving rise to such claim. Contractor shall only be entitled to an adjustment in the Contract Sum to the extent that such acts or omissions continue after the Contractor's written notice to the Owner of such acts or omissions, but in no case shall Force Majeure be the basis of an increase in the Contract sum. The Owner's exercise of any of its rights or remedies under the Contract Documents (including, without limitation, ordering changes in the Work, or directing suspension, rescheduling or correction of the Work) regardless of the extent or frequency of the Owner's exercise of such rights or remedies, shall not be the basis of any Claim for an increase in the Contract Sum or Contract Time. In the event Contractor is entitled to an adjustment in the Contract Sum for any delay, hindrance, obstruction or other adverse condition caused by the acts or omissions of the Owner, the Owner's Representative or the Architect, Contractor shall only be entitled to its actual direct costs caused thereby and Contractor shall not be entitled to and waives any right to special, indirect, or consequential damages including loss of profits, loss of savings or revenues, loss of anticipated profits, labor inefficiencies, idle equipment, home office overhead, and similar type of damages.

8.2.5 If the Contractor submits a progress report or any construction schedule indicating, or otherwise expressing an intention to achieve completion of the Work prior to any completion date required by the Contract Documents or expiration of the Contract Time, no liability of the Owner to the Contractor for any failure of the Contractor to so complete the Work shall be created or implied. Further, the Contractor acknowledges and agrees that even if Contractor intends or is able to complete the Work prior to the Contract Time, it shall assert no Claim and the Owner shall not be liable to Contractor for any failure of the Contractor, regardless of the cause of the failure, to complete the Work prior to the Contract Time.

8.3 Liquidated Damages

8.3.1 If Liquidated Damages are prescribed on the Bid Form and Special Conditions in the Contract Documents, the Owner may deduct from the Contract Sum and retain as Liquidated Damages, and not as penalty or forfeiture, the sum stipulated in the Contract Documents for each calendar day after the date specified for completion of the Work that the entire Work is not substantially complete and/or finally complete.

8.3.2 The Owner's Representative shall establish the date of Substantial completion and the date of Final Completion of the Work which shall be conclusive and binding on the Owner and Contractor for the purpose of determining whether or not Liquidated Damages shall be assessed under terms hereof and the sum total amount due.

8.3.3 Liquidated Damages or any matter related thereto shall not relieve the Contractor or his surety of any responsibility or obligation under this Contract.

ARTICLE 9
PAYMENTS AND COMPLETION

9.1 Commencement, Prosecution, and Completion

9.1.1 The Contractor shall commence Work within five (5) days upon the date of a "Notice to Proceed" from the Owner or the date fixed in the Notice to Proceed. Contractor shall prosecute the Work with faithfulness and diligence, and the

Contractor shall complete the Work within the Contract Time set forth in the Contract Documents.

9.1.2 The Owner will prepare and forward three (3) copies of the Contract and Performance Bond to the bidder to whom the contract for the Work is awarded and such bidder shall return two (2) properly executed prescribed copies of the Contract and Bond to the Owner.

9.1.3 The construction period, when specified in consecutive calendar days, shall begin when the Contractor receives notice requesting the instruments listed in below. Before the Owner will issue Notice to Proceed to permit the Contractor to begin Work, the Owner shall have received the following instruments, properly executed as described in the Contract Documents. The documents below shall have been received by the Owner within fifteen (15) days after receipt of request for documents:

.1 Contract
.2 Bond (See Article 11)
.3 Insurance (See Article 11)
.4 List of Subcontractors of any tier
.5 Affirmative Action Plan (see Article 13.4)

9.1.4 In the event Contractor fails to provide Owner such documents, Contractor may not enter upon the site of the Work until such documents are provided. The date the Contractor is required to commence and complete the Work shall not be affected by the Owner denying Contractor access to the site as a result of Contractor's failure to provide such documents and Contractor shall not be entitled to an adjustment of the Contract Time or Contract sum as a result of its failure to comply with the provisions of this Paragraph

9.1.5 Contracts executed by partnerships shall be signed by all general partners of the partnership. Contracts signed by corporations shall be signed by the President or Vice President and the Secretary or Assistant Secretary. In case the Assistant Secretary or Vice President signs, it shall be so indicated by writing the word "Asst." or "Vice" in front of the words "Secretary" and "President". The corporate seal of the corporation shall be affixed. For all other types of entities, the Contractor and the person signing the Contract on behalf of Contractor represent and warrant that the person signing the Contract has the legal authority to bind Contractor to the Contract.

9.1.6 Any successful bidder which is a corporation organized in a state other than Missouri or any bidder doing business in the State of Missouri under a fictitious name shall furnish, at no cost to the Owner, no later than the time at which the executed Contract for Construction, the Payment Bond, and the Performance Bond are returned, a properly certified copy of its current Certificate of Authority and License to do business in the State of Missouri. No contract will be executed by the Owner until such certificate is furnished by the bidder, unless there already is on file with the Owner a current certificate, in which event, no additional certificate will be required during the period of time for which such current certificate remains in effect.

9.1.7 Within fifteen (15) calendar days of the issuance of a Notice to Proceed, the Contractor shall submit one (1) signed copy of the following instruments. No payment will be processed until all of these instruments are received and approved by the Owner's Representative.

.1 Reproducible progress and payment schedule
.2 Contractor's Schedule of Values
.3 List of material suppliers
.4 Itemized breakdown of all labor rates for each classification. Overhead and profit shall not be included. Payroll cost shall include base rate salaries and wages plus the cost of fringe benefits required by agreement or custom and social security contributions, unemployment, payroll taxes and workers' or workmen's compensation insurance and other customary and legally required taxes paid by the Contractor or Subcontractors. Any item or expense outside of these categories is not allowed. The expense of performing Work after regular working hours, on Saturdays, Sundays or legal holidays shall not be included in the above, unless approved in writing and in advance by Owner.
.5 Itemized breakdown of anticipated equipment rates (breakout operator rate). Overhead and profit shall not be included. Breakdown for required equipment shall itemize (at a minimum) delivery/ pick-up charge, hourly rate and hours used. Operator hours and rate shall not be included in the equipment breakdown. Contractor must use the most cost-effective equipment available in the area and should not exceed the rates listed in the Rental Rate Blue Book for Construction Equipment (Blue Book). Contractor shall submit documentation for the Blue Book to support the rate being requested.

9.1.8 The Contractor shall be paid electronically using the Owner's web-based payment program with a direct electronic transfer from the Owner's account into the Contractor's account. The Contractor must submit the following information to the Owner's Representative:

.1 Bank Transit Number for the Contractor's bank into which the electronic deposit will be made.
.2 Bank Account Number for the Contractor's account into which the electronic deposit will be made.
.3 Contractor's E-Mail address so that formal notification of the deposit by the Owner can be provided.

9.2 Contract Sum

9.2.1 The Owner shall compensate Contractor for all Work described herein, and in the Contract Documents the Contract

Sum set forth in the Contract for Construction, subject to additions and deletions as provided hereunder.

9.3 Schedule of Values

9.3.1 Within fifteen (15) days after receipt of the Notice to Proceed, the Contractor shall submit to the Owner's Representative a schedule of values allocated to various portions of the Work, prepared in such form and supported by such data to substantiate its accuracy as the Owner's Representative may require. This schedule, unless objected to by the Owner's Representative, shall be used as a basis for reviewing the Contractor's Applications for Payment. The values set forth in such schedule may, at the Owner's option be used in any manner as fixing a basis for additions to or deletions from the Contract Sum.

9.3.2 The progress and payment schedule of values shall show the following:

.1 Enough detail as necessary to adequately evaluate the actual percent complete of any line item on a monthly basis, as determined by the Owner's Representative.

.2 Line items, when being performed by a subcontractor or material supplier, shall correlate directly back to the subcontract or purchase order amount if requested by the Owner's Representative.

9.4 Applications for Payment

9.4.1 The Contractor shall submit monthly to the Owner's Representative and the Architect an itemized Application for Payment for operations completed in accordance with the Schedule of Values. Such application shall be supported by such data substantiating the Contractor's right to payment as the Owner's Representative or Architect may require, such as copies of requisitions from Subcontractors and material suppliers, and reflecting retainage as provided for herein.

9.4.2 Such applications shall not include requests for payment of amounts the Contractor does not intend to pay to a Subcontractor or material supplier

9.4.3 Progress payments shall be made on account of materials and equipment delivered to the site and incorporated in the Work. No payments will be made for materials and equipment stored at the Project site but not yet incorporated into the Work except as provided in Paragraph 9.4.4.

9.4.4 If approved in writing and in advance by Owner, progress payments may be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. Owner may in its sole discretion refuse to grant approval for payments for materials and equipment stored at the Project site but not yet incorporated in the Work. Any approval by Owner for payment for materials and equipment delivered and suitably stored at the site, or stored offsite as noted below, for subsequent incorporation in the Work shall be conditioned upon Contractor's demonstrating that such materials and equipment are adequately protected from weather, damage, vandalism and theft and that such materials and equipment have been inventoried and stored in accordance with procedures established by or approved by the Owner. Nothing in this clause shall imply or create any liability on the part of the Owner for the Contractor's inventory and storage procedures or for any loss or damage to material, equipment or supplies stored on the site, whether incorporated into the work or not. In the event any such loss or damage occurs, the Contractor remains solely responsible for all costs associated with replacement of the affected materials, supplies and equipment including labor and incidental costs, and shall have no claim against the Owner for such loss.

No allowance shall be made in the project pay requests for materials not delivered to the site of the work and incorporated into the work, except as noted below. For the purposes of this Article, Offsite is defined as any location not owned or leased by the Owner. Contractor shall submit a list of materials that they are requesting payment for offsite storage within 60 days of Notice to Proceed.

.1 Items considered to be major items of considerable magnitude, if suitably stored, may be allowed in project pay requests on the basis of ninety percent (90%) of invoices

.2 Determination of acceptable "major items of considerable magnitude" and "suitably stored" shall be made by the Owner's Representative.

.3 Aggregate quantities of materials not considered unique to this project will not be considered for offsite storage payment.

.4 Contractor shall submit to the Owner's Representative a list of the material for which application for payment for offsite storage is anticipated no less than forty-five days prior to the submission of the applicable pay request. The list shall include a material description, applicable division, quantity, and discounts offered to the Owner for early payment. Contractor shall also submit the location the material will be stored and the method of protection

.5 The storage facility shall be subject to approval by the Owner's representative, shall be located within an acceptable distance of the project sites as established by the Owner's Representative and all materials for the Owner's project must be stored separately from all other items within the storage facility and shall be labeled and stored in the name of The Curators of the University of Missouri.

.6 The Owner's representative shall be provided a minimum of two weeks' notice to visit the storage facility and inspect the stored material prior to submission of the pay request.

.7 Upon favorable inspection by the Owner's Representative, the Contractor shall, at the Owner's option, submit a Bill of Sale and Bailment Agreement on forms provided by the Owner's

Representative, transferring title of the material or equipment to The Curators of the University of Missouri.

.8 An invoice provided by the supplier shall be included with the applicable pay request.

.9 The contractor shall remain fully responsible for all items, until acceptance of the project by the Owner.

.10 The contractor shall reimburse all costs incurred by the Owner in inspecting and verifying all material stored offsite, including mileage, airfare, meals, lodging and time, charged at a reasonable hourly rate.

.11 The Contractor shall furnish and maintain insurance covering the replacement cost of the material stored offsite against all losses and shall furnish proof of coverage with the application for payment for material stored offsite.

.12 The Contractor is responsible for all costs related to storage and handling of material stored offsite unless otherwise directed by the Owner's Representative.

9.4.5 The Application for Payment shall constitute a representation by the Contractor to the Owner that the Work has progressed to the point indicated; the quality of the Work covered by the Application for Payment is in accordance with the Contract Documents; and the Contractor is entitled to payment in the amount requested.

9.4.6 The Contractor will be reimbursed for ninety-five percent (95%) of the value of all labor furnished and material installed and computed in the same manner, less all previous payments made. On projects where a bond is not required, the contractor will be reimbursed for ninety percent (90%) of the value of all labor furnished and material installed and computed in the same manner, less all previous payments made

9.5 Approval for Payment

9.5.1 The Owner's Representative will, within fifteen (15) days after receipt of the Contractor's Application for Payment, either approve Contractor's Application for Payment for such amount as the Owner's Representative determines is properly due or notify the Contractor of the Owner's Representative's reasons for withholding certification in whole or in part as provided in Section 9.6.

9.6 Decisions to Withhold Approval

9.6.1 The Owner's Representative may decide not to certify payment and may withhold approval in whole or in part, to the extent reasonably necessary to protect the Owner. If the Owner's Representative is unable to approve payment in the amount of the Application, the Owner's Representative will notify the Contractor as provided in Paragraph 9.5.1. If the Contractor and Owner's Representative cannot agree on a revised amount, the Owner's Representative will promptly issue approval for payment for the amount for which the Owner's Representative is able to determine is due Contractor. The Owner's Representative may also decide not to approve payment or, because of subsequently discovered evidence or subsequent observations, may nullify the whole or a part of approval for payment previously issued, to such extent as may be necessary in the Owner's Representative opinion to protect the Owner from loss because of:

.1 defective or non-compliant Work not remedied, or damage to completed Work;

.2 failure to supply sufficient skilled workers or suitable materials;

.3 third party claims filed or reasonable evidence indicating probable filing of such claims;

.4 failure of the Contractor to make payments properly to Subcontractors or for labor, materials or equipment, Owner may, at its sole option issue joint checks to subcontractors who have presented evidence that it has not been paid in accordance with the Contract;

.5 reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;

.6 damage to the Owner or another contractor;

.7 reasonable evidence that the Work will not be completed within the Contract Time or an unsatisfactory rate of progress made by Contractor;

.8 Contractor's failure to comply with applicable Laws;

.9 Contractor's or Subcontractor's failure to comply with contract Prevailing Wage requirements; or

.10 Contractor's failure to carry out the Work in strict accordance with the Contract Documents.

9.6.2 When the above reasons for withholding approval are removed, approval will be made for amounts previously withheld.

9.7 Progress Payments

9.7.1 Based upon Applications for Payment submitted to the Owner by the Contractor and approvals issued by the Owner's Representative, the Owner shall make progress payments on account of the Contract Sum to the Contractor as provided below and elsewhere in the Contract Documents.

9.7.2 The period covered by each Application for Payment shall be one (1) calendar month.

9.7.3 The Owner shall make payment to Contractor for amounts due and approved by Owner's Representative not later than thirty (30) days after the Owner approves a properly detailed Application for Payment which is in compliance with the Contract Documents. The Owner shall not have the obligation to process or pay such Application for Payment until it receives an Application for Payment satisfying such requirements.

9.7.4 Based on the Schedule of Values submitted by Contractor, Applications for Payment submitted by Contractor

shall indicate the actual percentage of completion of each portion of Contractor's Work as of the end of the period covered by the Application for Payment.

9.7.5 The Contractor shall promptly pay each Subcontractor and Supplier, upon receipt of payment from the Owner, out of the amount paid to the Contractor on account of such Subcontractor's or supplier's portion of the Work, the amount to which said Subcontractor or supplier is entitled, reflecting percentages actually retained from payments to the Contractor on account of each Subcontractor's or supplier's portion of the Work, in full compliance with state statute. The Contractor shall, by appropriate agreement with each Subcontractor or supplier, require each Subcontractor or supplier to make payments to Sub-subcontractors in similar manner.

9.7.6 Neither the Owner nor Architect shall have an obligation to pay or to see to the payment of money to a Subcontractor of any tier nor a laborer or employee of Contractor except to the extent required by law. Retainage provided for by the Contract Documents are to be retained and held for the sole protection of Owner, and no other person, firm or corporation shall have any claim or right whatsoever thereto.

9.7.7 An approval for payment by Owner's Representative, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

9.8 Failure of Payment

9.8.1 If the Owner is entitled to reimbursement or payment from the Contractor under or pursuant to the Contract Documents, such payment by Contractor shall be made promptly upon demand by the Owner. Notwithstanding anything contained in the Contract Documents to the contrary, if the Contractor fails to promptly make any payment due the Owner, or the Owner incurs any costs and expenses to cure any default of the Contractor or to correct defective Work, the Owner shall have an absolute right to offset such amount against the Contract Sum and may, in the Owner's sole discretion, elect either to: (1) deduct an amount equal to that to which the Owner is entitled from any payment then or thereafter due the Contractor from the Owner, or (2) issue a written notice to the Contractor reducing the Contract Sum by an amount equal to that to which the Owner is entitled.

9.9 Substantial Completion

9.9.1 Substantial Completion is the stage in the progress of the Work as defined in Paragraph 1.1.14 as certified by the Owner.

9.9.2 When the Contractor considers the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall notify the Owner and the Architect. The Owner's Representative will make an inspection to determine whether the Work or designated portion thereof is substantially complete. If the Owner's Representative's inspection discloses any item which is not in accordance with the requirements of the Contract Documents, the Contractor shall complete or correct such item upon notification by the Owner's Representative. The Contractor shall then submit a request for another inspection by the Owner's Representative to determine Substantial Completion. When the Work or designated portion thereof is substantially complete, the Owner will issue a Certificate of Substantial Completion. Substantial Completion shall transfer from the Contractor to the Owner responsibilities for security, maintenance, heat, utilities, damage to the Work and insurance. In no event shall Contractor have more than thirty (30) days to complete all items on the Punch List and achieve Final Completion. Warranties required by the Contract Documents shall commence on the date of Substantial Completion or as agreed otherwise.

9.9.3 At the date of Substantial Completion, the Contractor may apply for, and if approved by Owner's Representative, the Owner, subject to the provisions herein, shall increase total payments to one hundred percent (100%) of the Contract Sum less one hundred fifty percent (150%) of the value of any incomplete Work and unsettled claims, as determined by the Owner's Representative.

9.10 Partial Occupancy or Use

9.10.1 The Owner may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage, security, maintenance, heat, utilities, damage to the Work and insurance. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld. The stage of the progress of the Work shall be determined by the Owner's Representative.

9.10.2 Immediately before such partial occupancy or use, the Owner, and Contractor shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work. Unless otherwise agreed upon, partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

9.11 Final Completion and Final Payment

9.11.1 Upon receipt of written notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Owner's Representative and the Architect will promptly make such inspection and, when the Owner's Representative and Architect find the Work acceptable under the Contract Documents and the Contract fully performed, the Owner's Representative will promptly issue a final approval for payment; otherwise, Owner's

Representative will return Contractor's Final Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application. Submission of a Final Application for Payment shall constitute a further representation that conditions listed in Paragraph 9.11.2 as precedent to the Contractor's being entitled to final payment have been fulfilled. All warranties and guarantees required under or pursuant to the Contract Documents shall be assembled and delivered by the Contractor to the Owner's Representative as part of the final Application for Payment. The final approval for payment will not be issued by the Owner's Representative until all warranties and guarantees have been received and accepted by the Owner.

9.11.2 The Owner will request the Contractor to submit the application for final payment along with a manually signed notarized letter on the Contractor's letterhead certifying that:

.1 Labor costs, prevailing wage rates, fringe benefits and material costs have been paid.

.2 Subcontractors of any tier and manufacturers furnishing materials and labor for the project have fully completed their Work and have been paid in full.

.3 The project has been fully completed in accordance with the Contract Documents as modified by Change Orders.

.4 The acceptance by Contractor of its Final Payment, by check or electronic transfer, shall be and operate as a release of all claims of Contractor against Owner for all things done or furnished or relating to the Work and for every act or alleged neglect of Owner arising out of the Work.

9.11.3 Final Payment constituting the entire unpaid balance due shall be paid by the Owner to the Contractor within thirty (30) days after Owner's receipt of Contractor's Final Application for Payment which satisfies all the requirements of the Contract Documents and Owner's receipt of all information and documents set forth in Section 9.11.

9.11.4 No payment under this Contract, including but not limited to final payment, shall constitute acceptance by Owner of any Work or act not in accordance with the requirements of the Contract Documents.

9.11.5 No recourse shall be had against any member of the Board of Curators, or officer thereof, for any payment under the Contract or any claim based thereon.

ARTICLE 10
PROTECTION OF PERSONS AND PROPERTY

10.1 Safety Precautions and Programs

10.1.1 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.

10.1.2 All contractors, subcontractors and workers on this project are subject to the Construction Safety Training provisions 292.675 RSMo.

10.1.3 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.

10.2 Safety Of Persons and Property

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

.1 students, faculty, staff, the public, construction personnel, and other persons who may be affected thereby;

.2 the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody, or control of the Contractor or the Contractor's Subcontractors of any tier; and

.3 other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction.

10.2.2 The Contractor shall 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.

10.2.3 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.

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

10.2.5 The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in Article 10 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 Article 10, 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.

10.2.6 The Contractor shall designate a responsible member of the Contractor's organization at the site whose duty shall be the prevention of accidents, 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.

10.2.7 The Contractor shall not load or permit any part of the construction or site to be loaded so as to endanger its safety.

10.2.8 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.

10.2.9 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.

ARTICLE 11
INSURANCE & BONDS

11.1 Insurance

11.1.1 Contractor shall secure from the date of the Contract for Construction and maintain for such periods of time as set forth below, insurance of such types and in such amounts specified below, to protect Contractor, Owner and others against all hazards or risks of loss described below. The form of such insurance together with carriers thereof, in each case, shall be approved by Owner, but, regardless of such approval, it shall be the responsibility of Contractor to maintain the insurance coverages set forth herein.

11.1.2 The contractor shall not be allowed on the Owners property without proof of the insurance coverages set forth herein

11.2 Commercial General Liability

11.2.1 Contractor shall secure and maintain from the date of the Contract and for a period of at least five (5) years from the date of Final Completion of the entire Work Commercial General Liability insurance ("CGL") with a combined single limit of not less than $2,000,000 per occurrence, $5,000,000 general aggregate, $5,000,000 products and completed operations aggregate and $1,000,000 personal injury and advertising injury. General Aggregate should apply per project. An umbrella policy may be used to satisfy these limits. If the General Aggregate is not on a per project basis, the contractor shall provide an additional $2,000,000 general aggregate.

11.2.2 CGL insurance shall be written on a comprehensive form and shall cover claims and liability in connection with or resulting from the Contractor's operations and activities under the Contract, for personal injuries, occupational sickness, disease, death or damage to property of others, including loss of use resulting therefrom, arising out of any operations or activities of the Contractor, its agents, or any Subcontractors of any tier or by anyone directly or indirectly employed by either of them.

11.2.3 CGL insurance shall include premises, operations, independent contractors, products-completed operations, personal injury and advertising injury and liability assumed under an insured contract (including the tort liability of another assumed in a business contract) coverages. In particular, and not by way of any limitation, the CGL

insurance shall cover the Contractor's indemnity obligations contained in the Contract Documents.

11.2.4 There shall be no endorsement or modification of the CGL policy limiting the scope of coverage for liability arising from blasting, explosion, collapse, or underground property damage.

11.2.5 "The officers, employees, and agents of The Curators of the University of Missouri" shall be endorsed as an "additional insured" under the CGL policy. The additional insured status must be conveyed by using the ISO CG 2 10 (2004) edition or equivalent and the ISO CG 20 37 (2004) edition. The policy shall be endorsed to be primary coverage and any other insurance carried by the Owner shall be excess only and will not contribute with Contractors' insurance. To confirm, the Endorsement should accompany the insurance certificate.

11.2.6 Contractor waives all rights against Owner and its agents, officers, representatives, and employees for recovery of damages to the extent those damages are covered by the CGL policy required hereunder.

11.3 Licensed for Use Vehicle Liability

11.3.1 Contractor shall secure and maintain from the date of the Contract for Construction until the date of Final Completion of the entire Work, insurance, to be on comprehensive form, which shall protect Contractor against any and all claims for all injuries and all damage to property arising from the use of automobiles, trucks and motorized vehicles, in connection with the performance of Work under this Contract, and shall cover the operation on or off the site of the Work of all motor vehicles licensed for highway use whether they are owned, non-owned or hired. Such insurance shall include contractual liability coverage and shall provide coverage on the basis of the date of any accident. The liability limits under such policy shall not be less than $2,000,000 combined single limit for bodily injury and property damage per accident.

11.3.2 Contractor waives all rights against Owner and its agents, officers, directors, and employees for recovery of damages to the extent such damages are covered by the automobile liability insurance required hereunder.

11.4 Workers' Compensation Insurance

11.4.1 Contractor shall purchase and maintain workers' compensation insurance and employers' liability insurance which shall protect Contractor from claims for injury, sickness, disease or death of Contractor's employees or statutory employees. The insurance policies required hereunder shall include an "all states" or "other states" endorsement. In case any Work is sublet, Contractor shall require any Subcontractor of any tier to provide the insurance coverages required under this Section 11.4.

11.4.2 Contractor's workers' compensation insurance coverage shall be in compliance with all applicable Laws, including the statutes of the State of Missouri. Contractor's employers' liability coverage limits shall not be less than $1,000,000 each accident for bodily injury by accident or $1,000,000 each employee for bodily injury by disease.

11.5 Liability Insurance General/Other Requirements

11.5.1 Any Consultant/Contractor providing professional design services as part of the contract shall be required to provide and maintain, from the date of this Contract and for a period of ten (10) years after the date of Final Completion, Professional Liability insurance to cover any claims, including but not limited to errors, omissions, and negligence, which may arise from the Design and related Services performed by the Consultant. The minimum limits for such Policy shall be $1,000,000.00 per occurrence/$1,000,000.00 aggregate. The insurance afforded by the policy shall meet the requirements of this Section 11.2 and Section 11.5 relating to CGL Policies, and without limiting the foregoing, shall be extended to cover the liability of "The officers, employees, and agents of The Curators of the University of Missouri", who shall be named as additional insureds therein, and this liability is assumed in writing by the Contractor's Consultant under the written Subcontract described herein. All insurance coverages procured by Contractor shall be provided by agencies and insurance companies acceptable to and approved by Owner. Any insurance coverage shall be provided by insurance companies that are duly licensed to conduct business in the State of Missouri as an admitted carrier. The form and content of all insurance coverage provided by Contractor are subject to the approval of Owner. All required insurance coverages shall be obtained and paid for by Contractor. Any approval of the form, content or insurance company by Owner shall not relieve the Contractor from the obligation to provide the coverages required herein.

11.5.2 All insurance coverage procured by the Contractor shall be provided by insurance companies having policyholder ratings no lower than "A-" and financial ratings not lower than "XI" in the Best's Insurance Guide, latest edition in effect as of the date of the Contract, and subsequently in effect at the time of renewal of any policies required by the Contract Documents. Insurance coverages required hereunder shall not be subject to a deductible amount on a per-claim basis of more than $10,000.00 and shall not be subject to a per-occurrence deductible of more than $25,000.00. Insurance procured by Contractor covering the additional insureds shall be primary insurance and any insurance maintained by Owner shall be excess insurance.

11.5.3 All insurance required hereunder shall provide that the insurer's cost of providing the insureds a defense and appeal, including attorneys' fees, shall be supplementary and shall not be included as part of the policy limits but shall remain the insurer's separate responsibility. Contractor shall cause its insurance carriers to waive all rights of subrogation,

except for Workers' Compensation, against the Owner and its officers, employees and agents.

11.5.4 The Contractor shall furnish the Owner with certificates, Additional Insured endorsements, policies, or binders which indicate the Contractor and/or the Owner and other Contractors (where required) are covered by the required insurance showing type, amount, class of operations covered, effective dates and dates of expiration of policies prior to commencement of the work. Contractor is required to maintain coverages as stated and required to notify the University of a Carrier Change or cancellation within 2 business days. The University reserves the right to request a copy of the policy. Contractor fails to provide, procure, and deliver acceptable policies of insurance or satisfactory certificates or other evidence thereof, the Owner may obtain such insurance at the cost and expense of the Contractor without notice to the Contractor.

11.5.5 With respect to all insurance coverages required to remain in force and affect after final payment, Contractor shall provide Owner additional certificates, policies and binders evidencing continuation of such insurance coverages along with Contractor's application for final payment and shall provide certificates, policies and binders thereafter as requested by Owner.

11.5.6 The maintenance in full current force and effect of such forms and amounts of insurance and bonds required by the Contract Documents shall be a condition precedent to Contractor's exercise or enforcement of any rights under the Contract Documents.

11.5.7 Failure of Owner to demand certificates, policies and binders evidencing insurance coverages required by the Contract Documents, approval by Owner of such certificates, policies and binders or failure of Owner to identify a deficiency from evidence that is provided by Contractor shall not be construed as a waiver of Contractor's obligations to maintain the insurance required by the Contract Documents.

11.5.8 The Owner shall have the right to terminate the Contract if Contractor fails to maintain the insurance required by the Contract Documents.

11.5.9 If Contractor fails to maintain the insurance required by the Contract Document, Owner shall have the right, but not the obligation, to purchase said insurance at Contractor's expense. If Owner is damaged by Contractor's failure to maintain the insurance required by the Contract Documents, Contractor shall bear all reasonable costs properly attributable to such failure.

11.5.10 By requiring the insurance set forth herein and in the Contract Documents, Owner does not represent or warrant that coverage and limits will necessarily be adequate to protect Contractor, and such coverages and limits shall not be deemed as a limitation on Contractor's liability under the indemnities granted to Owner in the Contract Documents.

11.5.11 If Contractor's liability policies do not contain a standard separation of insureds provision, such policies shall be endorsed to provide cross-liability coverage.

11.5.12 If a part of the Work hereunder is to be subcontracted, the Contractor shall: (1) cover any and all Subcontractors in its insurance policies; (2) require each Subcontractor to secure insurance which will protect said Subcontractor and supplier against all applicable hazards or risks of loss designated in accordance with Article 11 hereunder; and (3) require each Subcontractor or supplier to assist in every manner possible in the reporting and investigation of any accident, and upon request, to cooperate with any insurance carrier in the handling of any claim by securing and giving evidence and obtaining the attendance of witnesses as required by any claim or suit.

11.5.13 It is understood and agreed that the insurance coverages required by the provisions of this Article 11 are required in the public interest and that the Owner does not assume any liability for acts of Contractor or Subcontractors of any tier or their employees in the performance of the Contract or Work.

11.6 Builder's Risk Insurance

11.6.1 The Contractor shall purchase and maintain, in a company or companies lawfully authorized to do business in the State of Missouri, as an admitted carrier, builder's risk insurance on the entire Work. Such insurance shall be written on a completed value form for the entire Work. The insurance shall apply on a replacement cost basis.

11.6.2 The insurance as required herein shall name as insureds the Owner, Contractor, and all Subcontractors of any tier. The insurance policy shall contain a provision that the insurance will not be canceled, allowed to expire or materially changed until at least thirty (30) days prior written notice has been given to Owner.

11.6.3 The insurance as required herein shall cover the entire Work, including reasonable compensation for Architect's services and expenses made necessary by an insured loss. Insured property shall include portions of the Work located away from the site (including all offsite stored materials) but intended for use at the site and shall also cover portions of the Work in transit, including ocean transit. The policy shall include as insured property scaffolding, falsework, and temporary buildings located at the site. The policy shall cover the cost of removing debris, including demolition as may be made legally necessary by the operation of any law, ordinance, or regulation.

11.6.4 The insurance required herein shall be on an all risk form and shall be written to cover all risks of physical loss or damage to the insured party and shall insure at least against the perils of fire and extended coverage, theft, vandalism,

malicious mischief, collapse, lightening, earthquake, flood, frost, water damage, windstorm and freezing.

11.6.5 If there are any deductibles applicable to the insurance required herein, Contractor shall pay any part of any loss not covered because of the operation of such deductibles.

11.6.6 The insurance as required herein shall be maintained in effect until the earliest of the following dates:

.1 the date which all persons and organization who are insureds under the policy agree in writing that it shall be terminated;

.2 the date on which final payment of this Contract has been made by Owner to Contractor; or

.3 the date on which the insurable interests in the property of all insureds other than the Owner have ceased.

11.6.7 The Owner and Contractor waive all rights against (1) each other and any of their subcontractors of any tier, suppliers, agents and employees, each of the other, (2) the Architect and Architect's consultants, and (3) separate contractors described in Article 6, if any, and any of their subcontractors of any tier, suppliers, agents and employees, for damages caused by fire or other perils to the extent covered by property insurance obtained pursuant to this Section 11.7 or other insurance applicable to the Work, except such rights as they have to proceeds of such insurance. The Owner or Contractor, as appropriate, shall require of the Architect, Architect's consultants, separate contractors described in Article 6, if any, and the subcontractors of any tier, suppliers, agents, and employees of any of them, by appropriate agreements, written where legally required for validity, similar waivers each in favor of other parties enumerated herein. The policies shall provide such waivers of subrogation by endorsement or otherwise. A waiver of subrogation shall be effective as to a person or entity even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, did not pay the insurance premium directly or indirectly, was at fault or was negligent in causing the loss and whether or not the person or entity had an interest in the property damaged.

11.6.8 A loss insured under Contractor's property insurance shall be adjusted by the Owner in good faith and made payable to the Owner for the insureds, subject to requirements of the Contract Documents. The Contractor shall pay Subcontractors of any tier their just shares of insurance proceeds received by the Contractor, and by appropriate agreements, written where legally required for validity, shall require Subcontractors of any tier to make payments to their Sub-subcontractors in similar manner.

11.7 Bonds

11.7.1 When the Contract sum exceeds Fifty Thousand Dollars ($50,000), the Contractor shall procure and furnish a Performance Bond and a Payment Bond in the form prepared by the Owner, each in an amount equal to one hundred percent (100%) of the Contract Sum, as well as adjustments to the Contract Sum. The Performance Bond shall secure and guarantee Contractor's faithful performance of this Contract, including but not limited to Contractor's obligation to correct defects after final payment has been made as required by the Contract Documents. The Payment Bond shall secure and guarantee payment of all persons performing labor on the Project under this Contract and furnishing materials in connection with this Contract. These Bonds shall be in effect through the duration of the Contract plus the Guaranty Period as required by the Contract Documents.

11.7.2 The bonds required hereunder shall be executed by a responsible surety licensed in the State of Missouri, with a Best's rating of no less than A-/XI. The Contractor shall require the attorney in fact who executes the required bonds on behalf of the surety to affix thereto a certified and current copy of this power of attorney indicating the monetary limit of such power.

11.7.3 If the surety of any bond furnished by Contractor is declared bankrupt or becomes insolvent or its right to conduct business in the State of Missouri is terminated, or it ceases to meet the requirements of this paragraph, Contractor shall within ten (10) days substitute another bond and surety, both of which must be acceptable to Owner. If Contractor fails to make such substitution, Owner may procure such required bonds on behalf of Contractor at Contractor's expense.

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

11.7.5 The Contractor shall keep the surety informed of the progress of the Work, and, where necessary, obtain the surety's consent to or waiver of: (1) notice of changes in the Work; (2) request for reduction or release of retention; (3) request for final payment; and (4) any other material required by the surety. The Owner shall be notified by the Contractor, in writing, of all communications with the surety, as it relates to items one through four. The Owner may, in the Owner's sole discretion, inform surety of the progress of the Work, any defects in the Work, or any defaults of Contractor under the Contract Documents and obtain consents as necessary to protect the Owner's rights, interest, privileges and benefits under and pursuant to any bond issued in connection with the Work.

11.7.6 Contractor shall indemnify and hold harmless the Owner and any agents, employees, representative or member of the Board of Curators from and against any claims, expenses, losses, costs, including reasonable attorneys' fees, as a result of any failure of Contractor to procure the bonds required herein.

ARTICLE 12
UNCOVERING AND CORRECTION OF THE WORK

12.1 Uncovering of the Work

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

12.1.2 If a portion of the Work has been covered which the Architect or the Owner's Representative has not specifically requested to observe, prior to its being covered, the Architect or the Owner's Representative may request to see such Work, and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, costs of uncovering and replacement shall, by appropriate Change Order, be charged to the Owner. If such Work is not in accordance with the Contract Documents, the Contractor shall pay such costs unless the condition was caused by the Owner or a separate contractor in which event the Owner will be responsible for payment of such costs.

12.2 Correction of the Work

12.2.1 The Architect or Owner's Representative shall have the right to reject Work not in strict compliance with the requirements of the Contract Documents. The Contractor shall promptly correct Work rejected by the Architect or the Owner's Representative for failing to conform to the requirements of the Contract Documents, whether observed before or after final completion and whether or not fabricated, installed, or completed. If Work has been rejected by Architect or Owner's Representative, the Architect or Owner's Representative shall have the right to require the Contractor to remove it from the Project site and replace it with Work that strictly conforms to the requirements of the Contract Documents regardless, if such removal and replacement results in "economic waste." Contractor shall pay all claims, costs, losses and damages caused by or resulting from the correction, removal or replacement of defective, or non-compliant Work, including but not limited to, all costs of repair or replacement of Work of others. The Contractor shall bear costs of correcting, removing and replacing such rejected Work, including additional testing and inspections and compensation for the Architect's services and expenses made necessary thereby. If prior to the date of final payment, the Contractor, a Subcontractor, or anyone for whom either is responsible uses or damages any portion of the Work, including, without limitation, mechanical, electrical, plumbing, and other building systems, machinery, equipment or other mechanical device, the Contractor shall cause such item to be restored to "like new" condition at no expense to the Owner.

12.2.2 If, within twelve (12) months after the date of Final Completion of the Work or designated portion thereof, or after the date for commencement of warranties, or by terms of an applicable special warranty required by the Contract Documents, any of the Work is found not to be in strict accordance with the requirements of the Contract Documents, the Contractor shall correct or remove and replace such defective Work, at the Owner's discretion. Such twelve (12) month period is referred to as the "Guarantee Period." The obligations under this Paragraph 12.2.2 shall cover any repairs, removal, and replacement to any part of the Work or other property caused by the defective Work.

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

12.2.4 If the Contractor fails to correct nonconforming Work within a reasonable time, the Owner may correct or remove it and replace such nonconforming Work. If the Contractor does not proceed with correction of such nonconforming Work within a reasonable time fixed by written notice from the Owner, the Owner may take action to correct or remove the nonconforming work at the contractor's expense.

12.2.5 The Contractor shall bear the cost of correcting destroyed or damaged Work or property, whether completed or partially completed, of the Owner or of others caused by the Contractor's correction or removal of Work which is not in accordance with the requirements of the Contract Documents.

12.2.6 Nothing contained in Article 12 shall be construed to establish a period of limitation with respect to other obligations that the Contractor might have under the Contract Documents. Establishment of the twelve (12) month Guarantee Period as described in Article 12 relates only to the specific obligation of the Contractor to correct, remove or replace the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations under the Contract Documents. The requirements of Article 12 are in addition to and not in limitation of any of the other requirements of the Contract for warranties or conformance of the Work to the requirements of the Contract Documents.

12.3 Acceptance of Nonconforming Work

12.3.1 The Owner may accept Work which is not in accordance with the Contract Documents, instead of requiring its removal and correction, in its sole discretion. In Such case the Contract Sum will be adjusted as appropriate and equitable. Such adjustment shall be made whether or not final payment has been made. Nothing contained herein shall impose any obligation upon the Owner to accept nonconforming or defective Work.

ARTICLE 13
MISCELLANEOUS PROVISIONS

13.1 Written Notice

13.1.1 All notices required to be given by the contractor under the terms of this Contract shall be made in writing. Written notice when served by the Owner will be deemed to have been duly served if delivered in person to the individual or a member of the firm or entity or to an office of the corporation for which it was intended, or if delivered at or sent to the last business address known to the party giving notice.

13.2 Rights and Remedies

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

13.2.2 No action or failure to act by the Owner, the Architect, or the Owner's Representative will constitute a waiver of a right or duty afforded to the Owner under the Contract Documents, nor will such action or failure to act constitute approval of or acquiescence in a breach thereunder, except as may be specifically agreed in writing.

13.2.3 The terms of this Contract and all representations, indemnifications, warranties and guarantees made in, required by, or given in accordance with the Contract Documents, as well as all continuing obligations indicated in the Contract Documents, will survive final payment, completion and acceptance of the Work and termination or completion of the Work and shall remain in effect so long as the Owner is entitled to protection of its rights under applicable law.

13.2.4 Contractor shall carry out the Work and adhere to the current construction schedule during all disputes or disagreements with the Owner. No Work shall be delayed or postponed pending resolution of any disputes or disagreements except as the Owner and Contractor may otherwise agree to in writing.

13.3 Tests and Inspections

13.3.1 Tests, inspections, and approvals of portions of the Work required by the Contract Documents or by laws, ordinances, rules, codes, or regulations shall be made at an appropriate time. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections and approvals with an independent testing laboratory, the Owner's Authorized Agent, or entity acceptable to the Owner, and the Contractor shall bear related costs of tests, inspections, and approvals as required in the Contract Documents. The Contractor shall give the Architect, Owner's Representative, and the Owner's Authorized Agent timely notice of when and where tests and inspections are to be made so the Architect, the Owner's Representative and/or the Owner's Authorized Agent may observe procedures or perform the necessary tests or inspections.

13.3.2 If the Architect, Owner's Representative, or the Owner's Authorized Agent determine that portions of the Work require additional testing, inspection or approval not included in the Contract Documents, or required by law, the Architect, or the Owner's Representative will instruct the Contractor to make arrangements for such additional testing, inspection, or approval by an entity acceptable to the Owner's Representative and the Contractor shall give timely notice to the Architect, the Owner's Representative or the Owner's Authorized Agent, of when and where tests and inspections are to be made so the Architect, Owner's Representative and/or the Owner's Authorized Agent , ~~so~~ may choose that the tests or inspections can be performed or observed. The Owner will bear such costs except as provided elsewhere in Article 13.

13.3.3 If such procedures for testing, inspection, or approval under Article 13 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, the Contractor shall bear all costs made necessary by such failure including those of repeated procedures and compensation for the Architect's and Owner's Authorized Agent's services and expenses.

13.3.4 Required certificates of testing, inspection, or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor, and promptly delivered to the Owner's Representative and Architect.

13.3.5 Contractor shall take all necessary actions to ensure that all tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

13.3.6 Contractor shall arrange for and pay for all costs of all testing required by the Contract Documents or any applicable Laws for materials to be tested or certified at or on the place or premises of the source of the material to be supplied. The Owner shall have the right to require testing of all materials at the place of the source of the material to be supplied if not required by the Contract Documents or any applicable Laws. The Owner shall bear the costs of such tests and inspections not required by the Contract Documents or by applicable Laws unless prior defective Work provides Architect or Owner with a reasonable belief that additional defective Work may be found, in which case Contractor shall be responsible for all costs of tests and inspections ordered by the Owner or Architect, whether or not such tests or inspection reveals that Work is in compliance with the Contract Documents.

13.4 Nondiscrimination in Employment Equal Opportunity

13.4.1 The University serves from time to time as a contractor for the United States government. Accordingly, the provider of goods and/or services shall comply with

federal laws, rules and regulations applicable to subcontractors of government contracts including those relating to equal employment opportunity and affirmative action in the employment of minorities (Executive Order 11246), women (Executive Order 11375), persons with disabilities (29 USC 706) and Executive Order 11758, and certain veterans (38 USC 4212 formerly [2012]) contracting with business concerns with small disadvantaged business concerns (Publication L. 95-507). Contract clauses required by the Government in such circumstances are incorporated herein by reference.

13.5 Supplier Diversity Goal Program

13.5.1 The Contractor shall subcontract with diverse firms no less than the amount pledged in the Contractor's Bid and/or the amount accepted by the Owner.

13.5.2 If the Contractor must remove any diverse subcontractor of any tier, the Contractor shall replace the diverse subcontractor of any tier with another diverse subcontractor(s) of equal dollar value to the diverse supplier removed. The Contractor shall immediately notify the Owner's Representative in writing of the Contractor's intent to remove any, and the Contractor's plan to maintain subcontracts with diverse firms of no less than amount pledged in the Contractor's Bid and/or the amount accepted by the Owner. All changes of diverse subcontractor of any tier shall be approved by the Director of Facilities Planning & Development.

13.5.3 If the Contractor fails to meet or maintain the contractor's Supplier Diversity subcontracting pledge, the Contractor shall immediately notify in writing the Owner's Representative, and the Director of Facilities Planning & Development. Such notice shall include a description of the Contractor's good faith effort to comply with their Supplier Diversity subcontracting pledge.

13.5.4 If the Director of Facilities Planning & Development finds the Contractor has failed to comply in good faith with the Owner's Supplier Diversity goal program, the Director may take appropriate action, including but not limited to, declaring the Contractor ineligible to participate in any contracts with the Owner for a period not to exceed six (6) months, and/or directing that the Contractor's actions be declared a material breach of the Contract and that the Contract be terminated.

13.5.5 The Contractor and his subcontractors shall develop, implement, maintain, and submit in writing to the Director of Facilities Planning & Development, 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 as included in the Contract Documents. For the purpose of this section, an "Affirmative Action Program" means positive actions 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 40 and 70), disabled and Vietnam-era veteran status, and handicapped otherwise qualified status. 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 collective bargaining agreements.

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

13.5.6 In the enforcement of this non-discrimination requirement, 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 of any tier. The contractor shall submit a final Affidavit of Supplier Diversity Participation for each diverse firm at the end of the project stating the actual amount paid to the diverse firm.

13.6 Wage Rates (If the contract amount is less than $75,000, the requirements of this section will not apply. Any contract adjustments that increase the contract above $75,000 will be subject to this section.)

13.6.1 The Contractor shall pay workers employed in the execution of this contract in full each week and not less than the predetermined wage rates and overtime for work of a similar character that have been made a part of this Contract. These rates are determined by the University of Missouri Director of Facilities Planning and Development. The rates are based on wage rates published in the Annual Wage Orders of the Missouri Department of Labor and Industrial Relations (MDLIR). The Contractor is to use MDLIR 8 CSR 30-3.020; .030; .040, .060 in determining the appropriate occupational titles and rates for workers used in the execution of this contract. All determinations and/or interpretations regarding wage rates and classification of workers will be made by the office of the University of Missouri Director of Facilities Planning and Development. The Contractor is responsible for the payment of the aggregate of the Basic Hourly Rate and the Total Fringe Benefits to the workers on the project. Fringe benefit payments may be made to the worker in cash, or irrevocably made by a Contractor or Subcontractor to a trustee or to a third person pursuant to a fund, plan or program, or pursuant to an enforceable

commitment, or any combination thereof, to carry out a financially responsible plan or program which was communicated in writing to the workmen affected, for medical or hospital care, pensions on retirement or death, compensation for injuries or illness resulting from occupational activity, or insurance to provide any of the foregoing, for unemployment benefits, life insurance, disability and sickness insurance, accident insurance, for vacation and holiday pay, for defraying costs of apprenticeship or other similar programs, or for other bona fide fringe benefits, but only where the Contractor or Subcontractor is not required by other federal or state law to provide any of the benefits as referenced in §290.210(5) RSMo 1994. Pay for travel, mileage, meals, bonuses, or other expenses are not fringe benefits and cannot be considered part of the workers wage rate. The Contractor shall not make any deductions for food, sleeping accommodations, transportation, use of small tools, uniforms, or anything of any kind or description, unless the Contractor and employee enter into an agreement in writing at the beginning of the worker's term of employment, and such agreement is approved by the Owner. In the event the contract contains more than one wage determination the Contractor shall comply with both.

13.6.2 The Contractor shall submit to the Owner with the Contractor's periodic pay request, certified payroll records for labor performed by the Contractor and Subcontractors of any tier. The Contractor shall submit all required certified payroll information records electronically in pdf format using the Owner's web-based payment program. The certified payroll forms shall contain the name, address, personal identification number, and occupational title of the workers as well as the hours they work each day. The Owner's acceptance of certified payroll records does not in any way relieve the Contractor of any responsibility for the payment of prevailing wages to workers on the project. The Contractor shall also maintain copies of the certified payroll records. The Owner may, at any time, request copies of, and/or inspect all of the Contractor's payroll records for the Work to verify compliance. The Contractor shall furnish the Owner copies of payroll records within 10 days of the Owner's written request. The Contractor shall provide copies of workers I-9 forms within 24 hours of written notice. (If applicable, and required by Owner, the Contractor will demonstrate that the Contractor is enrolled and participating in a federal work authorization program with respect to the employees working in connection with this project.) Such payroll records shall be maintained in accordance with Article 13.7.1 and shall be available for inspection for two (2) years after final completion of the Work. The contractor further agrees, in the event the records are not presented as requested, he will abide by any decision made by the Owner regarding underpayment of wages to workers and amounts owed them as well as liquidated damages for underpayment of wages. Falsification of the certified payroll records may result in the debarment of the contractor or subcontractor from future work with the University.

13.6.3 The acquisition of products or services is subject to the supplier's conformance to the rules and regulations of the President's Committee on Equal Employment Opportunity (41 CFR, Ch. 60).

13.6.4 The Contractor shall comply with the Copeland Regulations of the Secretary of Labor (29 CFR, Part 3), which are incorporated herein by reference. In addition, the Weekly Statement of Compliance required by these Regulations shall also contain a statement that the applicable fringe benefits paid are equal to or greater than those set forth in the minimum wage decision.

13.6.5 Contractor acknowledges that violation of the requirements of Article 13.6 result in additional costs to Owner, including, but not limited to, cost of construction delays, of additional work for Owner's staff and legal expense. The cost of Contractor's violation of the provisions of Article 13.6 would be and is difficult to determine and establish. In the event that Contractor fails to comply with the provisions of this Article 13.6, Owner shall be entitled to retain or recover from the Contractor, as liquidated damages and not as a penalty, the sum of Fifty Dollars ($50.00) per day per individual who is paid less than the applicable prevailing wage, to approximate the investigative cost resulting to the Owner for such violations. To approximate the delay costs, Owner shall be entitled to retain or recover from the Contractor, as liquidated damages and not as a penalty, the sum of One Hundred Dollars ($100.00) per day for each day the Contract cannot be closed out and final payment made because of Contractor's failure to comply with the provisions of this Article 13.6. Such liquidated damages shall be collected regardless of whether the Work has been completed. The liquidated damages and other amounts set forth in this Article 13.6 shall be in addition to all other liquidated damages the Owner may be entitled as set forth in the Contract Documents.

13.6.6 The Owner may deduct liquidated damages described Article 13 and the amounts set forth in Article 13 from any unpaid amounts then or thereafter due the Contractor under the Contract. Any liquidated damages not so deducted from any unpaid amounts due the Contractor shall be payable to the Owner at the demand of the Owner.

13.6.7 The Contractor shall specifically incorporate the obligations of Article 13 into the subcontracts, supply agreements and purchase orders for the Work and require the same of any Subcontractors of any tier.

13.6.8 Contractor acknowledges and recognizes that a material factor in its selection by the Owner is the Contractor's willingness to undertake and comply with the requirements of this Article 13.6. If Contractor fails to comply with the provisions of this Article 13.6, Owner may, in its sole discretion, immediately terminate the Contract

upon written notice. The rights and remedies of Owner provided herein shall not be exclusive and are in addition to other rights and remedies provided by law or under this Contract.

13.6.9 Only such workers who are individually registered in a bona fide apprenticeship program approved by the U.S. Department of Labor, Office of Apprenticeship can be paid less than the journeyperson rate of pay. "Entry Level Workers; must be registered apprentices. The apprenticeship ratio will be one to one with a journeyperson of the same classification. Any worker not registered as an apprentice per this section will be paid as a journeyperson.

13.6.10 The Contractor shall post the wage rates for the contract in a conspicuous place at the field office on the project. On projects where there is no field office the Contractor may post the wage rates at their local office, as long as they provide a copy of the wage rates to a worker upon request. The wage rates shall be kept in a clearly legible condition for the duration of the project.

13.6.11 Neither the Contractor, nor any Subcontractor of any tier, nor any person hired by them or acting on their behalf, shall request or demand that workers pay back, return, donate, contribute, or give any part, or all, of said workers wages, salary, or any thing of value, upon the statement, representation or understanding that failure to comply with such request or demand will prevent such worker from procuring or retaining employment. The exception being to an agent or representative of a duly constituted labor organization acting in the collection of dues or assessments of such organization.

13.6.12 No contractor or subcontractor may directly or indirectly receive a wage subsidy, bid supplement, or rebate for employment on this project if such wage subsidy, bid supplement, or rebate has the effect of reducing the wage rate paid by the employer on a given occupational title below the prevailing wage rate as provided in contract. In the event a wage subsidy, bid supplement, or rebate is provided or received, the entity receiving such subsidy, supplement, or rebate shall report the date and amount of such subsidy, supplement, or rebate to the University within thirty days of receipt of payment. This disclosure report shall be a matter of public record. Any employer not in compliance with this Article shall owe to the University double the dollar amount per hour that the wage subsidy, bid supplement, or rebate has reduced the wage rate paid by the employer below the prevailing wage rate for each hour that work was performed.

13.6.13 Time and one-half overtime will be paid on all hours over 10 hours per day or 40 hours per week. The wage rate is the total of the "Basic Hourly Rate" plus "Total Fringe Benefits" or the "public works contracting minimum wage". For all work performed on a Sunday or Holiday, not less than twice the prevailing hourly rate of pay or public works contracting minimum wage will apply. Holidays are as follows: January first, the last Monday in May, July fourth, the first Monday in September, November 11, the fourth Thursday in November, December twenty-fifth. If any holiday falls on a Sunday, the following Monday shall be considered a holiday.

13.7 Records

13.7.1 The Owner, or any parties it deems necessary, shall have access to and the right to examine any accounting or other records of the Contractor involving transactions and Work related to this Contract for five (5) years after final payment or five (5) years after the final resolution of any on going disputes at the time of final payment. All records shall be maintained in accordance with generally accepted accounting procedures, consistently applied. Subcontractors of any tier shall be required by Contractor to maintain records and to permit audits as required of Contractor herein.

13.8 Codes and Standards

13.8.1 The Work shall be performed to comply with the International Code Council (ICC) Codes, and the codes and standards noted below. The latest editions and supplements of these Codes and Standards in effect on the date of the execution of the Contract for Construction shall be applicable unless otherwise designated in the Contract Documents. Codes and standards required by accreditation agencies will also be used unless the ICC requirements are more stringent. In the event that special design features and/or construction systems are not covered in the ICC codes, the applicable edition of the National Fire Protection Association (NFPA) family of standards and/or the NFPA 101 Life Safety Code shall be used.

.1 ICC International Building Code and reference standards
.2 ICC International Plumbing Code
.3 ICC International Mechanical Code
.4 ICC International Fire Code
.5 ICC International Fuel Gas Code
.6 NFPA 70 National Electric Code (NEC)
.7 Americans with Disabilities Act – Standards for Accessible Design.
.8 American National Standard Safety Code for Elevators, Dumbwaiters, Escalators, and Moving Walks as published by the American Society of Mechanical Engineers (ASME), American National Standards Institute (ANSI) A17.1
.9 NFPA 101 Life Safety Code (as noted above)
.10 American Concrete Institute (ACI)
.11 American National Standards Institute (ANSI)
.12 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
.13 American Refrigeration Institute (ARI)
.14 American Society for Testing and Materials (ASTM)
.15 Missouri Standard Specification for Highway Construction, Missouri State Highway Commission

.16 National Electrical Manufacturers Association (NEMA)

.17 Underwriter's Laboratories, Inc. (UL), Federal Specifications

.18 Williams Steiger Occupational Safety and Health Act of 1970 (OSHA)

13.9 General Provisions

13.9.1 Any specific requirement in this Contract that the responsibilities or obligations of the Contractor also apply to a Subcontractor is added for emphasis and are also hereby deemed to include a Subcontractor of any tier. The omission of a reference to a Subcontractor in connection with any of the Contractor's responsibilities or obligations shall not be construed to diminish, abrogate or limit any responsibilities or obligations of a Subcontractor of any tier under the Contract Documents or the applicable subcontract.

13.9.2 This Contract shall be interpreted, construed, enforced, and regulated under and by the laws of the State of Missouri. Whenever possible, each provision of this Contract shall be interpreted in a manner as to be effective and valid under applicable law. If, however, any provision of this Contract, or a portion thereof, is prohibited by law or found invalid under any law, only such provision or portion thereof shall be ineffective, without invalidating or affecting the remaining provisions of this Contract or valid portions of such provision, which are hereby deemed severable. Contractor and Owner further agree that in the event any provision of this Contract, or a portion thereof, is prohibited by law or found invalid under any law, this Contract shall be reformed to replace such prohibited or invalid provision or portion thereof with a valid and enforceable provision which comes as close as possible to expressing the intention of the prohibited or invalid provision.

13.9.3 Contractor and Owner each agree that the State of Missouri Circuit Court for the County where the Project is located shall have exclusive jurisdiction to resolve all Claims and any issue and disputes between Contractor and Owner. Contractor agrees that it shall not file any petition, complaint, lawsuit or legal proceeding against Owner in any other court other than the State of Missouri Circuit Court for the County where the Project is located.

13.9.4 Owner's total liability to Contractor and anyone claiming by, through, or under Contractor for any Claim, cost, loss, expense, or damage caused in part by the fault of Owner and in part by the fault of Contractor or any other entity or individual shall not exceed the percentage share that Owner's fault bears to the total fault of Owner, Contractor and all other entities and individuals as determined on the basis of comparative fault principles.

13.9.5 Contractor agrees that Owner shall not be liable to Contractor for any special, indirect, incidental, or consequential damage whatsoever, whether caused by Owner's negligence, fault, errors or omissions, strict liability, breach of contract, breach of warranty or other cause or causes whatsoever. Such special, indirect, incidental or consequential damages include, but are not limited to loss of profits, loss of savings or revenue, loss of anticipated profits, labor inefficiencies, idle equipment, home office overhead, and similar types of damages.

13.9.6 Nothing contained in this Contract, or the Contract Documents shall create any contractual relationship with or cause of action in favor of a third party against the Owner.

13.9.7 No member or officer of the Board of Curators of the University incurs or assumes any individual or personal liability under the Contract or by reason of the default of the Owner in the performance of any terms thereof. Contractor releases and discharges all members or officers of the Board of Curators of the University from any liability as a condition of and as consideration for the award of the Contract to Contractor.

13.9.8 The Contractor hereby binds itself, its partners, successors, assigns and legal representatives to the Owner in respect to covenants, agreements and obligations contained in the Contract Documents. Contractor shall not assign the Contract or proceeds hereof without written consent of the Owner. If Contractor attempts to make such an assignment without such consent, it shall be void and confer no rights on third parties, and Contractor shall nevertheless remain legally responsible for all obligations under the Contract. The Owner's consent to any assignment is conditioned upon Contractor entering into a written assignment which contains the following language: "it is agreed that the funds to be paid to the assignee under this assignment are subject to performance by the Contractor and to claims and to liens for services rendered or materials supplied for the performance of the Work required in said Contract in favor of all persons, firms, corporations rendering such services or supplying such materials."

13.10 Certification

13.10.1 The contractor certifies to the best of its knowledge and belief that it and its principals are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency in accordance with Executive Order 12549 (2/18/86).

13.10.2 If this contract is for $100,000 or more, and if the Contractor is a company with ten (10) or more employees, then Contractor certifies that it, and any company affiliated with it, does not boycott Israel, and will not boycott Israel during the term of this Contract. In this paragraph, the terms "company" and "boycott Israel" shall have the meanings described in Section 34.600 of the Missouri Revised Statutes.

ARTICLE 14
TERMINATION OR SUSPENSION OF THE CONTRACT

14.1 Termination by Owner for Cause

14.1.1 In addition to other rights and remedies granted to Owner under the Contract Documents and by law, the Owner may terminate the Contract if the Contractor:

.1 refuses or fails to supply enough properly skilled workers, superintendents, foremen, or managers;

.2 refuses or fails to supply sufficient or proper materials;

.3 fails to make payment to Subcontractors for materials or labor in accordance with the respective agreements between the Contractor and the Subcontractors;

.4 disregards laws, ordinances, rules, codes, regulations or orders of an authority having jurisdiction;

.5 disregards the authority of the Owner's Representative, Architect, or Owner's Authorized Agent;

.6 breaches any warranty or representations made by the Contractor under or pursuant to the Contract Documents;

.7 fails to furnish the Owner with assurances satisfactory to the Owner evidencing the Contractor's ability to complete the Work in compliance with all the requirements of the Contract Documents;

.8 fails after commencement of the Work to proceed continuously with the construction and completion of the Work for more than ten (10) days, except as permitted under the Contract Documents;

.9 fails to maintain a satisfactory rate of progress with the Work or fails to comply with approved progress schedules; or

.10 violates in any substantial way any provisions of the Contract Documents.

14.1.2 When any of the above reasons exist, the Owner may, without prejudice to any other rights or remedies of the Owner, terminate this Contract by delivering a written notice of termination to Contractor and Contractor's surety, and may:

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

.2 accept assignment of subcontracts pursuant to Paragraph 5.3; and

.3 finish the Work by whatever reasonable method the Owner may deem expedient, including turning the Work over to the surety.

14.1.3 The Contractor, in the event of a termination under Section 14.1, shall not be entitled to receive any further payments under the Contract until the Work is completed in its entirety. Then, if the unpaid balance under the Contract shall exceed all expenses of the Owner in finishing the Work, including additional compensation for the Architects services and expenses made necessary thereby, such excess will be paid to the Contractor; but, if such expenses of Owner to finish the Work shall exceed the unpaid balance, the Contractor and its surety shall be liable for, and shall pay the difference and any damages to the Owner. The obligation of the Contractor and its surety for payment of said amounts shall survive termination of the Contract.

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

14.1.5 The rights of the Owner to terminate pursuant to Article 14.1 will be cumulative and not exclusive and shall be in addition to any other remedy provided by law or the Contract Documents.

14.1.6 Should the Contractor fail to achieve Final Completion of the Work within thirty (30) calendar days following the date of Substantial Completion, the Owner may exercise its rights under Article 14.1.

14.2 Suspension by the Owner for Convenience

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

14.2.2 An adjustment will be made to the Contract Sum for increases in the cost of performance of the Contract caused by suspension, delay or interruption. However, in the event of a suspension under this Article 14.2, Contractor hereby waives and forfeits any claims for payment of any special, indirect, incidental or consequential damages such as lost profits, loss of savings or revenue, loss of anticipated profits, idle labor or equipment, home office overhead, and similar type damages. No adjustment will be made to the extent:

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

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

14.3 Owner's Termination for Convenience

14.3.1 The Owner may, at any time, terminate the Contract in whole or in part for the Owner's convenience and without cause. Termination by the Owner under this Paragraph shall be by a notice of termination delivered to the Contractor specifying the extent of termination and the effective date.

14.3.2 Upon receipt of a notice of termination for convenience, the Contractor shall immediately, in accordance with instructions from the Owner, proceed with performance

of the following duties regardless of delay in determining or adjusting amounts due under this Paragraph:

.1 cease operation as specified in the notice;

.2 place no further orders and enter into no further subcontracts for materials, labor, services or facilities except as necessary to complete Work not terminated;

.3 terminate all subcontracts and orders to the extent they relate to the Work terminated;

.4 proceed to complete the performance of Work not terminated; and

.5 take actions that may be necessary, or that the Owner may direct, for the protection and preservation of the terminated Work.

14.3.3 Upon such termination, the Contractor shall recover as its sole remedy payment for Work properly performed in connection with the terminated portion of the Work prior to the effective date of termination and for items properly and timely fabricated off the Project site, delivered and stored in accordance with the Owner's instructions and for all Owner approved claims, costs, losses and damages incurred in settlement of terminated contracts with Subcontractors and suppliers. The Contractor hereby waives and forfeits all other claims for payment and damages, including, without limitation, anticipated profits, consequential damages and other economic losses.

14.3.4 The Owner shall be credited for (1) payments previously made to the Contractor for the terminated portion of the Work, (2) claims which the Owner has against the Contractor under the Contract and (3) the value of the materials, supplies, equipment, or other items that are to be disposed of by the Contractor that are part of the Contract Sum.

14.3.5 Upon determination by a court that termination of Contractor or its successor in interest pursuant to Paragraph 14.1 was wrongful, such termination will be deemed converted to a termination for convenience pursuant to Paragraph 14.3, and Contractor's sole and exclusive remedy for wrongful termination is limited to recovery of the payments permitted for termination for convenience as set forth in Paragraph 14.3.

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SECTION 1.E
SPECIAL CONDITIONS

1. DEFINITIONS

a. "Drawings"

Drawings referred to in and accompanying Project Manual consist of Drawings prepared by and bearing name of below defined Architect, bearing "LOTTES HEALTH SCIENCE LIBRARY – RENOVATION FOR CONSOLIDATION" (project number CP211852) and "LOTTES HEALTH SCIENCE LIBRARY – REPLACE GLAZING & ROOFING IN BARREL ROOF SYSTEMS" (project number CP230151), dated April 14, 2023

b. Architect
SOA Architecture
2801 Woodard Drive, Suite 103
Columbia, MO 65202
573.443.1407

c. Mechanical & Electrical Engineer
Introba – St. Louis
6 South Old Orchard
St. Louis, MO 63119
800.404.7677

d. Structural Engineer
Crockett Engineering Consultants
1100 W Nifong Blvd. Bldg. 1
Columbia, MO 65201
573.447.0292

e. Other Definitions: See Article 1., General Conditions.

2. SPECIAL SCHEDULING REQUIREMENTS

a. Special scheduling requirements supplemental to the bid form:

(1) Contractor will not have access to the construction area prior to Owner's notice to proceed to perform any demolition or construction activities, unless notified otherwise by Owner's Representative.

(2) Project sequence and inter-project dependencies must be maintained in successful bidder's schedule. Schedule development shall include, but not limited to MU work activities of Controls, TAB, Commissioning, and Inspections and Testing.

(3) Contractor shall not perform any exterior work, or south atrium first and second floor work of any kind on the following dates and locations:
(a) Friday, October 6, 2023 (Alumni Weekend)
(b) Friday, November 10, 2023 (Health Science Research Day)
(c) Friday, March 15, 2024 (Match Day)

(4) Working Hours

a. Normal working hours are defined as weekdays, 7:00 am to 5:00 pm.
b. Night Hours are defined as Monday thru Thursday after 5:00 pm and before 6:00 am.

c. Weekend Hours are defined as after 6:00 pm Friday until 4:00 am Monday
d. Noisy work not allowed during Final Exam weeks. Reference MU academic calendar for Finals weeks in the Fall 2023 semester and the Spring 2024 semester.

3. SCOPE OF WORK

a. The Contractor shall furnish all labor, materials, tools, equipment necessary for, and incidental to, construction of this project as indicated on Drawings and specified herein.

b. Work shall include everything requisite and necessary to finish work properly, notwithstanding that every item of labor or materials or accessories required to make project complete may not be specifically mentioned.

c. General Description Scope of Work (CP211852):

(1) Project consists of remodel of the interior of the Lottes Health Sciences Library, including approximately 12,900 s.f. of space at the first floor for use as School of Medicine office space, approximately 16,260 s.f. of space at the second floor for use as the Health Sciences Library, and approximately 14,140 s.f. of space at the third floor for use as Child Health faculty offices.

(2) Architectural Demolition shall consist of removal and disposal drywall shaft-walls, partitions, soffits, and ceilings; acoustical lay-in ceilings; carpet, VCT, and ceramic tile flooring; solid core wood doors, hollow metal frames, and sidelight glazing; restroom partitions and accessories; casework, countertops, and window sills; and high-density library shelving. Selective demolition includes removal and replacement of small portions of existing concrete floor to install plumbing and electrical services.

(3) Architectural work shall consist of metal stud and drywall shaft-walls, partitions, soffits, and ceilings; spray applied cementitious fire proofing; acoustical lay-in and applied panel ceilings; carpet, LVT, and ceramic tile flooring; solid core wood doors, hollow metal frames and sidelight glazing, interior butt glazing and all-glass entries, interior aluminum storefronts and entrances; sound absorbing room dividers; glass marker boards; toilet accessories, fire protection cabinets, projection screen, and roller window-shades; plastic laminate casework / countertops and solid-surface countertops; and fall-protection railings at roof equipment.

(4) Structural Demolition shall consist of removal and disposal of concrete stairs and metal railings.

(5) Structural work shall consist of infill of an atrium opening with composite structural steel beam, metal decking, and concrete slab; and infill of stair floor openings with reinforced concrete slabs.

(6) Mechanical demolition shall consist of disconnection and removal of existing mechanical equipment including (but not limited to) AHUs, relief and exhaust fans on roof, air terminal units, ductwork, piping, controls, within the scope limits. Existing air terminals and associated ductwork, piping, controls etc. serving HR and Anesthesiology suite to remain.

(7) Mechanical work shall consist of new AHUs, blower coil unit (Rare Books room), relief and exhaust fans on roof, DDC air terminal units, ductwork, piping, controls, within the scope limits.

(8) Electrical demolition shall consist of disconnection and removal all electrical equipment, devices, and associated wiring related to power, fire alarm, lighting, telecommunications, etc. and to include HVAC equipment removal within the scope limits. Existing distribution panels in east and west mechanical rooms (1st Floor) and associated branch panelboards serving HR and Anesthesiology suite to remain.

(9) Electrical work shall consist of new electrical equipment, devices, and associated wiring related to power, fire alarm, lighting, telecommunications, etc. and to include new HVAC equipment and controls withing the scope limits. Existing distribution panels in east and west mechanical rooms will be utilized to serve new branch panelboards on each of the east and west sides of each of floors 1, 2, and 3. The existing Honeywell fire alarm system will be extended and programmed to incorporate and interface with new devices as indicated on drawings. The existing telecom room on 1st Floor will remain and two (2) new telecom rooms on 2nd and 3rd floor will be provided to serve telecommunication provisions on these floors. New lighting system will employ LED luminaires with a digital, low voltage, room controller-based lighting control system including occupancy/daylighting sensor controls.

(10) Plumbing demolition shall consist of disconnection and removal of existing plumbing fixtures and associated piping and accessories within the scope limits. The existing vent piping within the scope limits shall be removed to indoor side of VTR and capped for reuse. Underground sanitary piping shall be demolished within the scope limits.

(11) Plumbing work shall consist of new plumbing fixtures and associated water, waste, and vent piping and accessories within the scope limits. The existing cold water, hot water, and hot water return systems shall be modified and extended to serve new plumbing fixtures. New waste and vent piping shall be provided for new plumbing fixtures and tied into the existing waste and vent systems.

(12) Fire Protection demolition shall consist of disconnection and removal of existing sprinkler heads and associated branch piping within the scope limits.

(13) Fire Protection work shall consist of new sprinkler heads and associated branch piping within the scope limits. The existing fire protection piping shall be modified and extended to serve new sprinkler head layouts within the scope limits.

d. General Description Scope of Work (CP230151):

(1) Project consists of Replacement of roofing, glazing, and skylights of the the Lottes Health Sciences Library north half barrel vault and the full barrel vault over the atrium between the Lottes Health Sciences Library and the Medical Sciences Addition buildings.

(2) Demolition shall consist of removal and disposal of radius metal roofing, plywood coverboard, rigid insulation, asphalt vapor barriers, and perimeter stainless steel edge flashing; removal and reinstallation of stainless steel parapet flashing; vertical aluminum storefront systems; and radiused aluminum and acrylic skylight systems.

(3) Architectural work shall consist of new PVC roofing assemblies (with battens); metal flashing; low-rise curtain wall vertical glazing systems; radiused fiberglass sandwich skylight assemblies; and interior drywall ceiling repair and repainting.

(4) Structural work shall consist of miscellaneous steel shapes and attachments to support the fiberglass sandwich skylight assemblies.

4. LOCATION

Work shall be performed under this Contract on campus of the University of Missouri - Columbia, at Lottes Health Sciences Library at 9 Hospital Drive Building.

5. NUMBER OF CONSTRUCTION DOCUMENTS

a. The Owner's Representative will furnish the Contractor a digital copy of executed Contract and a complete set of Drawings and Specifications in PDF format.

b. Hard copy prints of any documents (bid or explanatory) will be printed at the Contractor's expense through a printer of their choosing.

c. The Owner will furnish explanatory and changed Drawings in pdf format to Contractor as issued during project.

d. The Owner will provide electronic data files to the Contractor for their convenience and use in progressing the Work and the preparation of shop drawings or other submittal requirements required for construction of the referenced project. The electronic data files shall reflect Construction Documents and Bid Addenda only. These files will be transmitted subject to the following terms and conditions:

(1) The Owner makes no representation as to the compatibility of these files with the Contractor's hardware or software.

(2) Data contained on these electronic files shall not be used by the Contractor or anyone else for any purpose other than as a convenience in progressing the Work or in the preparation of shop drawings or other required submittals for the referenced project. Any other use or reuse by the Contractor or by others will be at their own sole risk and without liability or legal exposure to Owner. The Contractor agrees to make no claim and hereby waive, to the fullest extent permitted by law, any claim or cause of action of any nature against the Owner and its consultants, contractors, agents, employees, and representatives that may arise out of or in connection with the use of the electronic files transmitted.

(3) Furthermore, the Contractor shall, to the fullest extent permitted by law, indemnify and hold harmless the Owner and its consultants, contractors, agents, employees, and representatives, against all damages, liabilities or costs, including reasonable attorney's fees and defense costs, arising out of or resulting from the use of these electronic files.

(4) These electronic files are not contract documents. Differences may exist between these electronic files and corresponding hard-copy construction documents. The Owner makes no representation regarding the accuracy or completeness of the electronic files you receive. In the event that a conflict arises between the signed or sealed hard-copy construction documents prepared by the Consultant and the electronic files, the signed and sealed hard-copy construction documents shall govern. The Contractor is responsible for determining if any conflict exists. By use of these electronic files, the Contractor is not relieved of their duty to fully comply with the contract documents.

(5) Because information presented on the electronic files can be modified, unintentionally or otherwise, the Owner reserves the right to remove all indications of ownership and/or involvement from each electronic display.

(6) Under no circumstances shall delivery of the electronic files be deemed a sale by the Owner and no warranties are made, either expressed or implied, of merchantability and fitness for any particular purpose. In no event shall the Owner be liable for any loss of profit, or any consequential damages as a result of use or reuse of these electronic files.

6. SUBMITTALS

a. The Contractor shall submit for approval to the Architect, equipment lists and Shop Drawings, as expediently as possible. Failure of the Contractor to submit Shop Drawings in a timely manner will result in the Owner holding back Contractor payments. (See General Conditions)

b. The material and equipment lists shall be submitted and approved before any material or equipment is purchased and shall be corrected to as-built conditions before the completion of the project.

c. The Contractor shall submit electronic versions of all required Shop Drawings, material and equipment lists. The Contractor shall upload all Shop Drawings to a secure information sharing website determined by the Owner notifying the Owner and Consultant that these shop drawings are available for review. Each submittal shall have the General Contractors digital stamp affixed to the first page signifying their review and acceptance. Review comments, approvals, and rejections will be posted on this same site with notification to the contractor. Submittals requiring a professional seal shall be submitted hard copy with a manual seal affixed.

(1) The Contractor shall identify each submittal item with the following:

(a) Project Title and Location
(b) Project Number
(c) Supplier's Name
(d) Manufacturer's Name
(e) Contract Specification Section and Article Number
(f) Contract Drawing Number
(g) Acrobat file name: Spec Section_Times Submitted-Spec Title: 033000 _01-Cast In Place Concrete.pdf

(2) Reference the accompanying Shop Drawing and Submittal Log at the end of this section (1.E.3) for required submittal information.

d. The Contractor shall submit to the Architect four (4) bound copies of all required Operating Instructions and Service Manuals for the Architect's and the Owner's sole use prior to completing 50% of the adjusted contract. Payments beyond 50% of the contract amount may be withheld until all Operating Instructions and Service Manuals are received as referenced in the accompanying Operating Instructions and Service Manual Log at the end of this section (1.E.4).

e. The Contractor shall submit to the Owner's Representative all items referenced in the accompanying Closeout Log (1.E.5) within 30 days following substantial completion of the work. The Owner's Representative will maintain the closeout log and include as an agenda item at all coordination meetings.

7. NOTIFICATION

a. Before beginning Noisy Demolition Work, the Contractor shall provide, at minimum, seventy-two (72) hours advance notice to Owner's Representative.

b. Utility shut-downs, outages, and tie-ins: All such work may be done during normal, night, and/or weekend hours, and/or coordinated with the Owner's Representative. All such work shall be done continuously until fully restored. Contractor shall coordinate such work at least 5 (five) working days prior to starting the work. Utility shut-downs shall be reviewed, coordinated, and approved by the Owner's Representative.

8. USE OF PREMISES

a. Access: Access to construction site shall be as indicated on Drawings and as directed by the Owner's Representative.

b. Parking:

(1) The Owner will issue Contractor one (1) service vehicle parking permit(s) for use in University Parking lot WG1/L. The permits will be issued at no cost to the contractor up to the contract completion date. After the contract completion date, the permits will be re-issued on an as available basis at the contractor's expense. These permits are to be used for general contractor or subcontractor owned and labeled vehicles only. Personal vehicles are prohibited from use of these permits. Violation of this requirement may result in ticketing and/or towing at the vehicle owner's expense and suspension of progress payments.

(2) Parking of personal vehicles within project access/lay down/staging areas is prohibited. Violation of this requirement may result in ticketing and/or towing at the vehicle owner's expense and suspension of progress payments.

(3) Parking or driving on sidewalks, landscaped areas, within fire and service lanes or generally in areas not designated for vehicular traffic is prohibited except as allowed in the contract documents. Violation of this requirement may result in ticketing and/or towing at the vehicle owner's expense and suspension of progress payments.

(4) Sidewalk(s) and Hardscape – Parking/driving on hardscapes is strictly prohibited unless specifically directed by the Owner's Representative through the MU sidewalk permitting process. Restricted use permits will be limited to activities that are constrained by an absolute need to access from a sidewalk. Such activities shall be considered the exception and not the norm. Adequate signage, fencing and alternate routes must be provided in the immediate and adjacent areas.

(5) Free parking for contractor employees is available in the Ashland Road Contractor lot on an as available basis. This space is for use by contractor employees for parking their personal vehicles only and is not to be used for staging or storage.

(6) Vendor Permits may be purchased by contractor management personnel on an as available basis by contacting the Parking and Transportation office in the General Services Building. These permits will allow contractor management personnel to park in various University lots while conducting business on University construction projects.

(7) Temporary University parking permits may be purchased by contractor employees for use with their personal vehicles on an as available basis by contacting the Parking and Transportation office in the General Services Building.

(8) Conley Avenue between Missouri Avenue and University Avenue and Hitt Street between University Avenue and the Memorial Union are designated for pedestrian use only during the work week between the hours of 8:15 AM and 3:45 PM. Unless otherwise indicated in the contract documents, this area is strictly off limits to vehicular traffic without authorization from the Owner's Representative.

c. Storage of materials: The Contractor shall store all materials within project limits. The Contractor shall confine apparatus, materials, and operation of workers to location established by the Owner's Representative. The Contractor shall not unreasonably encumber premises with materials. In addition, storage trailer locations may be available

within 1-1/2 miles of project site as directed by the Owner's Representative. Storage trailer locations shall be subject to approval by the Owner's Representative and are available to the Contractor without cost.

d. Utilities: Drinking water, water required to carry on work, and 120 volt electrical power required for small tool operation may be obtained without cost to the Contractor from existing utilities at locations designated by the Owner's Representative. Provisions for obtaining power, including temporary extensions, shall be furnished and maintained by the Contractor. Upon completion of work such extensions shall be removed and any damage caused by use of such extensions shall be repaired to satisfaction of the Owner's Representative, at no cost to the Owner.

e. Restroom: Existing toilet facilities in Lottes until demolished, then restrooms as designated by the Owner's Representative for use by the Contractor will be available. Failure of the Contractor to maintain restrooms in a clean condition will be cause for the Contractor's discontinued use of the restroom.

f. Smoking is prohibited at the University of Missouri and all properties owned, operated, leased or controlled by the University of Missouri. Violation of the policy is defined as smoking any tobacco products, including e-cigarettes.

g. Landfill: The Contractor shall not use the Owner's landfill. Dumping or disposal of excavated or demolition materials on Owner's property shall not be permitted. The Contractor shall remove and legally dispose of excavated or demolished materials off the Owner's property.

h. Care of Project Work Site: The contractor shall be responsible for maintaining the construction site in a reasonably neat and orderly condition by regular cleaning and mowing of the premises as determined by the Owner's Representative.

i. Discharge to Sewer Request: The University of Missouri's MS4 permit and NPDES Storm Water Discharge Permits along with the City of Columbia's POTW Operating Permit as well as local ordinances, and state and federal environmental regulations prohibit hazardous materials from being disposed into either the storm water or sanitary sewer systems. Unless specifically approved, all chemical products such as paints, dyes, lawn care products, maintenance products, and oil ~~is~~ are prohibited from drain disposal. Any product, including contaminated water, being discarded into the storm water or sanitary sewer systems requires written approval from the Owner through a formal "Discharge to Sewer Request" form obtained at Discharge to Sewer Request Form. The contractor should submit the form to the Owner's Representative, not to the Department of Environmental Health and Safety as the form indicates.

j. All concrete waste material including washout water shall be totally contained and removed from the Owner's property.

k. Artifacts Found During Construction: Contractor shall immediately notify the Owner's Representative when artifacts are uncovered or found during the demolition or construction process. Artifacts include, but are not limited to, tools, drawings (construction or other), photographs, books and other objects/devices which may hold historical importance/significance. Do not remove or disturb the object(s) in question. Artifacts are not considered part of demolished materials and shall remain the property of the University of Missouri.

l. **"Permit Required Confined Space" Entry Communication and Coordination**
(See OSHA 1926 subpart aa – Construction Confined Space for the definition of "permit required confined spaces" - Note: OSHA does not apply to the University. However, the University will provide a list of all known "permit required confined spaces")

There are no known “permit required confined spaces” within the project limits. Each contractor shall conduct a survey to confirm whether or not any confined spaces exist within the project limits. It is incumbent upon each contractor to list all “permit required spaces”.

The Contractor shall notify the Owner’s Representative if 1) conditions change resulting in a non-permit required confined space being reclassified to a “permit required confined space” after evaluation of the space by a competent person; 2) a space previously thought to be non-permit required space is classified as a “permit required confined space”; or 3) during the course of construction a “permit required confined space” is created after evaluation by a competent person.

The Contractor shall submit to the Owner’s Representative a copy of the cancelled confined space entry permit and a written report summarizing the permit space program followed and all hazards confronted or created during entry operations. This information shall be submitted within one week of cancelling the permit.

9. PROTECTION OF OWNER'S PROPERTY

a. The Contractor shall be responsible for repair of damage to building exterior and interior, drives, curbs, streets, walks, grass, shrubbery and trees, which was caused by workmen or equipment employed during progress of work. All such repairs shall be made to satisfaction of the Owner's Representative, at no cost to the Owner, or reimburse the Owner if the Owner elects to make repairs. For landscape damage, the Owner shall make such repairs. Compensation for these repairs shall be determined by the Owner's Representative using the "Valuation of Landscape Trees, Shrubs, and other Plants" as published by the International Society of Arboriculture, as last revised.

b. Construction Project Fencing:

(1) Fencing material will be provided by the University of Missouri. The portion of the site area that is available for this project is defined in the Drawings. Contractor shall install and maintain fencing and throughout the course of the construction contract, and return fencing to the University of Missouri at the end of the project in a condition equal to or better than the state when the fencing material was received.

(2) Using existing landmarks, lamp posts, trees or other Owner property for support of fencing is strictly prohibited unless a written waiver is obtained from Owner's Representative.

(3) Use of ribbon, snow fence, chicken wire, rope, and wooden barricades as fencing is prohibited.

(4) Fencing shall be maintained in an "as-installed" condition throughout the life of the project.

(5) The Contractor may use used fencing provided it is in good condition and is satisfactory to the Owner's Representative.

c. Preserving and Protecting Existing Vegetation:

(1) Protection and compensation for damages:

(a) Trees and shrubs within work area designated to remain shall be protected

from damage during construction by fixed chain link fencing or armoring as indicated on Drawings or specified herein. Plant protection devices shall be installed before work has begun and shall be maintained for duration of work unless otherwise directed by Owner's Representative.

(b) In the event that damage(s) to the Owner's trees, shrubs or vegetation occurs as a result of the Contractor's unauthorized operations, the Contractor shall pay or allow to the Owner compensation for said damage(s). Compensation shall be determined by the Owner's Representative using the "Valuation of Landscape Trees, Shrubs, and other Plants" as published by the International Society of Arboriculture, as last revised.

(2) To prevent compaction of soil over tree roots, vehicles or equipment shall not at any time park or travel over, nor shall any materials be stored within drip line of trees designated to remain.

(3) Owner's Representative will stop work immediately when proper measures are not being employed to protect trees and shrubs. Contractor will be notified to resume work after required protection measures are implemented.

(4) Pruning of limbs necessary to repair damage or provide clearance for work shall be done by the MU Landscape Services Department.

(5) Contractor shall repair tire ruts and other damages to existing lawn areas. Repairs shall match surrounding area.

10. SUBSTITUTIONS and EQUALS

a. Substitutions are defined in General Conditions article 3.11.8 for and Equals are defined General Conditions Article 3.12 .

b. Use of materials, products or equipment other than those named and described in the Contract Documents are substitutions and/or equal. Substitutions and/or equals submitted during the bidding period shall be received by both the Architect and the Owner at least ten calendar days prior to the date for receipt of bids. To be considered, bidder's proposal shall include a complete description of the proposed substitution and/or equal and a comparison of significant qualities of the proposed substitution and/or equal with those specified including drawings, performance and test data, and other information necessary for an evaluation. The Architect's decision on the approval or disapproval of a proposed substitution and/or equal shall be final.

c. If the Architect and Owner approve a proposed substitution prior to receipt of Bids, such approval will be set forth in an Addendum. Bidders shall not rely upon approval made in any other manner.

c. No substitutions and/or equal will be allowed for the following items:

Item	Specification Section
N/A	

11. CODES AND STANDARDS

The Contractor shall comply with applicable codes and standards as listed in General Conditions. The following codes and standards shall also apply:

12. PERMITS

Before commencement of Boilers, Water Heaters or Pressure Vessels the Contractor must obtain an installation permit from the State of Missouri, Division of Fire Safety, Boiler and Pressure Unit as required by 11 CSR 40-2.010 through 11 CSR 40-2.065. The permit applications are available at http://www.dfs.dps.mo.gov/programs/bpv/ .
.

13. SPECIALTIES (NOT USED)

14. PRE-BID INSPECTION

All pre-bid inspections of work areas shall be scheduled with pre-bid inspection guide, telephone: (573) 882-2228.

15. ROOF WARRANTY REQUIREMENT

a. Owner has an existing roof warranties on the Lottes Health Sciences Library roof of 4 years and on the Medical Science Addition of 5 years and are included at the end of this section. The Contractor shall verify roofing manufacturer and warranty provider. The Contractor shall use a licensed applicator of existing roofing system to make and repair roof penetrations in order for the Owner's existing warranty to remain in full force and effect.

Lottes Health Sciences Library
Roof System Manufacturer: Firestone Building Products
Roof Type: EPDM
Installer: Weathercraft of Cedar City
Manufacturer's Warranty: Twenty (20) Years
Substantial Completion: 10/18/2007
Expiration Date: 10/18/2027

Medical Science Addition
Roof System Manufacturer: Firestone Building Products
Roof Type: Modified Bitument
Installer: Weathercraft of Cedar City
Manufacturer's Warranty: Twenty (20) Years
Substantial Completion: 08/14/2008
Expiration Date: 08/14/2028

16. MODIFICATIONS TO INFORMATION TO BIDDERS

a. Information to Bidders:

(1) Referenced Information to Bidders, Page IFB/5.
Add new Article 15.8.5 as follows:

15.8.5 Within 48 hours of the receipt of bids, the apparent low bidder shall submit to the Director of Facilities Planning and Development an "Affidavit of Supplier Diversity Participation" for every diverse subcontractor or supplier the bidder intends to award work to on the contract. The affidavit will be signed by both the bidder and the diverse firm.

17. MODIFICATIONS TO GENERAL CONDITIONS

a. General Conditions:

(1) Reference: General Conditions Article 11.2.1 Commercial General Liability.

Delete in the first sentence of 11.2.1: "$2,000,000 per occurrence, $5,000,000 in general aggregate, $5,000,000 products and completed operations aggregate and $1,000,000 personal injury and advertising injury"

and insert: "$2,000,000 per occurrence, $10,000,000 in general aggregate, $10,000,000 products and completed operations aggregate and $1,000,000 personal injury and advertising injury"

18. PROJECT SCHEDULING

The project scheduling specification for the project are included immediately after the Special Conditions. For this project the Contractor shall meet the following scheduling requirements.

Option 3: Contractor Schedule – Contractor is responsible for the schedule and he may provide with in-house personnel or hire a third party scheduling consultant. See Contractor Schedule Specification included in these documents.

19. PROJECT COORDINATION

a. Coordinate construction operations included in various Sections of these Specifications to assure efficient and orderly installation of each part of the Work. Coordinate construction operations included under different Sections that depend on each other for proper installation, connection, and operation.

(1) Schedule construction operations in the sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.

(2) Coordinate installation of different components to assure maximum accessibility for required maintenance, service, and repair.

(3) Make provisions to accommodate items scheduled for later installation.

b. Coordination Drawings: Refer to Divisions 21, 22, 23, and 26 specifications for coordination drawing requirements.

20. PROJECT PARTNERING (NOT USED)

21. VALUE ENGINEERING (NOT USED)

22. BUILDING SYSTEM COMMISSIONING

a. Contractor shall provide all personnel and equipment required to complete the commissioning activities referenced in the Commissioning Plan. The requirements of the commissioning plan shall be completed in their entirety before substantial completion and submitted as referenced in the Closeout Log.

b. The contractor shall designate a competent person, separate from the superintendent or Project Manager, to act as the contractor's commissioning coordinator. The commissioning coordinator is responsible for planning, scheduling, coordinating, conducting and verifying all commissioning activities required by the commissioning plan and ensuring all building systems are complete, operable and ready for use by the Owner. At a minimum, building ventilation systems, chilled/hot water generation systems, hydronic distribution systems, power distributions systems and fire detection and alarm systems, as

applicable.

23. MECHANICAL, ELECTRICAL, PLUMBING (MEP) PRE-INSTALLATION MEETING(S)

a. Before the start of MEP installation, the Owner's Representative will convene an MEP pre-installation meeting. Meeting participants to include contractor (including MEP subcontractors), Owner's Representative and additional contractor and University operational staff invited by the Owner's Representative. Topics will include underground rough-ins, steam piping, chilled water piping, sprinkler piping, hot water piping, electrical system, duct, telephone/data wiring, control wiring. Additional meetings will be conducted as required for the review of coordination drawings and scope specific installations. Cross section drawings of corridor ceilings and other congested areas will be of highest priority and will be reviewed prior to the start of installations in the affected areas. Meeting minutes and sign-up sheet will be transcribed by contractor and distributed to attendees.

24. COST BREAKOUT FOR OWNER'S ACCOUNTING PURPOSES

a. Contractor will be required to submit the following cost breakouts on company letterhead prior to the end of the next business day following the bid opening.

(1) Cost Break Out #1 – CP211852 – as indicated in Lottes Health Science Library – Renovation for Consolidation drawing set
(2) Cost Break Out #2 - CP230151 – as indicated Lottes Replace Glazing & Roofing in Barrel Roof Systems drawing set.
(3) All contractor costs, including but not limited to, General Conditions, Overhead and Profit, Fees, Insurance, and Bonding shall be allocated proportionally to each cost breakout.
(4) Contractor shall submit separate Schedule of Values for each listed project.
(5) Contractor shall submit separate monthly pay application for each listed project.

25. PROJECT MANAGEMENT/COMMUNICATION REQUIREMENTS

a. The Contractor shall be represented at the site by both a competent full-time Project Manager and a full-time, competent superintendent with no other assigned duties or responsibilities from the beginning of the work until its final acceptance, unless otherwise permitted by the Owner's Representative. The superintendent for the Contractor for the general building work shall exercise general supervision over all subcontractors of any tier engaged on the work with decision-making authority of the Contractor.

b. The Contractor shall use a current industry standard (Primavera, Microsoft Project, etc.) project scheduling software which provides as a minimum: Critical paths, milestones, estimated and actual start and completion dates, scheduled vs. actual progress, and detailed task and subtask breakdown. The following schedules shall be provided as a minimum and kept current: Overall project schedule, four- (4-) week look-ahead, and two- (2-) week look-ahead.

c. The Contractor shall furnish on-site Internet access for use by his Project Manager and superintendent. The contractor shall utilize the Owner's secure information sharing system for submittals, construction payment process, change orders, RFI's/ASI's, O&M manuals and all other project manual requirements as directed by the Owner's Representative. Field staff are also required to utilize this software as directed by the Owner's Representative.

d. The Contractor shall provide at least two (2) job site FM handheld communication radios (walkie-talkies) for use by the on-site superintendent and the Owner's Representative or the Contractor shall provide his on-site superintendent with a handheld cellular telephone.

26. SAFETY PRECAUTIONS AND PROGRAMS

a. The Bidder's Statement of Qualifications includes a requirement that the Bidder provide its Worker's Compensation Experience Modification Rates (EMR) and Incidence Rates for the three recent years. The Bidder shall also include the EMR and Incidence Rates of listed major subcontractors on the Bid for Lump Sum Contract. If the EMR exceeds 1 or the Incidence Rate exceeds 13, the Contractor or major subcontractor shall take additional safety measures including, but not limited to, developing a site specific safety plan and assigning a Safety Manager to the Project to perform inspections on a schedule as determined acceptable by the Owner with written reports to be submitted to the Owner. The Owner reserves the right to reject a Bidder or major subcontractor whose rates exceed these stated rates.

b. The contractor shall provide Emergency Contact Information for the Contractor's on-site staff and home office management as well as contact information for all major subcontractor personnel. This information shall contain business and personal phone numbers for each individual for contact during or after hours in case of an emergency. This information shall be submitted within 15 days of the Notice to Proceed.

27. HOT WORK PERMITTING AND GENERAL REQUIREMENTS

Hot work Requirements: The contractor shall comply with the following hot work requirements and the requirements of the International Fire Code and 2014 NFPA 51B.

a. Hot work shall be defined as any work involving burning, welding, grinding, cutting, or similar operations that are capable of initiating fires or explosions.

a. The Contractor shall utilize the hot work permit decision tree and permit provided in the 2014 NFPA 51B for all Hot Work operations.

b. A hot work permit shall be used on all hot work performed outside a designated hot work area. The hot work permit shall be posted and clearly visible within proximity of the hot work area. The hot work permit authorizing individual (PAI) shall be as designated by the Contractor.

c. Notify the Owner's Representative 24 hours prior to starting hot work in buildings with operational fire alarm or fire suppression systems. The Owner's Representative will coordinate the appropriate system outage with Campus Maintenance personnel.

d. Unless otherwise instructed by the Owner's Representative, the Contractor shall post a copy of each completed hot work permit to the Owner's project management file system the following business day.

28. GENERAL REQUIREMENTS FOR CRANE AND HOISTING OPERATIONS

All crane and hoisting operations shall be performed in compliance with OSHA 29 CFR 1926. All Operators, riggers, and signal persons must have the proper qualifications and training necessary to perform the intended hoisting activities for this project.

a. Only fully certified and evaluated Operators shall perform equipment operations. Operators in an "Operator in Training" status shall not be used.

b. Submittal requirements:

1. Submit copies of Operator certifications, licenses, and evaluations to the Owners Representative.

2. Submit Rigger and Signal Person qualifications to the Owners Representative.

3. Unless otherwise directed by the Owners Representative, submit a lift plan and conduct a lift coordination meeting for hoisting or crane operations for any lift greater than 2,000 pounds, or for any multi pick lift. Include protective measures for existing underground utilities, occupied buildings, pedestrian and vehicle pathways, adjacent buildings and overhead power lines. If the lift is to occur over an occupied building, provide a registered structural engineer's review and verification that the building can resist the impact of a dropped load for the intended lift. If evacuation of an occupied building is necessary to conduct the lift, the decision for building evacuation or scheduling the lift for off-hours will be determined by the Owner.

29. CONSTRUCTION WASTE MANAGEMENT (for projects without a Division 02 specification)

The goal of Construction Waste Management is to divert waste from the sanitary landfill. This shall be accomplished through reuse, recycling and/or salvage of non-hazardous construction and demolition debris to the greatest extent practical. Track and report all efforts related to reuse, recycling and/or salvage materials from the project (including clean fill material). Report all material types and weights, where material was diverted, type of diversion, documentation of diversion (eg: waste or recycling tickets), and applicable dates. In order to calculate the diversion percentage, total weights of all non-hazardous landfill material must be reported. This information shall be updated monthly utilizing the Construction Waste Management Worksheet provided here: [for MU] http://www.cf.missouri.edu/cf/pdc/contractor_information. Copies of all applicable receipts, tickets and tracking logs shall be uploaded to the Owner's information sharing website or reported as required by the Construction Project Manager.

(A summary worksheet is required prior to substantial completion).

30. WARRANTY WALKTHROUGH

Contractor shall attend a walk-thru with the Owner at 11 months after acceptance to review and document any warranty items to be addressed as part of the 12 month warranty stated in article 3.1 of the General Conditions.

END OF SECTION

RED SHIELD WARRANTY

RED SHIELD ROOFING SYSTEM LIMITED WARRANTY

Warranty No: RO019769 **FBPCO #EC9630** **Square Footage: 16660 s.f.**
Building Owner: UNIVERSITY OF MISSOURI - COLUMBIA
Building Identification: LOTTES HSL
Building Address: MA202 HEALTH SCIENCE CENTER, COLUMBIA, MO, 65212
Warranty Period Of: TWENTY (20) Years Beginning on: 10/18/07
Roofing Contractor: WEATHERCRAFT OF CEDAR CITY (02368)

For the warranty period indicated above, Firestone Building Products Company, LLC ("Firestone"), an Indiana limited liability company, warrants to the Building Owner ("Owner") named above that Firestone will, subject to the Terms, Conditions and Limitations set forth below, repair any leak in the Firestone Roofing System ("System").

TERMS, CONDITIONS AND LIMITATIONS

1. **Products Covered.** The System shall mean only the Firestone brand roofing membranes, Firestone brand roofing insulations, Firestone brand roofing metal, and other Firestone brand roofing accessories when installed in accordance with Firestone technical specifications by a Firestone-licensed applicator.
2. **Notice.** In the event any leak should occur in the System, the Owner must give notice in writing or by telephone to Firestone within thirty (30) days of any occurrence of a leak. Written notice may be sent to Firestone at the street address or fax number shown on the reverse side of this Limited Warranty. Evidence of this notice shall be the receipt by Owner of a Firestone Leak Notification Acknowledgement. By so notifying Firestone, the Owner authorizes Firestone or its designee to investigate the cause of the leak.
3. **Investigation.** If upon investigation, Firestone determines that the leak is not excluded under the Terms, Conditions and Limitations set forth in this Red Shield Roofing System Limited Warranty (the "Limited Warranty"), the Owner's sole and exclusive remedy and Firestone's total liability shall be limited to the repair of the leak. Should the investigation reveal that the leak is excluded under the Terms, Conditions and Limitations, the Owner shall be responsible for payment of the investigation costs. Failure by Owner to pay for these costs shall render this Limited Warranty null and void. Firestone will advise the Owner of the type and/or extent of repairs required to be made at the Owner's expense that will permit this Limited Warranty to remain in effect for the unexpired portion of its term. Failure by the Owner to properly make these repairs in a reasonable manner using a Firestone-licensed applicator and within 60 days shall render this Limited Warranty null and void.
4. **Disputes.** Any dispute, controversy or claim between the Owner and Firestone concerning this Limited Warranty shall be settled by mediation. In the event that the Owner and Firestone do not resolve the dispute, controversy or claim in mediation, the Owner and Firestone agree that neither party will commence or prosecute any suit, proceeding, or claim other than in the courts of Hamilton County in the state of Indiana or the United States District Court, Southern District of Indiana, Indianapolis Division. Each party irrevocably consents to the jurisdiction and venue of the above-identified courts.
5. **Payment Required.** Firestone shall have no obligation under this Limited Warranty unless and until Firestone and the licensed applicator have been paid in full for all materials, supplies, services, approved written change orders, warranty costs and other costs which are included in, or incidental to, the System. In the event that repairs not covered by this Limited Warranty are necessary in the future, Firestone reserves the right to suspend this Limited Warranty until such repairs have been completed and the licensed applicator and/or Firestone has been paid in full for such repairs.
Exclusions. Firestone shall have no obligation under this Limited Warranty, or any other liability, now or in the future if a leak or damage is caused by: (a) Natural forces, disasters, or acts of God including, but not limited to winds in excess of 55 MPH, fires, hurricanes, tornadoes, hail, wind-blown debris, lightning, earthquakes, volcanic activity, atomic radiation, insects or animals; (b) Any act(s), conduct or omission(s) by any person, or act(s) of war, terrorism or vandalism, which damage the System or which impair the System's ability to resist leaks; (c) Failure by the Owner to use reasonable care in maintaining the System, said maintenance to include, but not limited to those items listed on the reverse side of this Limited Warranty titled "Building Envelope Care and Maintenance Guide"; (d) Deterioration or failure of building components, including, but not limited to, the roof substrate, walls, mortar, HVAC units, etc.; (e) Condensation or infiltration in, through, or around the walls, copings, rooftop, hardware or equipment, building structure or underlying or surrounding materials; (f) Any acid, oil, harmful chemical, chemical or physical reaction and the like which comes in contact with the System, which damages the System, or which impairs the System's ability to resist leaks;
(g) Alterations or repairs to the System that are not completed in accordance with our published specifications, not completed by licensed contractor, and/or where current notification procedures were not followed; (h) The architecture, engineering, construction, or design of the roof, roofing system, or building. Firestone does not undertake any analysis of the architecture or engineering required to evaluate what type of roof system is appropriate; (i) A change in building use or purpose; (j) Deterioration to metal roofing materials and accessories caused by marine salt water atmosphere or by regular spray of either salt or fresh water. or (k) Failure to give proper notice as set forth in paragraph 2(a) above.
6. **Transfer.** This Limited Warranty shall be transferable subject to Owner's payment of the current transfer fee set by Firestone.
7. **Term.** The term of this Limited Warranty shall be for the period set forth above and such term shall not be extended under any circumstances.
8. **Roof Access.** During the term of this Limited Warranty, Firestone's designated representative or employees shall have free access to the roof during regular business hours. In the event that roof access is limited due to security or other restrictions, Owner shall reimburse Firestone for all reasonable cost incurred during inspection and/or repair of the System that are due to delays associated with said restrictions. Owner shall be responsible for the damage caused by, removal and replacement of any overburdens, superstrata or overlays, either permanent or temporary, excluding accepted stone ballast or pavers, as necessary to expose the system for inspection and/or repair.
9. **Waiver.** Firestone's failure to enforce any of the terms or conditions stated herein shall not be construed as a waiver of such provision or of any other terms and conditions of this Limited Warranty.
10. **Governing Law.** This Limited Warranty shall be governed by and construed in accordance with the laws of the State of Indiana without regard to that State's rules on conflict of laws.
11. **Severability.** If any portion of this Limited Warranty is held by a court of competent jurisdiction to be invalid, void or unenforceable, the remaining provisions shall nevertheless continue in full force.

FIRESTONE DOES NOT WARRANT PRODUCTS INCORPORATED OR UTILIZED IN THIS INSTALLATION THAT WERE NOT FURNISHED BY FIRESTONE. FIRESTONE SPECIFICALLY DISCLAIMS LIABILITY UNDER ANY THEORY OF LAW ARISING OUT OF THE INSTALLATION OF, PERFORMANCE OF, OR DAMAGES SUSTAINED BY OR CAUSED BY, PRODUCTS NOT FURNISHED BY FIRESTONE.

THIS LIMITED WARRANTY SUPERSEDES AND IS IN LIEU OF ALL OTHER WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, AND FIRESTONE HEREBY DISCLAIMS ALL SUCH WARRANTIES. THIS LIMITED WARRANTY SHALL BE THE OWNER'S SOLE AND EXCLUSIVE REMEDY AGAINST FIRESTONE, AND FIRESTONE SHALL NOT BE LIABLE FOR ANY CONSEQUENTIAL, SPECIAL, INCIDENTAL OR OTHER DAMAGES INCLUDING, BUT NOT LIMITED TO, LOSS OF PROFITS OR DAMAGES TO THE BUILDING OR ITS CONTENTS OR THE ROOF DECK. THIS LIMITED WARRANTY CANNOT BE AMENDED, ALTERED OR MODIFIED IN ANY WAY EXCEPT IN WRITING SIGNED BY AN AUTHORIZED OFFICER OF FIRESTONE. NO OTHER PERSON HAS ANY AUTHORITY TO BIND FIRESTONE WITH ANY REPRESENTATION OR WARRANTY WHETHER ORAL OR WRITTEN.

FIRESTONE BUILDING PRODUCTS COMPANY, LLC
By: **John R. Geary**

Authorized Signature: John R. Geary

Title: **VP of Quality, Technology & Product Development**

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Firestone

BUILDING ENVELOPE CARE AND MAINTENANCE GUIDE
(For Red Shield Warranted Roofing Systems)

Congratulations on your purchase of a Firestone Roofing System! Your roof is a valuable asset that should be properly maintained. **All roofs and roofing systems require periodic inspection and maintenance to perform as designed and to keep your Limited Warranty in full force and effect.**

1. The roof should be inspected at least twice yearly and after any severe storms. A record of all inspection and maintenance activities should be maintained, including a listing of the date and time of each activity as well as the identification of the parties performing the activity.
2. Proper maintenance and good roofing practice require that ponded water (defined as water standing on the roof forty-eight hours after it stops raining) not be allowed on the roof. Roofs should have slope to drain, and all drain areas must remain clean. Bag and remove all debris from the roof since such debris can be quickly swept into drains by rain. This will allow for proper water run-off and avoid overloading the roof.
3. The Firestone Roofing System should not be exposed to acids, solvents, greases, oil, fats, chemicals and the like. If the Firestone Roofing System is in contact with any such materials, these contaminants should be removed immediately and any damaged areas should be inspected by a Firestone Licensed Applicator and repaired if necessary.
4. The Firestone Roofing System is designed to be a waterproofing membrane and not a traffic surface. Roof traffic other than periodic traffic to maintain rooftop equipment and conduct periodic inspections should be prohibited. In any areas where periodic roof traffic may be required to service rooftop equipment or to facilitate inspection of the roof, protective walkways should be installed by a Firestone Licensed Applicator as needed to protect the roof surface from damage.
5. Some Firestone roofing membranes require maintenance of the surface of the membrane:
   a. **Smooth-surfaced Firestone APP membranes** should be coated with an approved liquid coating, such as Firestone Aluminum Roof Coating or Firestone AcryliTop applied in accordance with Firestone specifications, in order to maximize the service life of the membrane. If this coating is not applied as part of the initial roofing installation, it should be applied within the first five years after the roof is installed to help protect the membrane from surface crazing and cracking. In addition, this coating should be maintained as needed to re-coat any areas that have blistered, peeled or worn through.
   b. **Granule-surfaced Firestone APP and SBS membranes** do not normally require surface maintenance other than periodic inspection for contaminants, cuts or punctures. If areas of granular loss are discovered during inspection, these areas should be coated with Firestone AcryliTop or other Firestone-approved coating applied in accordance with Firestone specifications.
   c. **Gravel-surfaced Firestone BUR membranes** do not normally require surface maintenance other than periodic inspection for contaminants or damage. If areas of gravel loss are discovered during inspection, gravel must be reinstalled into hot asphalt to protect the surface of the membrane. Coatings on smooth surface BUR membranes must be maintained as needed to re-coat any areas that have blistered, peeled or worn through.
   d. **Firestone EPDM and TPO roofing membranes** do not normally require surface maintenance other than periodic inspection for contaminants, cuts or punctures. Occasionally, approved liquid roof coatings, such as Firestone AcryliTop, are applied to the surface of EPDM membranes in order to provide a lighter surface color. Such coatings do not need to be maintained to assure the performance of the underlying EPDM roof membrane, but some maintenance and re-coating may be necessary in order to maintain a uniform surface appearance.
   e. **Firestone Una-Clad metal roofing panels and trim** do not normally require surface maintenance other than periodic inspection for contaminants or damage. In addition, periodic cleaning of the surface may be required to remove dirt and maintain the aesthetic appearance of the coated metal. Simple washing with plain water using hoses or pressure spray equipment is usually adequate. If cleaning with agents other than water is contemplated, several precautions should be observed: (1) do not use wire brushes, abrasives, or similar cleaning tools which will mechanically abrade the coating surface, and (2) cleaning agents should be tested in an inconspicuous area before use on a large scale.
6. All metal work, including counter-flashings, drains, skylights, equipment curbs and supports, and other Firestone brand rooftop accessories must be properly maintained at all times. Particular attention should be paid to sealants at joints in metal work and flashings. If cracking or shrinkage is observed, the joint sealant should be removed and replaced with new sealant.

7. Any alterations to the roof, including but not limited to roof curbs, pipe penetrations, roof-mounted accessories, and tie-ins to building additions must be performed by a licensed Firestone Licensed Applicator and reported to Firestone. Additional information and reporting forms for roof alterations are available at www.firestonebpco.com.

9. Should you experience a leak:
   (a) Check for the obvious: clogged roof drains, loose counterflashings, broken skylights, open grills or vents, broken water pipes.
   (b) Note conditions resulting in leakage. Heavy or light rain, wind direction, temperature and time of day that the leak occurs are all-important clues to tracing roof leaks. Note whether the leak stops shortly after each rain or continues to drip until the roof is dry. If you are prepared with the facts, the diagnosis and repair of the leak can proceed more rapidly.
   (c) Contact Firestone Warranty Claims at 1-800-830-5612 as soon as possible...but please don't call until you are reasonably sure that the Firestone Roofing System is the cause of the leak.

Firestone feels that the preceding requirements will assist you, the building owner, in maintaining a watertight roof for many years. Your roof is an investment, and maintenance is essential to maximize your return on this important investment.

Firestone
BUILDING PRODUCTS
NOBODY COVERS YOU BETTER.®
310 East 96th Street – Indianapolis, IN 46240
1-800-428-4442 * 1-317-575-7000 * FAX 1-317-575-7100
www.firestonebp.com

RED SHIELD WARRANTY

RED SHIELD ROOFING SYSTEM LIMITED WARRANTY

Warranty No: RO023727 **FBPCO #LC9629** **Square Footage: 16440 s.f.**
Building Owner: UNIVERSITY OF MISSOURI - COLUMBIA
Building Identification: MEDICAL SCIENCE ADDITION
Building Address: MA202 HEALTH SCIENCE CENTER, COLUMBIA, MO, 65212
Warranty Period Of: TWENTY (20) Years Beginning on: 08/14/08
Roofing Contractor: WEATHERCRAFT OF CEDAR CITY (02368)

For the warranty period indicated above, Firestone Building Products Company, LLC ("Firestone"), an Indiana limited liability company, warrants to the Building Owner ("Owner") named above that Firestone will, subject to the Terms, Conditions and Limitations set forth below, repair any leak in the Firestone Roofing System ("System").

TERMS, CONDITIONS AND LIMITATIONS

1. **Products Covered**. The System shall mean only the Firestone brand roofing membranes, Firestone brand roofing insulations, Firestone brand roofing metal, and other Firestone brand roofing accessories when installed in accordance with Firestone technical specifications by a Firestone licensed applicator.
2. **Notice**. In the event any leak should occur in the System, the Owner must give notice in writing or by telephone to Firestone within thirty (30) days of any occurrence of a leak. Written notice may be sent to Firestone at the street address or fax number shown on the reverse side of this Limited Warranty. Evidence of this notice shall be the receipt by Owner of a Firestone Leak Notification Acknowledgement. By so notifying Firestone, the Owner authorizes Firestone or its designee to investigate the cause of the leak.
3. **Investigation**. If upon investigation, Firestone determines that the leak is not excluded under the Terms, Conditions and Limitations set forth in this Red Shield Roofing System Limited Warranty (the "Limited Warranty"), the Owner's sole and exclusive remedy and Firestone's total liability shall be limited to the repair of the leak. Should the investigation reveal that the leak is excluded under the Terms, Conditions and Limitations, the Owner shall be responsible for payment of the investigation costs. Failure by Owner to pay for these costs shall render this Limited Warranty null and void. Firestone will advise the Owner of the type and/or extent of repairs required to be made at the Owner's expense that will permit this Limited Warranty to remain in effect for the unexpired portion of its term. Failure by the Owner to properly make these repairs in a reasonable manner using a Firestone-licensed applicator and within 60 days shall render this Limited Warranty null and void.
4. **Disputes**. Any dispute, controversy or claim between the Owner and Firestone concerning this Limited Warranty shall be settled by mediation. In the event that the Owner and Firestone do not resolve the dispute, controversy or claim in mediation, the Owner and Firestone agree that neither party will commence or prosecute any suit, proceeding, or claim other than in the courts of Hamilton County in the state of Indiana or the United States District Court, Southern District of Indiana, Indianapolis Division. Each party irrevocably consents to the jurisdiction and venue of the above-identified courts.
5. **Payment Required**. Firestone shall have no obligation under this Limited Warranty unless and until Firestone and the licensed applicator have been paid in full for all materials, supplies, services, approved written change orders, warranty costs and other costs which are included in, or incidental to, the System. In the event that repairs not covered by this Limited Warranty are necessary in the future, Firestone reserves the right to suspend this Limited Warranty until such repairs have been completed and the licensed applicator and/or Firestone has been paid in full for such repairs.
   Exclusions. Firestone shall have no obligation under this Limited Warranty, or any other liability, now or in the future if a leak or damage is caused by: (a) Natural forces, disasters, or acts of God including, but not limited to winds in excess of 55 MPH, fires, hurricanes, tornadoes, hail, wind-blown debris, lightning, earthquakes, volcanic activity, atomic radiation, insects or animals; (b) Any act(s), conduct or omission(s) by any person, or act(s) of war, terrorism or vandalism, which damage the System or which impair the System's ability to resist leaks; (c) Failure by the Owner to use reasonable care in maintaining the System, said maintenance to include, but not limited to those items listed on the reverse side of this Limited Warranty titled "Building Envelope Care and Maintenance Guide"; (d) Deterioration or failure of building components, including, but not limited to, the roof substrate, walls, mortar, HVAC units, etc.; (e) Condensation or infiltration in, through, or around the walls, copings, rooftop, hardware or equipment, building structure or underlying or surrounding materials; (f) Any acid, oil, harmful chemical, chemical or physical reaction and the like which comes in contact with the System, which damages the System, or which impairs the System's ability to resist leaks; (g) Alterations or repairs to the System that are not completed in accordance with our published specifications, not completed by licensed contractor, and/or where current notification procedures were not followed; (h) The architecture, engineering, construction, or design of the roof, roofing system, or building. Firestone does not undertake any analysis of the architecture or engineering required to evaluate what type of roof system is appropriate; (i) A change in building use or purpose; (j) Deterioration to metal roofing materials and accessories caused by marine salt water atmosphere or by regular spray of either salt or fresh water; or (k) Failure to give proper notice as set forth in paragraph 2(a) above.
6. **Transfer**. This Limited Warranty shall be transferable subject to Owner's payment of the current transfer fee set by Firestone.
7. **Term**. The term of this Limited Warranty shall be for the period set forth above and such term shall not be extended under any circumstances.
8. **Roof Access**. During the term of this Limited Warranty, Firestone's designated representative or employees shall have free access to the roof during regular business hours. In the event that roof access is limited due to security or other restrictions, Owner shall reimburse Firestone for all reasonable cost incurred during inspection and/or repair of the System that are due to delays associated with said restrictions. Owner shall be responsible for the damage caused by, removal and replacement of any overburdens, superstrata or overlays, either permanent or temporary, excluding accepted stone ballast or pavers, as necessary to expose the system for inspection and/or repair.
9. **Waiver**. Firestone's failure to enforce any of the terms or conditions stated herein shall not be construed as a waiver of such provision or of any other terms and conditions of this Limited Warranty.
10. **Governing Law**. This Limited Warranty shall be governed by and construed in accordance with the laws of the State of Indiana without regard to that State's rules on conflict of laws.
11. **Severability**. If any portion of this Limited Warranty is held by a court of competent jurisdiction to be invalid, void or unenforceable, the remaining provisions shall nevertheless continue in full force.

FIRESTONE DOES NOT WARRANT PRODUCTS INCORPORATED OR UTILIZED IN THIS INSTALLATION THAT WERE NOT FURNISHED BY FIRESTONE. FIRESTONE SPECIFICALLY DISCLAIMS LIABILITY UNDER ANY THEORY OF LAW ARISING OUT OF THE INSTALLATION OF, PERFORMANCE OF, OR DAMAGES SUSTAINED BY OR CAUSED BY, PRODUCTS NOT FURNISHED BY FIRESTONE.

THIS LIMITED WARRANTY SUPERSEDES AND IS IN LIEU OF ALL OTHER WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, AND FIRESTONE HEREBY DISCLAIMS ALL SUCH WARRANTIES. THIS LIMITED WARRANTY SHALL BE THE OWNER'S SOLE AND EXCLUSIVE REMEDY AGAINST FIRESTONE, AND FIRESTONE SHALL NOT BE LIABLE FOR ANY CONSEQUENTIAL, SPECIAL, INCIDENTAL OR OTHER DAMAGES INCLUDING, BUT NOT LIMITED TO, LOSS OF PROFITS OR DAMAGES TO THE BUILDING OR ITS CONTENTS OR THE ROOF DECK. THIS LIMITED WARRANTY CANNOT BE AMENDED, ALTERED OR MODIFIED IN ANY WAY EXCEPT IN WRITING SIGNED BY AN AUTHORIZED OFFICER OF FIRESTONE. NO OTHER PERSON HAS ANY AUTHORITY TO BIND FIRESTONE WITH ANY REPRESENTATION OR WARRANTY WHETHER ORAL OR WRITTEN.

FIRESTONE BUILDING PRODUCTS COMPANY, LLC
By: **John R. Geary**

Authorized Signature: John R. Geary
Title: **VP of Quality, Technology & Product Development**

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Firestone

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Option #3 – Contractor Schedule

1. GENERAL
   a) Time is of the essence for this contract.
      The time frames spelled out in this contract are essential to the success of this project. The University understands that effective schedule management, in accordance with the General Conditions and these Special Conditions is necessary to insure to that the critical milestone and end dates spelled out in the contract are achieved.
   b) Related Documents
      Drawings and general provisions of the Contract, including General Conditions' Article 3.17 shall apply to this Section.
   c) Stakeholders
      A Stakeholder is anyone with a stake in the outcome of the Project, including the University, the University Department utilizing the facility, the Design Professionals, the Contractor and subcontractors.
   d) Weather
      (1) Contractor acknowledges that there will be days in which work cannot be completed due to the weather, and that a certain number of these lost days are to be expected under normal weather conditions in Missouri.
      (2) Rather than speculate as to what comprises "normal" weather at the location of the project, Contractor agrees that it will assume a total of 44 lost days due to weather over the course of a calendar year, and include same in its as planned schedule. For projects of less than a calendar year, lost weather days should be prorated for the months of construction in accordance with the following schedule.
      (3) Anticipated weather days for allocation/proration only. For projects lasting 12 months or longer, the 44 days per year plus whatever additional months are included will constitute normal weather.

Jan – 5 days	Feb – 5 days	Mar – 4 days	Apr – 4 days
May – 3 days	Jun – 3 days	Jul – 2 days	Aug – 2 days
Sep – 3 days	Oct – 4 days	Nov – 4 days	Dec – 5 days

2. SCHEDULING PROCESS
   a) The intent of this section is to insure that a well-conceived plan, that addresses the milestone and completion dates spelled out in these documents, is developed with input from all stakeholders in the project. Input is limited to all reasonable requests that are consistent with the requirements of the contract documents, and do not prejudice the Contractor's ability to perform its work consistent with the contract documents.
      Further, the plan must be documented in an understandable format that allows for each stakeholder in the project to understand the plan for the construction and/or renovation contained in the Project.

   b) Contractor Requirements
      (1) Schedule Development
          Contractor shall prepare the Project Schedule using Primavera P3 or Oracle P6.
      (2) Schedule Development
          Within 4 weeks of the NTP, contractor shall prepare a schedule, in CPM format, that reflects the contractor's and each subcontractors plan for performing the contract work.

          Contractor shall review each major subcontractor's schedule with the sub and obtain the subcontractor's concurrence with the schedule, prior to submitting to the University.
      (3) Schedule Updates.

(a) Schedule Updates will be conducted once a month, at a minimum.
Actual Start and Finish dates should be recorded regularly during the month. Percent Complete, or Remaining Duration shall be updated as of the data date, just prior to Contractor's submittal of the update data.
(b) Contractor will copy the previous months schedule and will input update information into the new monthly update version.
(c) Contractor will meet with the Owner's Representative to review the draft of the updated schedule. At this meeting, Owner's Representative and Contractor will:
(i) Review out of sequence progress, making adjustments as necessary,
(ii) Add any fragnets necessary to describe changes or other impacts to the project schedule and
(iii) Review the resultant critical and near critical paths to determine any impact of the occurrences encountered over the last month.

(4) Schedule Narrative
After finalization of the update, the Contractor will prepare a Narrative that describes progress for the month, impacts to the schedule and an assessment as to the Contractor's entitlement to a time extension for occurrences beyond its control during the month and submit in accordance with this Section.

(5) Progress Meetings
(a) Review the updated schedule at each monthly progress meeting. Payments to the Contractor may be suspended if the progress schedule is not adequately updated to reflect actual conditions.
(b) Submit progress schedules to subcontractors to permit coordinating their progress schedules to the general construction work. Include 4 week look ahead schedules to allow subs to focus on critical upcoming work.

3. CRITICAL PATH METHOD (CPM)
a) This Section includes administrative and procedural requirements for the critical path method (CPM) of scheduling and reporting progress of the Work.
b) Refer to the General and Special Conditions and the Agreement for definitions and specific dates of Contract Time.
c) Critical Path Method (CPM): A method of planning and scheduling a construction project where activities are arranged based on activity relationships and network calculations determine when activities can be performed and the critical path of the Project.
d) Critical Path: The longest continuous chain of activities through the network schedule that establishes the minimum overall project duration.
e) Network Diagram: A graphic diagram of a network schedule, showing the activities and activity relationships.
f) Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling, the construction project. Activities included in a construction schedule consume time and resources.
g) Critical activities are activities on the critical path.
h) Predecessor activity is an activity that must be completed before a given activity can be started.
i) Milestone: A key or critical point in time for reference or measurement.
j) Float or Slack Time: The measure of leeway in activity performance. Accumulative float time is not for the exclusive use or benefit of the Owner or Contractor, but is a project resource available to both parties as needed to meet contract milestones and the completion date.
k) Total float is herein defined as the measure of leeway in starting or completing an activity without adversely affecting the planned project completion date.
l) Weather: Adverse weather that is normal for the area must be taken into account in the Contractor's Project Schedule. See 1.d.3, above.

m) Force Majeure Event: Any event that delays the project but is beyond the control and/or contractual responsibility of either party.

n) Schedule shall including the following, in addition to Contractor's work.

(1) Phasing: Provide notations on the schedule to show how the sequence of the Work is affected by the following:

(a) Requirements for phased completion and milestone dates.
(b) Work by separate contractors.
(c) Work by the Owner.
(d) Coordination with existing construction.
(e) Limitations of continued occupancies.
(f) Uninterruptible services.
(g) Partial occupancy prior to Substantial Completion.
(h) Area Separations: Use Activity Codes 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.

4. TIME EXTENSION REQUESTS

a) Refer to General Conditions of the Contract for Construction, Article 4.7 Claims for Additional Time.

b) Changes or Other Impacts to the Contractor's Work Plan
The Owner will consider and evaluate requests for time extensions due to changes or other events beyond the control of the Contractor on a monthly basis only, with the submission of the Contractor's updated schedule, in conjunction with the monthly application for payment. The Update must include:

(1) An activity depicting the event(s) impacting the Contractors work plan shall be added to the CPM schedule, using the actual start date of the impact, along with actually required predecessors and successors.

(2) After the addition of the impact activity(ies), the Contractor will identify subsequent activities on the critical path, with finish to start relationships that can be realistically adjusted to overlap using good, standard construction practice.

(a) If the adjustments above result in the completion date being brought back within the contract time period, no adjustment will be made in the contract time.
(b) If the adjustments above still result in a completion date beyond the contract completion date, the delay shall be deemed excusable and the contract completion date shall be extended by the number of days indicated by the analysis.
(c) Contractor agrees to continue to utilize its best efforts to make up the time caused by the delays. However the Contractor is not expected to expend costs not contemplated in its contract, in making those efforts.

c) Questions of compensability of any delays shall be held until the actual completion of the project. If the actual substantial completion date of the project based on excusable delays, excluding weather delays, exceeds the original contract completion date, AND there are no delays that are the responsibility of the contractor to consider, the delays days shall be considered compensable. The actual costs, if any, of the Contractor's time sensitive jobsite supervision and general conditions costs, shall be quantified and a change order issued for these costs.

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UNIVERSITY OF MISSOURI
ROOF SYSTEM MANUFACTURERS CERTIFICATION
(Revised 12/94)

TO:_____ Title_____
Project No. _____
Location _____

Our technical staff has examined the Architect/Engineer's Drawings, Specifications and required warranty for the roofing work on this project. We do not wholly endorse the building design or any materials or services not part of our advertised roofing system.

CERTIFICATION

We hereby certify that:

1. All materials we will furnish and deliver to the project shall be of good merchantable quality, shall meet or exceed the Specifications required and shall, if properly applied by one of our approved roofing applicator firms in accord with our instructions, provide a sound weather/watertight roofing system.
2. Upon completion of the installation in accord with the Drawings and specifications and our recommended installation procedures, we shall issue a total system warranty specified in the project Specifications.
3. The Drawings and Specifications follow the recommendations of our roofing manual for this type of roofing system with:

   No exceptions.

   The following exceptions: (The roofing system will be approved for this project if the following changes are made to the Contract Documents. The bid provided with this Document includes the required changes).

   NOTE: Exceptions may cause Owner to reject bid.
   Exceptions are as follows:

_____
_____
_____
_____
_____
_____

4. The Warranty will be issued for the following proposed roofing system:

_____
_____
_____

ROOFING SYSTEM MANUFACTURER: _____

Authorized Signature: _____

Title: _____ Date _____

Telephone Number: ( ) _____

Fax Number: ( ) _____

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UNIVERSITY OF MISSOURI
CONTRACTORS ROOFING/FLASHING/SHEET METAL GUARANTEE
(Revised 12/94)

WHEREAS (NAME AND ADDRESS OF COMPANY) _____
herein referred to as Roofing Contractor, certify that they have furnished and installed all roofing, flashing, sheet metal and related components in accordance with the Contract Documents and as required by the Roofing System Manufacturer=s installation instructions on the facility described below:

Facility: _____

Owner: University of Missouri-(CAMPUS)
(CAMPUS ADDRESS)

Date of Full Completion: _____

Approximate Area of Roof: _____

Type of Roofing Material: _____

Manufacturer's Specification Number: _____

Thickness and Type of Roof Insulation: _____

NOW, THEREFORE, Roofing Contractor guaranties to the Owner, subject only to the exclusions stated hereinafter, that all roofing, flashing and sheetmetal work is fully and integrally watertight and is free from faults and defects in material or workmanship, and is guaranteed for a period of three (3) years from date of full completion of work.

EXCLUSIONS: This guarantee does not cover, and Roofing Contractor shall not be liable for the following:

1. Damage to the roofing system caused by fire, lightning, tornado, hurricane or hailstorm.

2. Damage to roofing system caused by significant settlement, distortion or failure of roof deck, walls, or foundations of building, excepting normal building expansion and contraction is not a part of this exclusion.

3. Abuse by the Owner and/or third parties.

REPAIRS: Owner shall promptly notify Roofing Contractor, in writing, of the need for repair of roofing, flashing, or sheet metal:

1. Roofing Contractor, within eight (8) hours after receipt of such notice, shall make emergency repairs at its expense, as required to render the facility watertight.

2. Within five (5) days after receipt of such notice, Roofing Contractor shall at its expense correct any faults or defects in material or workmanship.

3. Should needed repairs not be covered by this guarantee, Roofing Contractor, after having obtained Owner's written consent, shall make such repairs at Owner's expense. Following said repairs, this guarantee shall thereafter remain in effect for the unexpired portion of the original term. If Owner does not so consent or repairs are made by others than the Roofing Contractor, this guarantee shall terminate for those parts of the roof affected by the repair.

4. In the event that Owner has notified the Roofing Contractor of the need for repairs and (i) Roofing Contractor does not immediately make repairs, or (ii) Roofing Contractor disclaims responsibility for the repairs and Owner disagrees, or (iii) Owner considers Roofing Contractor=s quoted cost for repairs not covered by this guarantee to be unreasonable and, an emergency condition exists which requires prompt repair to avoid substantial damage or loss to Owner, then, Owner may make such temporary repairs as he finds necessary and such action shall not be a breach of the provisions of this guarantee.

ANNUAL INSPECTIONS: Roofing Contractor shall inspect roof installation prior to each of the three anniversary dates from date of full completion of the work.

1. Inspection team to include Roofing Contractor, Roof Manufacturer, and Owner=s Representative.

2. Inspection of total roof system will be included in the annual inspections.

3. All defects in total roof system will be corrected by the Roofing Contractor within 30 days of inspection.

4. Roof manufacturer will certify by a written report that roof inspection has been completed, defects are acknowledged, and will warrant any repairs.

5. All corrective work completed by Roofing Contractor shall be warranted as approved by the Roofing Manufacturer.

ROOF MODIFICATION: Should Owner require work to be done on roof of said facility including modifications, alternations, extensions or additions to roof and including installation of vents, platforms, equipment, bracings or fastenings, Owner shall notify Roofing Contractor and give Roofing Contractor an opportunity to make recommendations as to methods necessary to safeguard against damage to roofing covered by this guarantee. Failure of Owner to give Roofing Contractor such opportunity or failure to follow methods recommended by Roofing Contractor shall render this guarantee null and void to the extent such failure should result in damage to roofing covered by this guarantee.

NOTICES: Notification of Roofing Contractor by Owner, shall be fulfilled by sending notice to Roofing Contractor.

IN WITNESS WHEREOF, we set our hands this _____ day of _____, 20___.

By:_____

Title:_____

For Roofing Contractor

Name:_____

Address:_____

Phone:_____

SHOP DRAWING AND SUBMITTAL LOG

DATE REC'D	SUBMITTAL #	SPEC. SECTION # | REVISION	SPEC / SUBMITTAL DESCRIPTION	SUBCONTRACTOR	Owner to Review (SOA is not recording if Owner has reviewed or date when Owner has reviewed)	# REC'D.	REFERRED					ACTION							COPIES TO				
							TO	SOA Transmittal No.	Date sent to Consultant	# COPIES	Date Rec'd from consultant	APPROVED	APPROVED AS CORRECTED	REVISE & RESUBMIT	REJECTED	SUBMIT SPECIFIC ITEM	Date Ret'd to General Contractor	SOA Transmittal No.	CONTRACTOR	OWNER	CONSULTANT	ARCHITECT
ARCHITECTURAL																						
		03 3000	**CAST-IN-PLACE CONCRETE**																			
			Product Data																			
			Design Mixtures																			
			Steel Reinforcement Shop Drawings																			
		05 1200	**STRUCTURAL STEEL FRAMING**																			
			Product Data																			
			Welding Qualification Data, Welding Certificates																			
			Shop Drawings																			
			Mill reports																			
		05 3100	**STEEL DECKING**																			
			Product Data, Certificates																			
			Welding Qualification Data, Welding Certificates																			
			Shop Drawings																			
			Mill reports																			
		06 4116	**PLASTIC - LAMINATE - CLAD ARCHITECTURAL CABINETS**																			
			Product Data																			
			Shop Drawings																			
			Samples for Verification																			
		07 5419	**POLYVINYL-CHLORIDE (PVC) ROOFING**																			
			Product Data, Wind Uplift Resistance report																			
			Shop Drawings																			
			Samples for Verification																			
			Sample Warranties																			
		07 8100	**APPLIED FIRE PROTECTION**																			
			Product Data																			
			Installer Qualifications																			
		07 8413	**PENETRATION FIRESTOPPING**																			
			Product Data																			
			Product Schedule																			
			Installer Qualifications																			
		07 8443	**JOINT FIRESTOPPING**																			
			Product Data																			
			Product Schedule																			
			Installer Qualifications																			
		07 9200	**JOINT SEALANTS**																			
			Product Data																			
			Product Schedule																			
			Samples for Initial Selection																			

SHOP DRAWING AND SUBMITTAL LOG

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			Samples for Verification																			
		07 9513.13	**INTERIOR EXPANSION JOINT COVER ASSEMBLIES**																			
			Product Data																			
			Product Schedule																			
			Samples for Initial Selection																			
		08 1113	**HOLLOW METAL DOORS AND FRAMES**																			
			Product Data																			
			Shop Drawings																			
		08 1416	**FLUSH WOOD DOORS**																			
			Product Data																			
			Shop Drawings																			
			Samples for Initial Selection																			
			Samples for Verification																			
			Sample Warranty																			
		08 3113	**ACCESS DOORS AND FRAMES**																			
			Product Data																			
		08 4113	**ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS**																			
			Product Data																			
			Shop Drawings																			
			Door Hardware Schedule																			
			Sample Warranty																			
		08 4126.23	**INTERIOR ALL-GLASS ENTRANCES**																			
			Product Data																			
			Shop Drawings																			
			Door Hardware Schedule																			
		08 4413	**GLAZED ALUMINUM CURTAIN WALLS**																			
			Product Data																			
			Shop Drawings																			
			Delegated Design Submittal																			
			Qualification Data																			
			Product Test Reports																			
			Sample Warranty																			
		08 4523	**FIBERGLASS-SANDWICH-PANEL ASSEMBLIES**																			
			Product Data																			
			Shop Drawings																			
			Samples for Initial Selection																			
			Samples for Verification																			
			Qualification Data																			
			Product Test Reports																			

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			Sample Warranty																			
		08 7100	**DOOR HARDWARE**																			
			Product Data																			
			Shop Drawings																			
			Door Hardware Schedule																			
			Sample Warranty																			
		08 8000	**GLAZING**																			
			Product Data																			
			Samples for Verification																			
		09 2116.23	**GYPSUM BOARD SHAFT WALL ASSEMBLIES**																			
			Product Data																			
		09 2216	**NON-STRUCTURAL METAL FRAMING**																			
			Product Data																			
		09 2900	**GYPSUM BOARD**																			
			Product Data																			
		09 3013	**CERAMIC TILING**																			
			Product Data																			
			Samples for Verification																			
			Installer Qualification Data																			
		09 5113	**ACOUSTICAL PANEL CEILINGS**																			
			Product Data																			
			Samples for Verification																			
		09 6513	**RESILIENT BASE AND ACCESSORIES**																			
			Product Data																			
			Product Schedule																			
			Samples for Verification																			
		09 6519	**RESILIENT TILE FLOORING**																			
			Product Data																			
			Samples for Verification																			
			Installer Qualification Data																			
			Seam & Pattern Diagram																			
			Product Schedule																			
		09 6813	**TILE CARPETING**																			
			Product Data																			
			Samples for Verification																			
			Seam & Pattern Diagram																			
			Product Schedule																			
			Installer Qualification Data																			
			Sample Warranty																			

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		09 8100	**ACOUSTIC INSULATION AND JOINT SEALANT**																			
			Product Data																			
		09 8433	**SOUND-ABSORBING WALL UNITS**																			
			Product Data																			
			Shop Drawings																			
			Samples for Verification																			
			Sample Warranty																			
		09 8436	**SOUND-ABSORBING CEILING UNITS**																			
			Product Data																			
			Shop Drawings																			
			Samples for Verification																			
		09 8453	**SOUND BARRIER MULLION TRIM CAP**																			
			Product Data																			
			Shop Drawings																			
			Samples for Verification																			
		09 9123	**INTERIOR PAINTING**																			
			Product Data																			
			Samples for Verification																			
			Product List																			
		10 1100	**GLASS MARKER BOARDS**																			
			Product Data																			
			Shop Drawings																			
			Samples for Verification																			
			Sample Warranty																			
		10 2600	**WALL AND DOOR PROTECTION**																			
			Product Data																			
			Shop Drawings																			
			Samples for Verification																			
		10 2613	**FRP PANELS**																			
			Product Data																			
			Samples for Initial Selection																			
		10 2800	**TOILET AND BATH ACCESSORIES**																			
			Product Data																			
			Product Schedule																			
		10 4413	**FIRE PROTECTION CABINETS**																			
			Product Data																			
		11 5213	**PROJECTION SCREENS**																			
			Product Data																			
			Shop Drawings																			

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		12 2413	ROLLER WINDOW SHADES																			
			Product Data																			
			Shop Drawings																			
			Samples for Verification																			
			Product Schedule																			
		12 3623.13	PLASTIC-LAMINATE-CLAD COUNTERTOPS																			
			Product Data																			
			Shop Drawings																			
			Samples for Verification																			
		12 3661.16	SOLID SURFACING COUNTERTOPS, WINDOWSILLS AND WALL PANEL																			
			Product Data																			
			Shop Drawings																			
			Samples for Verification																			
		13 9000	COVER SYSTEM FOR CONCEALMENT OF FIRE SPRINKLER SYSTEMS, PIPING, CONDUIT, WIRING AND CABLE																			
			Product Data																			
			Shop Drawings																			
			MECHANICAL - PLUMBING																			
		21 1313	WET-PIPE SPRINKLER SYSTEMS																			
			Shop Drawings																			
			Pipe and Sprinkler Layout																			
			Coordination Drawings																			
			Calculations																			
			Product Data																			
		22 0100	BASIC PLUMBING REQUIREMENTS																			
			Coordination Drawings																			
		22 0523	PLUMBING VALVES																			
			Shop Drawings																			
			Product Data																			
		22 0529	HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT																			
			Shop Drawings																			
			Product Data																			
		22 0700	PLUMBING INSULATION																			
			Shop Drawings																			
			Product Data																			
		22 1116	DOMESTIC WATER PIPING																			
			Shop Drawings																			
			Product Data																			
		22 1119	DOMESTIC WATER PIPING SPECIALTIES																			
			Shop Drawings																			

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			Product Data																			
		22 1316	**SANITARY WASTE AND VENT PIPING**																			
			Shop Drawings																			
			Product Data																			
		22 1319	**SANITARY WASTE PIPING SPECIALTIES**																			
			Shop Drawings																			
			Product Data																			
		22 4300	**PLUMBING FIXTURES**																			
			Product Data																			
		23 0513	**MOTORS**																			
			Motor Data																			
		23 0523	**VALVES**																			
			Shop Drawings																			
			Product Data																			
		23 0529	**HANGERS AND SUPPORTS**																			
			Shop Drawings																			
			Product Data																			
		23 0700	**MECHANICAL INSULATION**																			
			Shop Drawings																			
			Manufacturer's Installation Instructions																			
		23 0900	**CONTROL SYSTEMS**																			
			Shop Drawings																			
			Product Data																			
			Electrical Wiring Diagrams and I/O Panel																			
			Control Panel Face Details																			
			Sequence of Operation																			
		23 0990	**TESTING, ADJUSTING AND BALANCING**																			
			Completed testing and balancing report																			
		23 2113	**HYDRONIC PIPING**																			
			Shop Drawings																			
			Product Data																			
			Qualification Data																			
			Field quality-control test reports																			
			Operation and Maintenance Data																			
			Water Analysis																			
		23 2123	**HYDRONIC PUMPS**																			
			Shop Drawings																			
			Product Data																			
			Wiring Diagrams																			

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			Operation and Maintenance Data																			
		23 3113	**METAL DUCTS**																			
			Shop Drawings																			
			Product Data																			
			Coordination Drawings																			
			Record Drawings																			
		23 3300	**DUCT ACCESSORIES**																			
			Shop Drawings																			
			Operation and Maintenance Data																			
		23 3423	**FANS AND VENTILATORS**																			
			Shop Drawings																			
			Product Data																			
			Wiring Diagrams																			
			Coordination Drawings																			
			Field quality-control test reports																			
			Operation and Maintenance Data																			
		23 3600	**AIR TERMINAL UNITS**																			
			Shop Drawings																			
			Product Data																			
			Electrical Power/Controls Wiring Diagrams																			
			Operation and Maintenance Data																			
		23 3713	**DIFFUSERS, REGISTERS, AND GRILLES**																			
			Product Data																			
		23 7313	**MODULAR PACKAGED AIR-HANDLING UNITS**																			
			Shop Drawings																			
			Product Data																			
			Manufacturer's Installation Instructions																			
			Operation and Maintenance Data																			
			Coordination Drawings																			
		23 8239	**IN-ROOM TERMINAL EQUIPMENT**																			
			Shop Drawings																			
			Product Data																			
			Wiring Diagrams																			
			Operation and Maintenance Data																			
ELECTRICAL																						
		26 0519	**CONDUCTORS AND CABLES**																			
			Product Data																			

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		26 0526	**GROUNDING AND BONDING**																			
			Product Data																			
		26 0533	**RACEWAYS**																			
			Product Data																			
		26 0534	**BOXES, CABINETS, AND ENCLOSURES**																			
			Product Data																			
		26 0536	**CABLE TRAYS**																			
			Product Data																			
			Shop Drawings																			
			Coordination Drawings																			
		26 0553	**ELECTRICAL IDENTIFICATION**																			
			Product Data for each type of product specified.																			
			Schedule of nomenclature to be used for identification																			
		26 0573	**POWER SYSTEM STUDY**																			
			Product Certificates																			
			Qualification Data																			
			First Submittal																			
			Second Submittal																			
		26 0923	**LIGHTING CONTROL DEVICES**																			
			Product Data																			
			Floor Plans																			
			Device List																			
			Control Wiring Diagram																			
		26 2416	**PANELBOARDS**																			
			Product Data																			
			Shop Drawings																			
		26 24 19	**MOTOR CONTROL**																			
			Product Data																			
			Shop Drawings																			
			Warranty Sample																			
		26 2726	**WIRING DEVICES**																			
			Product data showing configurations, finishes,																			
		26 2816	**DISCONNECT SWITCHES**																			
			Product Data																			
			Electrical Characteristics																			
		26 2923	**VARIABLE FREQUENCY DRIVES**																			
			Product Data																			
			Shop Drawings																			
			Coordination Drawings																			

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		26 5119	**LED LIGHTING**																			
			Shop Drawings																			
		26 5215	**EMERGENCY LIGHTING INVERTER**																			
			Shop Drawings																			
			Manufacturer's installation instructions.																			
		27 0526	**COMMUNICATIONS BONDING**																			
			Shop Drawings																			
			Manufacturer's Technical Product Sheet																			
		27 0528	**INTERIOR COMMUNICATION PATHWAYS**																			
			Manufacturer's Data																			
			Coordination Drawings																			
		27 1100	**COMMUNICATION EQUIPMENT ROOMS (CER)**																			
			Manufacturer's Data																			
		27 1300	**BACKBONE CABLING REQUIREMENTS**																			
			Manufacturer's Data																			
		27 1500	**HORIZONTAL CABLING REQUIREMENTS**																			
			Manufacturer's Data																			
		27 5119	**SOUND-MASKING SYSTEM**																			
			Product Data																			
		28 31 01	**FIRE ALARM AND DETECTION SYSTEMS**																			
			Shop Drawings																			
			Product Data																			
			CAD Floor Plans as Shop Drawings																			
			Wiring requirements & voltage drop calculations																			
			Manufacturer's certificates																			
			Information on the system batteries																			
ADDITIONAL SUBMITTALS																						

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OPERATING INSTRUCTIONS AND SERVICE MANUAL LOG

Project: **Lottes HSL – Renovation for Consolidation | Replace Glazing & Roofing in Barrel Roof Systems**

Project Number: **CP211852 | CP230151**

Section	Description	Extra Materials	Catalog Data	Wiring Diagrams	Installation Instructions	Service & Maintenance Instructions	Parts List & Availability	Performance Curves	Startup & Operating Instructions
03 3000	CAST-IN-PLACE CONCRETE								
05 1200	STRUCTURAL STEEL FRAMING								
05 3100	STEEL DECKING								
06 4116	PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS		X						
07 5419	POLYVINYL-CHLORIDE (PVC) ROOFING		X			X			
07 8100	APPLIED FIRE PROTECTION								
07 8413	PENETRATION FIRESTOPPING								
07 8443	JOINT FIRESTOPPING								
07 9200	JOINT SEALANTS		X			X			
07 9513.13	INTERIOR EXPANSION JOINT COVER ASSEMBLIES		X			X			
08 1213	HOLLOW METAL FRAMES		X						
08 1416	FLUSH WOOD DOORS		X						
08 3113	ACCESS DOORS AND FRAMES		X						
08 4113	ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS		X			X			
08 4126.23	INTERIOR ALL-GLASS ENTRANCES		X			X			
08 4413	GLAZED ALUMINUM CURTAIN WALLS		X			X			
08 4523	FIBERGLASS-SANDWICH-PANEL ASSEMBLIES		X			X			
08 7100	DOOR HARDWARE		X	X		X			X

OPERATING INSTRUCTIONS AND SERVICE MANUAL LOG

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Project Number: **CP211852 | CP230151**

Section	Description	Extra Materials	Catalog Data	Wiring Diagrams	Installation Instructions	Service & Maintenance Instructions	Parts List & Availability	Performance Curves	Startup & Operating Instructions
08 8000	GLAZING		X						
09 2116.23	GYPSUM BOARD SHAFT WALL ASSEMBLIES		X						
09 2216	NON-STRUCTURAL METAL FRAMING		X						
09 2900	GYPSUM BOARD								
09 3013	CERAMIC TILING	X	X			X			
09 5113	ACOUSTICAL PANEL CEILINGS	X	X			X			
09 6513	RESILIENT BASE AND ACCESSORIES	X	X			X			
09 6519	RESILIENT TILE FLOORING	X	X			X			
09 6813	TILE CARPETING	X	X			X			
09 8100	ACOUSTIC INSULATION AND JOINT SEALANT		X						
09 8433	SOUND-ABSORBING WALL UNITS	X	X			X			
09 8436	SOUND-ABSORBING CEILING UNITS	X	X						
09 8453	SOUND BARRIER MULLION TRIM CAP		X			X			
09 9123	INTERIOR PAINTING	X	X						
10 1100	GLASS MARKER BOARDS		X			X			
10 2600	WALL AND DOOR PROTECTION	X	X			X			
10 2613	FRP PANELS								
10 2800	TOILET, BATH, AND LAUNDRY ACCESSORIES		X						

OPERATING INSTRUCTIONS AND SERVICE MANUAL LOG

Project: **Lottes HSL – Renovation for Consolidation | Replace Glazing & Roofing in Barrel Roof Systems**

Project Number: **CP211852 | CP230151**

Section	Description	Extra Materials	Catalog Data	Wiring Diagrams	Installation Instructions	Service & Maintenance Instructions	Parts List & Availability	Performance Curves	Startup & Operating Instructions
10 4413	FIRE PROTECTION CABINETS		X						
11 5213	PROJECTION SCREENS		X	X		X	X		
12 2413	ROLLER WINDOW SHADES		X			X			
12 3623.13	PLASTIC-LAMINATE-CLAD COUNTERTOPS		X			X			
12 3661.16	SOLID SURFACING COUNTERTOPS, WINDOWSILLS AND WALL PANEL		X			X			
13 9000	COVER SYSTEM FOR CONCEALMENT OF FIRE SPRINKLER SYSTEMS, PIPING,		X						
21 0100	BASIC FIRE PROTECTION REQUIREMENTS								
21 0500	COMMON WORK RESULTS FOR FIRE SUPPRESSION								
21 0553	IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT								
21 1313	WET-PIPE SPRINKLER SYSTEMS								
22 0100	BASIC PLUMBING REQUIREMENTS								
22 0500	BASIC PLUMBING MATERIALS AND METHODS								
22 0523	VALVES								
22 0529	HANGER AND SUPPORTS								
22 0700	PLUMBING INSULATION								
22 1116	DOMESTIC WATER PIPING								
22 1119	DOMESTIC WATER PIPING SPECIALTIES								
22 1316	SANITARY WASTE AND VENT PIPING								

OPERATING INSTRUCTIONS AND SERVICE MANUAL LOG

Project: **Lottes HSL – Renovation for Consolidation | Replace Glazing & Roofing in Barrel Roof Systems**

Project Number: **CP211852 | CP230151**

Section	Description	Extra Materials	Catalog Data	Wiring Diagrams	Installation Instructions	Service & Maintenance Instructions	Parts List & Availability	Performance Curves	Startup & Operating Instructions
22 1319	SANITARY WASTE PIPING SPECIALTIES								
22 4300	PLUMBING FIXTURES								
23 0100	BASIC MECHANICAL REQUIREMENTS								
23 0500	BASIC MECHANICAL MATERIALS AND METHODS								
23 0513	MOTORS								
23 0523	VALVES								
23 0529	HANGERS AND SUPPORTS								
23 0700	MECHANICAL INSULATION								
23 0900	CONTROL SYSTEMS								
23 0990	TESTING, ADJUSTING, AND BALANCING								
23 2113	HYDRONIC PIPING								
23 2123	HYDRONIC PUMPS								
23 3113	METAL DUCTS								
23 3300	DUCT ACCESSORIES								
23 3423	FANS AND VENTILATORS								
23 3600	AIR TERMINAL UNITS								
23 3713	DIFFUSERS, REGISTERS, AND GRILLES								
23 7313	MODULAR PACKAGED AIR-HANDLING UNITS								

OPERATING INSTRUCTIONS AND SERVICE MANUAL LOG

Project: **Lottes HSL – Renovation for Consolidation | Replace Glazing & Roofing in Barrel Roof Systems**

Project Number: **CP211852 | CP230151**

Section	Description	Extra Materials	Catalog Data	Wiring Diagrams	Installation Instructions	Service & Maintenance Instructions	Parts List & Availability	Performance Curves	Startup & Operating Instructions
23 8239	IN-ROOM TERMINAL EQUIPMENT								
26 0500	COMMON WORK RESULTS FOR ELECTRICAL								
26 0519	CONDUCTORS AND CABLES								
26 0526	GROUNDING AND BONDING								
26 0529	HANGERS AND SUPPORTS								
26 0533	RACEWAYS								
26 0534	BOXES, CABINETS AND ENCLOSURES								
26 0536	CABLE TRAYS								
26 0553	IDENTIFICATION FOR ELECTRICAL SYSTEMS								
26 0573	POWER SYSTEM STUDIES								
26 0600	ELECTRICAL DEMOLITION								
26 0923	LIGHTING CONTROL DEVICES								
26 2416	PANELBOARDS								
26 2419	MOTOR CONTROL								
26 2726	WIRING DEVICES								
26 2813	FUSES								
26 2816	ENCLOSED SWITCHES								
26 2923	VARIABLE FREQUENCY DRIVES								

OPERATING INSTRUCTIONS AND SERVICE MANUAL LOG

Project: **Lottes HSL – Renovation for Consolidation | Replace Glazing & Roofing in Barrel Roof Systems**

Project Number: **CP211852 | CP230151**

Section	Description	Extra Materials	Catalog Data	Wiring Diagrams	Installation Instructions	Service & Maintenance Instructions	Parts List & Availability	Performance Curves	Startup & Operating Instructions
26 5100	LIGHTING								
28 3111	DIGITAL ADDRESSABLE FIRE ALARM SYSTEM								

CLOSEOUT LOG

Project: **Lottes HSL – Renovation for Consolidation | Replace Glazing & Roofing in Barrel Roof Systems**

Project Number: **CP211852 | CP230151**

Contractor:

Section	Description	Contractor/Subcontractor	Date Rec'd	# of Copies	CPM Initials	Remarks
03 3000	CAST-IN-PLACE CONCRETE					
05 1200	STRUCTURAL STEEL FRAMING					
05 3100	STEEL DECKING					
06 4116	PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS					
07 5419	POLYVINYL-CHLORIDE (PVC) ROOFING					
07 8100	APPLIED FIRE PROTECTION					
07 8413	PENETRATION FIRESTOPPING					
07 8443	JOINT FIRESTOPPING					
07 9200	JOINT SEALANTS					
07 9513.13	INTERIOR EXPANSION JOINT COVER ASSEMBLIES					
08 1213	HOLLOW METAL FRAMES					
08 1416	FLUSH WOOD DOORS					
08 3113	ACCESS DOORS AND FRAMES					
08 4113	ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS					
08 4126.23	INTERIOR ALL-GLASS ENTRANCES					
08 4413	GLAZED ALUMINUM CURTAIN WALLS					
08 4523	FIBERGLASS-SANDWICH-PANEL ASSEMBLIES					

CLOSEOUT LOG

Project: **Lottes HSL – Renovation for Consolidation | Replace Glazing & Roofing in Barrel Roof Systems**

Project Number: **CP211852 | CP230151**

Contractor:

Section	Description	Contractor/Subcontractor	Date Rec'd	# of Copies	CPM Initials	Remarks
08 7100	DOOR HARDWARE					
08 8000	GLAZING					
09 2116.23	GYPSUM BOARD SHAFT WALL ASSEMBLIES					
09 2216	NON-STRUCTURAL METAL FRAMING					
09 2900	GYPSUM BOARD					
09 3013	CERAMIC TILING					
09 5113	ACOUSTICAL PANEL CEILINGS					
09 6513	RESILIENT BASE AND ACCESSORIES					
09 6519	RESILIENT TILE FLOORING					
09 6813	TILE CARPETING					
09 8100	ACOUSTIC INSULATION AND JOINT SEALANT					
09 8433	SOUND-ABSORBING WALL UNITS					
09 8436	SOUND-ABSORBING CEILING UNITS					
09 8453	SOUND BARRIER MULLION TRIM CAP					
09 9123	INTERIOR PAINTING					
10 1100	GLASS MARKER BOARDS					
10 2600	WALL AND DOOR PROTECTION					

CLOSEOUT LOG

Project: **Lottes HSL – Renovation for Consolidation | Replace Glazing & Roofing in Barrel Roof Systems**

Project Number: **CP211852 | CP230151**

Contractor:

Section	Description	Contractor/Subcontractor	Date Rec'd	# of Copies	CPM Initials	Remarks
10 2613	FRP PANELS					
10 2800	TOILET, BATH, AND LAUNDRY ACCESSORIES					
10 4413	FIRE PROTECTION CABINETS					
11 5213	PROJECTION SCREENS					
12 2413	ROLLER WINDOW SHADES					
12 3623.13	PLASTIC-LAMINATE-CLAD COUNTERTOPS					
12 3661.16	SOLID SURFACING COUNTERTOPS, WINDOWSILLS AND WALL PANEL					
13 9000	COVER SYSTEM FOR CONCEALMENT OF FIRE SPRINKLER SYSTEMS, PIPING,					
13 9000	COVER SYSTEM FOR CONCEALMENT OF FIRE SPRINKLER SYSTEMS, PIPING,					
21 0100	BASIC FIRE PROTECTION REQUIREMENTS					
21 0500	COMMON WORK RESULTS FOR FIRE SUPPRESSION					
21 0553	IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT					
21 0100	FIRE PROTECTION AS-BUILTS					
21 0100	FIRE PROTECTION O&M DATA					
21 1313	WET-PIPE SPRINKLER SYSTEMS					
21 0100	PLUMBING AS-BUILTS					
21 0100	PLUMBING O&M DATA					

CLOSEOUT LOG

Project: **Lottes HSL – Renovation for Consolidation | Replace Glazing & Roofing in Barrel Roof Systems**

Project Number: **CP211852 | CP230151**

Contractor:

Section	Description	Contractor/Subcontractor	Date Rec'd	# of Copies	CPM Initials	Remarks
22 0100	BASIC PLUMBING REQUIREMENTS					
22 0500	BASIC PLUMBING MATERIALS AND METHODS					
22 0523	VALVES					
22 0529	HANGER AND SUPPORTS					
22 0700	PLUMBING INSULATION					
22 1116	DOMESTIC WATER PIPING					
22 1119	DOMESTIC WATER PIPING SPECIALTIES					
22 1316	SANITARY WASTE AND VENT PIPING					
22 1319	SANITARY WASTE PIPING SPECIALTIES					
22 4300	PLUMBING FIXTURES					
23 0100	BASIC MECHANICAL REQUIREMENTS					
23 0500	BASIC MECHANICAL MATERIALS AND METHODS					
23 0513	MOTORS					
23 0523	VALVES					
23 0529	HANGERS AND SUPPORTS					
23 0700	MECHANICAL INSULATION					
23 0900	CONTROL SYSTEMS					

CLOSEOUT LOG

Project: **Lottes HSL – Renovation for Consolidation | Replace Glazing & Roofing in Barrel Roof Systems**

Project Number: **CP211852 | CP230151**

Contractor:

Section	Description	Contractor/Subcontractor	Date Rec'd	# of Copies	CPM Initials	Remarks
23 0990	TESTING, ADJUSTING, AND BALANCING					
23 2113	HYDRONIC PIPING					
23 2123	HYDRONIC PUMPS					
23 3113	METAL DUCTS					
23 3300	DUCT ACCESSORIES					
23 3423	FANS AND VENTILATORS					
23 3600	AIR TERMINAL UNITS					
23 3713	DIFFUSERS, REGISTERS, AND GRILLES					
23 7313	MODULAR PACKAGED AIR-HANDLING UNITS					
23 8239	IN-ROOM TERMINAL EQUIPMENT					
26 0923	LIGHTING CONTROL DEVICES - Operation & Maintenance Data					
26 0923	LIGHTING CONTROL DEVICES - Warranty					
26 2416	PANELBOARDS - Warranty					
26 2419	MOTOR CONTROL - Operation & Maintenance Data					
26 2419	MOTOR CONTROL - Warranty					
26 2419	MOTOR CONTROL - Manufacturer's Instructions					
26 2923	VARIABLE FREQUENCY DRIVES - Operation & Maintenance Data					

CLOSEOUT LOG

Project: **Lottes HSL – Renovation for Consolidation | Replace Glazing & Roofing in Barrel Roof Systems**

Project Number: **CP211852 | CP230151**

Contractor:

Section	Description	Contractor/Subcontractor	Date Rec'd	# of Copies	CPM Initials	Remarks
26 2923	VARIABLE FREQUENCY DRIVES - Manufacturer's Instructions					
26 2923	VARIABLE FREQUENCY DRIVES - Warranty					
26 2923	VARIABLE FREQUENCY DRIVES - Test Reports					
26 5100	LED LIGHTING - Warranties					
26 5100	LED LIGHTING - Field Quality Control Report					
27 0528	INTERIOR COMMUNICATION PATHWAYS					
27 1100	COMMUNICATION EQUIPMENT ROOMS (CER)					
27 1300	BACKBONE CABLING REQUIREMENTS					
27 1500	HORIZONTAL CABLING REQUIREMENTS					
27 5119	SELF-CONTAINED SOUND-MASKING EQUIPMENT					
28 3100	FIRE ALARM AND DETECTION SYSTEMS					
28 3111	DIGITAL ADDRESSABLE FIRE ALARM SYSTEM - Field Quality Control Report					
28 3111	DIGITAL ADDRESSABLE FIRE ALARM SYSTEM - Installation and Maintenance Manuals					
28 3111	DIGITAL ADDRESSABLE FIRE ALARM SYSTEM - Operation and Maintenance Data					
28 3111	DIGITAL ADDRESSABLE FIRE ALARM SYSTEM - Device Address List					
28 3111	DIGITAL ADDRESSABLE FIRE ALARM SYSTEM - Record Documents					
28 3111	DIGITAL ADDRESSABLE FIRE ALARM SYSTEM - Warranty					

CP211852 Lottes Health Science Library Renovation Commissioning Log

Commissioning Items by CSI Division	Verified by: Name	Firm	Date compl	Coord Initial	Documentation Required	Owner Witness Required
1						
Building System Commissioning						
Commissioning Agent - Conduct pre-installation meetings per specifications.					Meeting Minutes	☑
24119						
Selective Demolition						
Do not start demolition until utility disconnect and sealing has been verified in writing						☑
Hold Preinstallation meeting as specified					Meeting Minutes	☑
Perform Field Quality Control section of specifications					Test Report	☑
51200						
Structural Steel Framing						
Help a third party perform Field Quality Control section of specifications					Third party test report	☑
Provide welder qualification report for each welder on site					Welder Qualifications	☑
53100						
Steel Decking						
Help a third party perform Field Quality Control section of specifications					Third party test report	☑
Provide welder qualification report for each welder on site					Welder Qualifications	☑

Commissioning Items by CSI Division	Verified by: Name	Firm	Date compl	Coord Initial	Documentation Required	Owner Witness Required
75419						
Polyvinyl-Chloride (PVC) Roofing						
Conduct a preinstallation conference at project site per specifications					Document proceedings; provide copy to participants	☑
Perform Final Roof Inspection (Manufacturer's Rep) Per Field Quality Control section of specs.					field report	☑
78100						
Applied Fireproofing						
Conduct a preinstallation conference at project site per specifications					Meeting Minutes	☑
Help a third party perform Field Quality Control section of specifications					Third party test report	☑
78413						
Penetration Firestopping						
Help a third party perform Field Quality Control section of specifications					Third party test report	☑
78443						
Joint Firestopping						
Help a third party perform Field Quality Control section of specifications					Third party test report	☑
79200						
Joint Sealants						
Clean out joints immediately before installing joint sealant						☑
81213						
Hollow Metal Frames						
Inspect label for fire rated doors and frames					itemized list of doors	☑

Commissioning Items by CSI Division	Verified by: Name	Firm	Date compl	Coord Initial	Documentation Required	Owner Witness Required
81416						
Flush Wood Doors						
Inspect label for fire rated doors and frames					Door List	☑
84113						
Aluminum-Framed Entrances and Storefronts						
Conduct a preinstallation conference at project site per specifications					Meeting Minutes	☑
84126						
Interior All-Glass Entrances						
Conduct a preinstallation conference at project site per specifications					Meeting Minutes	☑
84413						
Glazed Aluminum Curtain Walls						
Conduct a preinstallation conference at project site per specifications					Meeting Minutes	☑
Help a third party perform Field Quality Control section of specifications					Third Party Test Report	☑
84523						
Fiberglass-Sandwich-Panel Assemblies						
Conduct a preinstallation conference at project site per specifications					Meeting Minutes	☑
Help a third party perform Field Quality Control section of specifications					Third Party Test Report	☑

Commissioning Items by CSI Division	Verified by: Name	Firm	Date compl	Coord Initial	Documentation Required	Owner Witness Required
87100						
Door Hardware						
Verify that all fire doors close and latch positively					test report	☐
87111						
Door Hardware						
Conduct a preinstallation conference at project site per specifications					Third Party Test Report	☑
88000						
Glazing						
Wash clear glass on both faces not more than 4 days prior to punch list inspection						☐
92116						
Gypsum Board Shaft Wall Assemblies						
Verify fire rating compliance is maintained, including all wall penetrations. Ensure walls stenciled as specified					inspection report	☑
93013						
Ceramic Tiling						
Conduct a preinstallation conference at project site per specifications					Meeting Minutes	☑
Provide Extra Material as specified					Transmittal	☑
95113						
Acoustical Panel Ceilings						
Complete all above ceiling inspections prior to installation of tiles						☑
Provide Extra Material as specified					Transmittal	☑

Commissioning Items by CSI Division	Verified by: Name	Firm	Date compl	Coord Initial	Documentation Required	Owner Witness Required
96513						
Resilient Base and Accessories						
Provide Extra Material as specified					Transmittal	☑
96519						
Resilient Tile Flooring						
Hold pre-installation conference per specifications					Meeting Minutes	☑
Perform pH, Chloride (moisture) and bond tests per manufacturer. Do not proceed until all manufacturing requirements are met.					test reports	☑
Provide Extra Material as specified					Transmittal	☑
96813						
Tile Carpeting						
Hold pre-installation conference per specifications					Meeting Minutes	☑
Provide Extra Material as specified					Transmittal	☑
98433						
Sound-Absorbing Wall Units						
Hold pre-installation conference per specifications					Meeting Minutes	☑
Provide Extra Material as specified					Transmittal	☑

Commissioning Items by CSI Division	Verified by: Name	Firm	Date compl	Coord Initial	Documentation Required	Owner Witness Required
98436						
Sound-Absorbing Ceiling Units						
Provide Extra Material as specified					Transmittal	☑
99123						
Interior Painting						
Periodically Check Wet Film Thickness To Assure Conformance With Manufacturer's Requirements To Achieve Dry Film Thickness per Field Quality Control section of specs					field report	☑
Provide Extra Material as specified					Transmittal	☑
102800						
Toilet, Bath & Laundry Accessories						
Adjust and clean per specifications.						☐
104413						
Fire Protection Cabinets						
Hold preinstallation conference as specified					Meeting Minutes	☑
122413						
Roller Window Shades						
Provide factory training per demonstration section of specificaitons					Sign-in Sheet	☑
Verify proper operation and limit settings						☐

Commissioning Items by CSI Division	Verified by: Name	Firm	Date compl	Coord Initial	Documentation Required	Owner Witness Required
211313						
Wet-Pipe Sprinkler Systems						
Perform Field Quality Control section of specifications					NFPA 13 Certification	☑
Provide Extra Material as specified					Transmittal	☑
Provide system operation & maintenance training Per specifications					Sign In Sheet	☑
Verify all labeling						☐
220500						
Common Work Results For Plumbing						
Hold MEP pre-installation meeting(s).					Meeting Minutes and Sign-up Sheet	☑
Verify fire rating compliance at all wall, ceiling and floor penetrations						☐
220523						
Valves						
Check valves for leaks and replace in necessary						☐
220700						
Plumbing Piping Insulation						
Verify all valve stems are extended and accessible						☐

Commissioning Items by CSI Division	Verified by: Name	Firm	Date compl	Coord Initial	Documentation Required	Owner Witness Required
221116						
Domestic Water Piping						
Fill and flush each system						☐
Perform Disinfection of Domestic Water Piping System section of specifications					Bacteria test results	☑
Provide pressure testing per Field Quality Control section of specifications					test report	☑
221119						
Domestic Water Piping Specialties						
Perform Field Quality Control section of specifications					Test Report	☑
221316						
Sanitary Waste and Vent Piping						
Perform leak test per Field Quality Control section of specifications					test report	☑
221319						
Sanitary Waste and Storm Piping Specialties						
Perform Field Quality Control section of specifications					Test Reports	☑
230100						
Basic Mechanical Requirements						
Conduct start-up and tests per specifications					Startup Report	☑
Hold MEP pre-installation meeting(s).					Meeting Minutes	☑

Commissioning Items by CSI Division	Verified by: Name	Firm	Date compl	Coord Initial	Documentation Required	Owner Witness Required
230500						
Basic Mechanical Materials and Methods						
Train all End Users on the equipment they will use on a periodic basis.					Sign-in Sheet	☑
230513						
Motors						
Check each motor for alignment, lubrication, rotation, voltage and current and Efficiency					List of motors	☑
230523						
Valves						
Test and adjust valves per specifications						☐
230700						
Mechanical Insulation						
Build Mockups as specified					Inspection Report	☑
Verify all piping unions are accessible for maintenance						☐
Verify fire rating at fire dampers,walls, floors, ceilings and roof						☐
230900						
Control Systems						
Check and record amp draw on supply transformers of I/O panels					Test Report	☑
Ensure shipping material has been removed from thermostats and other control devices						☐

Commissioning Items by CSI Division	Verified by: Name	Firm	Date compl	Coord Initial	Documentation Required	Owner Witness Required
Perform commissioning section of specifications					Commissioning Report	☑
Post laminated control diagram in mechanical room						☐
Provide factory authorized training for maintenance personnel					training report summary	☑
230990						
Testing, Adjusting, and Balancing						
Coordinate temperature control testing and adjusting with temperature controls contractor						☐
Ensure pre-test requirements as specified in paragraph 1.02C have been completed						☐
Hold Pre Balancing Conference as specified					Meeting Minutes	☑
Mark equipment settings including central positions, value indicators, fan speed control levers, etc.						☐
Notify Owner's Representative 14 days prior to the scheduled date for balancing the system.					written notification	☐
232113						
Hydronic Piping						
Pressure test piping per Field Quality Control section of specifications					test report	☑
Provide Extra Materials as specified					Transmittal	☑
Remove and clean all strainers after flushing system					Flush Report	☑

Commissioning Items by CSI Division	Verified by: Name	Firm	Date compl	Coord Initial	Documentation Required	Owner Witness Required
232123						
Hydronic Pumps						
Align pumps to conform with manufacturer's published tolerances					test report	☐
Flush system and replace strainers						☐
Lubricate bearings per manufacturers recommendations						☐
Perform Startup Service section of specifications					Start-up report	☑
Provide factory training per demonstration section of specs.					Sign In sheet	☑
233113						
Metal Ducts						
test for duct leakage per "Field Quality Control" section of spec. Ducts shall meet leakage requirement prior to testing and balancing					test report	☑
233300						
Duct Accessories						
Demonstrate Proper Operation of All Fire Dampers per NFPA-90A.					Inspection report	☑
Perform Field Quality Control section of specifications					Test Report	☑
Provide Extra Materials as specified					Transmittal	☑

Commissioning Items by CSI Division	Verified by: Name	Firm	Date compl	Coord Initial	Documentation Required	Owner Witness Required
233423						
Fans and Ventilators						
Perform Demonstration section of specifications					Sign In sheet	☑
Perform Field Quality Control section of specifications					Test Report	☑
233600						
Air Terminal Units						
Notify owner's rep after fully installing a representative unit (in-place mockup) for approval. Coordinate and cooperate with owner's commissioning of the boxes.						☐
Perform Demonstration section of specifications					Sign-In Sheet	☑
Perform Field Quality Control section of specifications					Test Report	☑
237313						
Modular Packaged Air Handling-Units						
Adjust fan to required RPM						☐
All actuators and control valves must be checked for operation and spring ranges .						☑
Perform Commissioning section of specifications					Commissioning Report	☑
Perform Field Quality Control section of specifications					Test Report	☑
Perform Startup Service section of specifications					Startup Report	☑

Commissioning Items by CSI Division	Verified by: Name	Firm	Date compl	Coord Initial	Documentation Required	Owner Witness Required
Provide Extra Materials as specified					Transmittal	☑
Provide factory training per Demonstration section of spec.					Sign-In Sheet	☑
238239						
In-Room Terminal Equipment						
Perform Field Quality Control section of specifications					Test Report	☑
260500						
Common Work Results for Electrical						
Perform Field Quality Control Section of specifications					Test Report	☑
Train all End Users on the equipment they will use on a periodic basis per Demonstration section of specifications					Sign-in Sheet	☑
Verify that every penetration through fire walls (re: life safety plans) has been properly firestopped					certification	☐
260519						
Conductors and Cables						
Ensure wires are color coded per specifications						☐
Perform independent tests per "Field Quality Control" section of spec, including megohm/high pot tests					test report	☐
260526						
Grounding and Bonding						
Perform resistance test as described in "Field Quality Control" section of spec					test report	☑

Commissioning Items by CSI Division	Verified by: Name	Firm	Date compl	Coord Initial	Documentation Required	Owner Witness Required
260536						
Cable Trays						
Perform resistance test as described in "Field Quality Control" section of spec					test report	☑
260553						
Identification for Electrical Systems						
Ensure identification devices are applied per specifications						☐
Verify all equipment, panels, conduits and conductors are correctly labeled.						☐
260573						
Poower System Studies						
Factory certified technician to set electronic overcurrent devices to approved coordination study setpoints					Inspection Report	☑
Place arcflash labels on equipment as specified						☑
SKM data to be e-mailed to MU Commissioning Engineer					SKM Data	☑
Train owners representatives in setting of overcurrent devices					Sign-up Sheet	☑
260923						
Lighting Control Devices						
Perform "Field Quality Control" section of spec					Test Report	☑
Provide factory training per Demonstration section of spec.					Sign in sheet	☑

Commissioning Items by CSI Division	Verified by: Name	Firm	Date compl	Coord Initial	Documentation Required	Owner Witness Required
262416						
Panelboards						
Perform checks per "Field Quality Control" section of spec					Test Report	☑
262726						
Wiring Devices						
Perform checks per "Field Quality Control" section of spec					Test Report	☑
262923						
Variable-Frequency Drives						
Perform tests per "Field Quality Control" section of spec					Test Report	☑
Provide Extra Material as specified					Transmittal	☑
Provide factory training					Sign in sheets	☑
Start-up of VFD's shall be by factory rep. Perform all checks per manufacturer's written start-up checklist					field report, certification	☑
265100						
Lighting						
Illuminate emergency lights for 90 minutes on battery power.					Test Report	☑
Illuminate exit lights for 90 minutes on battery power.					Test Report	☑
Perform checks per "Field Quality Control" section of spec					Test Report	☑

Commissioning Items by CSI Division	Verified by: Name	Firm	Date compl	Coord Initial	Documentation Required	Owner Witness Required
283111						
Digital, Addressable Fire-Alarm System						
Perform checks per "Field Quality Control" section of spec					NFPA Certification	☑
Perform Field Quality Control section of specifications					Test Report	☑
Precheck all fire alarm devices					Precheck Checklist	☐
Provide factory training per system training section of spec.					Sign in sheet	☑
Test each system for continuity						☐
Test system operation of pull stations horns/strobes by factory trained representative					Written certification of fire alarm system per NFP	☑
Verify battery power available						☐
Verify door hardware interlock						☑

Please see following website for suggested commissioning forms:

https://operations.missouri.edu/facilities/commissioning-forms

Construction Management Checklist for Energizing Utilities

(Contractor to initial each item upon completion and provide completed form to the Owner's Representative prior to energizing utility) AM #1

Water – turned on to the first valve past Energy Management's last valve.

___ Review all piping and equipment being turned on for proper installation and completed testing.
___ Insulation installed (preferred but not required)
___ Meter properly installed, working, and in readable location.
___ Contractor has swabbed out with chlorine all piping from the backflow preventer to the source while installing.
___ All bacteriological tests have been completed and passed.
___ Backflow preventer installed and tested. (will need water pressure to test)
___ Pressure test completed in piping being turned on.
___ Contractor has method to communicate "Services On" to other contractor personnel and Owner's personnel.
___ Consultant has signed off

Steam – turned on to the first valve past Energy Management's last valve.

___ Review all piping, equipment, valves, reducing stations, relief valves, etc. for proper installation and complete testing.
___ Piping protected from the weather.
___ Insulation must be installed.
___ All hangers and bolts have been installed.
___ Meter installed, working and in readable location. (Don't need metasys to turn on.)
___ All needed traps are installed and able to be tested as they are turned on.
___ Condensate system is installed and operating including the pumping system.
___ Pressure test completed in piping being turned on.
___ Contractor has method to communicate "Services On" to other contractor personnel and Owner's personnel.
___ Consultant has signed off

Condensate – turned on to the first valve past Energy Management's last valve.

___ Review all piping and equipment being turned on for proper installation and completed testing.
___ Piping protected from the weather.
___ Insulation installed (preferred but not required)
___ Pressure test completed in piping being turned on.
___ Contractor has method to communicate "Services On" to other contractor personnel and Owner's personnel.
___ Consultant has signed off

Electric – turned on to the first breaker past 13.8kV transformer.

___ Review all wiring and equipment being turned on for proper installation and completed testing
___ GFCI set and tested.
___ Breakers set and tested.
___ All needed permanent grounds are installed.
___ Meter installed, working and in readable location.
___ Main switchgear protected from the weather.
___ Contractor has method to communicate "Services On" to other contractor personnel and Owner's personnel.
___ Consultant has signed off

Chilled Water – turned on to the first valve inside of building.

___ Review all piping and equipment being turned on for proper installation and completed testing.
___ Pressure test completed in piping being turned on.
___ Insulation must be installed.
___ Meter installed, working and connected to Metasys.
___ Building pump and automatic isolation/control valve must be installed and under control.
___ If chillers are installed, automatic loop pump isolation must be installed.
___ Control valves must be installed and automatically controlled on all loads.
___ Contractor has method to communicate "Services On" to other contractor personnel and Owner's personnel.
___ Consultant has signed off

INDEX OF DRAWINGS

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STRUCTURAL

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ED202 - LIGHTING SECOND FLOOR -DEMO
ED203 - LIGHTING THIRD FLOOR -DEMO
ED301 - FIRE ALARM FIRST FLOOR -DEMO
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ED600 – ELECTRICAL ENLARGED MECHANICAL ROOM DEMOLITION PLANS
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E102 - POWER & SYSTEMS SECOND FLOOR NEW WORK
E103 - POWER & SYSTEMS THIRD FLOOR NEW WORK
E104 - ELECTRICAL ROOF -NEW WORK PLAN
E201 - LIGHTING FIRST FLOOR -NEW WORK
E202 - LIGHTING SECOND FLOOR -NEW WORK
E203 - LIGHTING THIRD FLOOR -NEW WORK
E301 - FIRE ALARM FIRST FLOOR NEW WORK
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PD100 - PLUMBING UNDERGROUND DEMOLITION PLAN

PD101 - PLUMBING FIRST FLOOR DEMOLITION PLAN
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Missouri
Division of Labor Standards
WAGE AND HOUR SECTION

MICHAEL L. PARSON, Governor

Annual Wage Order No. 28

Section 010
BOONE 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
Taylor Burks, Director
Division of Labor Standards

Filed With Secretary of State: **March 10, 2021**

Last Date Objections May Be Filed: **April 8, 2021**

Prepared by Missouri Department of Labor and Industrial Relations

OCCUPATIONAL TITLE	**Prevailing Hourly Rate
Asbestos Worker	$53.30
Boilermaker	*$29.89
Bricklayer	$47.96
Carpenter	$45.52
Lather	
Linoleum Layer	
Millwright	
Pile Driver	
Cement Mason	$43.58
Plasterer	
Communications Technician	$51.71
Electrician (Inside Wireman)	$52.90
Electrician Outside Lineman	$74.24
Lineman Operator	
Lineman - Tree Trimmer	
Groundman	
Groundman - Tree Trimmer	
Elevator Constructor	*$29.89
Glazier	$39.34
Ironworker	$59.74
Laborer	$39.77
General Laborer	
First Semi-Skilled	
Second Semi-Skilled	
Mason	*$29.89
Marble Mason	
Marble Finisher	
Terrazzo Worker	
Terrazzo Finisher	
Tile Setter	
Tile Finisher	
Operating Engineer	$59.21
Group I	
Group II	
Group III	
Group III-A	
Group IV	
Group V	
Painter	$37.48
Plumber	$66.54
Pipe Fitter	
Roofer	$54.20
Sheet Metal Worker	$53.89
Sprinkler Fitter	$55.78
Truck Driver	*$29.89
Truck Control Service Driver	
Group I	
Group II	
Group III	
Group IV	

*The Division of Labor Standards received less 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.

Heavy Construction Rates for
BOONE County

Section 010

OCCUPATIONAL TITLE	**Prevailing Hourly Rate
Carpenter	$48.97
Millwright	
Pile Driver	
Electrician (Outside Lineman)	$74.24
Lineman Operator	
Lineman - Tree Trimmer	
Groundman	
Groundman - Tree Trimmer	
Laborer	$44.32
General Laborer	
Skilled Laborer	
Operating Engineer	$56.12
Group I	
Group II	
Group III	
Group IV	
Truck Driver	*$29.89
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 less 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.

TECHNICAL SPECIFICATIONS -

UNIVERSAL/HAZARDOUS MATERIALS REMOVAL AND DISPOSAL

For

UNIVERSITY OF MISSOURI

PROJECT CP211852

Lottes Health Sciences Library Renovation

Prepared for

UNIVERSITY OF MISSOURI

Campus Facilities

Columbia, Missouri 65211

Prepared by

UNIVERSITY OF MISSOURI

ENVIRONMENTAL HEALTH &SAFETY

SECTION 020810 – UNIVERSAL/HAZARDOUS MATERIALS REMOVAL AND Disposal

PART 1 - GENERAL

Provisions of the General Conditions and Special Conditions are part of this Division.

1.1 WORK COVERED BY CONTRACT DOCUMENTS

1.1.1 The Contractor shall inform him/herself of the conditions for the project, and is responsible for verifying the quantities and location of all work to be performed as outlined in this section. Failure to do so shall not relieve the Contractor of his obligation to furnish all materials and labor necessary to carry out the provisions of the Contract. The work of the Contract can be summarized as follows:

The work consists of the proper removal of the following approximate quantities of hazardous materials from the Lottes Health Sciences Library Renovation CP211852:

Demolition/Construction Waste

Hazardous Waste

NA

Universal Waste

One thousand four Hundred and fifty (1,450) Fluorescent Light bulbs,
Seven Hundred and eighty (780) ballasts
Two (2) Fire rated doors
Thirteen (13) Automatic door closers
Ten (10) Smoke Detectors
Forty-two (42) Emergency Strobe lights
Thirty-three (33) Exit Signs
Forty-five (45) LED light bulbs

Reclaim/Recycle

NA

Building Materials Painted with Regulated Heavy Metals

NA

1.2 **CODES AND REGULATIONS:**

1.1.2.1 All applicable codes, regulations, standards, statutes, laws, and rules have the same force and effect (and are made a part of the contract documents by reference) as if copied directly into the contract documents, or as if published copies are bound herewith. Where conflicts arise, the most stringent specification shall apply.

1.1.2.2 Federal and State requirements which govern universal and hazardous removal work or hauling and disposal of such waste materials include but are not limited to the following:

1.1.2.2.1 U.S. Department of Labor, Occupational Health and Safety Administration (OSHA), 29 CFR 1910 and 29 CFR 1926.

1.1.2.2.1.1 Construction Industry - 29 CFR 1926.1101

1.1.2.2.1.2 Respiratory Protection – 29 CFR 1910.134

1.1.2.2.1.3 Hazard Communication – 29 CFR 1910.1200

1.1.2.2.1.4 Accident Prevention Signs – 29 CFR 1910.145

1.1.2.2.2 U.S. Environmental Protection Agency (EPA)

1.1.2.2.1.5 1.1.3 **CONTRACTOR'S DUTIES**

1.1.3.1 Except as specifically noted, provide and pay for:

- Labor, materials, and equipment.
- Tools, construction equipment, and machinery.
- Other facilities and services necessary for proper execution and completion of work.

1.1.3.2 Pay legally required sales, consumer, use, payroll, privilege and other taxes. Retail sales tax shall not be included in the bid amount.

1.1.3.3 Secure and pay for, as necessary for proper execution and completion of work, and as applicable at the time of bids:

- Permits
- Government Fees
- Licenses
- Except where specifically noted, provide and pay for waste disposal permits and costs

1.1.3.4 Give required notices.

1.1.3.5 Contractor shall assume full responsibility and liability for compliance with all codes, ordinances, rules, regulations, orders and other legal requirements of Local, State, and Federal public authorities including Environmental Protection Agency (EPA) regulations, Missouri Department of Natural Resources (MDNR) and Occupational Safety and Health Administration (OSHA) which bear on performance work. Where conflicts occur between these specifications and/or the above-mentioned regulations, the more stringent shall govern. The Contractor shall hold the owner and owner's air monitoring firm harmless for failure to comply with any applicable work, hauling, safety, health, or other regulations on the part of the contractor, contractor's employees, or contractor's subcontractors.

1.1.3.6 If the Contractor observes that any of the Contract Documents are at variance therewith in any respect, he shall promptly notify MU in writing, and any necessary changes shall be accomplished by appropriate modification. It is not the Contractor's responsibility to make certain that the Contract Documents are in accordance with applicable laws, statutes, building codes and regulations. If the Contractor performs any work knowing it to be contrary to such laws, ordinances, rules and regulations, and without such notice to MU, he shall assume full responsibility therefore and shall bear all cost attributable thereto.

1.1.3.7 Enforce strict discipline and good order among employees. Do not employ unfit persons or persons not skilled in assigned task.

1.1.3.8 Comply with all applicable federal, state, and local laws regarding job discrimination and payment of prevailing wage rates for the base bid.

1.1.3.9 The use of the best available technology, procedures, and methods for preparation, execution, cleanup, disposal, and safety are absolutely required. This compliance is the sole responsibility of the abatement contractor.

1.1.3.10 Assume responsibility for the proper and safe execution of the work.

1.1.8 **COORDINATION**: The hazard remediation contractor shall be responsible for the coordination of the universal/hazardous materials removal for this project. The hazard remediation contractor shall coordinate with all other on-site contractors and all subcontractors working under separate contracts so as to facilitate the general progress of the work. Each trade shall afford all trades every reasonable opportunity for the installation of their work.

1.2 **STOP WORK**

1.2.1 If the Owner, or his designated representative, presents a written or verbal stop work order, immediately stop all work or that portion of the work designated. A verbal stop work order shall be confirmed by a written stop work order within 24 hours. Do not commence referenced work until authorized in writing by the Owner or his representative.

1.3 **CONTRACTOR USE OF PREMISES**

1.3.1 **GENERAL**: During the construction period for the building, the hazard remediation will have full access to Pickard Hall for construction operations. Owner will keep the elevators operational.

1.3.2 **USE OF THE SITE**: Confine operations at the site to the areas permitted under the Contract. Portions of the site beyond areas on which work is indicated are not to be disturbed. Conform to site rules and regulations affecting the work while engaged in project construction.

1.3.2.1 Keep existing driveways and entrances serving the premises clear and available to the Owner and his employees at all times.

1.3.2.2 Do not unreasonably encumber the site with materials or equipment. Confine stockpiling of materials and location of storage to areas acceptable to Owner. If additional storage is necessary, obtain and pay for such storage off-site.

1.3.2.3 Do not load structure with weight that will endanger structure.

1.3.2.4 Assume full responsibility for protection and safekeeping of products stored on premises.

1.3.2.5 Move any stored products which interfere with operations of Owner or other contractors.

1.3.2.6 Contractor personnel shall utilize only those entrances/exits and parking lots designated by the Owner.

1.3.2.7 Contractor shall utilize only those areas designated by the Owner for the storage of equipment and the placement of dumpsters/transport containers.

1.3.2.8 Take all cautions necessary to ensure there is no universal and hazardous material contamination to those areas not included in work schedule. Should areas outside the work area become contaminated with hazardous materials, the Contractor shall immediately clean them utilizing the wet cleaning and HEPA vacuum methods specified herein. The hazard remediation contractor is responsible for the proper cleanup of all items in the work areas to maintain a clean and safe environment.

1.3.3 **CONTRACTOR'S USE OF THE EXISTING BUILDING**: Maintain the existing building in a safe and weather tight condition throughout the construction period. Take all precautions necessary to protect the building and its occupants during the construction period.

1.3.3.1 Keep areas such as walkways and stairs free from accumulation of waste material, rubbish or construction debris.

1.3.3.2 Smoking or open fires are prohibited within the building or on the premises.

1.4 **OWNER OCCUPANCY**

1.4.1 PARTIAL OWNER OCCUPANCY: The Owner reserves the right to occupy areas of the building in which universal/hazardous waste removal has been completed, provided that such occupancy does not substantially interfere with completion of the work. The Owner also reserves the right to occupy portions of the building not involved in this Scope of Work. Such partial occupancy shall not constitute acceptance of the work or any part of the work. The Owner shall also maintain the right to access areas where no universal and Hazardous waste work is being performed.

2.1 **SUBMITTAL REQUIREMENTS**

2.1.1 The following will be submitted by the contractor prior to commencement of work for approval by Owner's Certified Industrial Hygienist (one copy for the Owner's Representative). The Owner's C.I.H. will return reviewed copies to contractor and Owner's Representative.

2.1.1.1 One copy of any Safety Data Sheets (SDS) for products to be used by the contractor in the performance of his work. Contractor will also maintain copies of SDS on site per OSHA.

2.1.2 Submit the following for all Supervisor(s) and Workers who will be on the project site prior to commencement of work:

2.1.2.1 A list of project personnel and contact phone numbers

2.1.2.2 Current training certificates, if applicable

2.1.2.3 Physician's Statement that each person is physically fit to wear a respirator, if respirator use is required

2.1.2.4 Respirator Fit Test, if respirator use is required

2.1.3 Submit a detailed plan of the procedures proposed for use in complying with requirements of this specification. Include in the plan the layout and location of work areas, route of ingress and egress for the work areas, methods used to assure safety of building occupants and visitors, method of removal of material, and disposal container requirements for lead based paint material to be disposed.

2.1.4 Proposed disposal site for lead-based paint materials, including a disposal plan to detail type of disposal container, method of transportation to disposal site, and waste hauler.

2.1.5 Any other submittals as required by MU.

2.1.6 Upon completion of the universal/hazardous material removal, submit to the Owner's Representative, copies of hazardous materials shipping records, disposal receipts, incineration documentation, etc. for all hazardous materials removed from the project site.

2.1.7 Upon completion of the universal waste/hazardous material removal, the following information shall be submitted by the Owner's C.I.H. to the contractor:

2.1.7.1 Construction and demolition waste landfill receipts, disposal receipts, truck tickets, incineration/recycling receipts and documentation.

2.1.7.2 Written visual certification from the Owner's Certified Industrial Hygienist that universal waste/hazardous material have been removed from the facility.

2.2 **TERMINOLOGY** (Definitions)

2.2.1 **APPROVED Construction and Demolition WASTE DISPOSAL SITE**: A permitted solid waste landfill that is authorized by the Missouri Department of Natural Resources to receive construction and demolition wastes.

2.2.2 **AUTHORIZED VISITOR**: The Building Owner, the Building Owner's representative, MU personnel, or a representative of any regulatory or other agency having jurisdiction over the project.

2.2.3 **BARRIER**: Any surface that seals off the work area to non-authorized personnel from entering the work area.

2.2.4 **BUILDING OWNER**: A representative of the University of Missouri.

2.2.5 **DISPOSAL CONTAINER**: A properly labeled container for universal/hazardous materials. The proposed disposal container for lead-based paint will be provided to the Owner's Representative and part of the hazard remediation contractor's pre-work

2.2.6 **HEPA VACUUM EQUIPMENT**: High efficiency particulate air filtered vacuuming equipment with a filter system capable of collecting and retaining hazardous particulates. Filters should be of 99.97% efficiency for retaining particulates greater than 0.3 microns.

2.2.7 **ON-SITE REPRESENTATIVE**: MU's full-time representative responsible for air monitoring and enforcement of the specifications.
2.2.8 **OWNER'S CERTIFIED INDUSTRIAL HYGIENIST (C.I.H.)**: An Industrial Hygienist, certified in comprehensive practice by the American Board of Industrial Hygiene (ABIH).

2.2.9 **HAZARDOUS MATERIAL SHIPMENT RECORD/DISPOSAL RECEIPT**: The shipping document, required to be originated and signed by the waste generator, used to track and substantiate the disposition of universal/hazardous materials.

2.2.10 **WET CLEANING/WIPING**: The process of eliminating contamination from building surfaces and objects by using cloths, mops, or other cleaning tools which have been dampened with water, and by afterwards disposing of these cleaning tools as necessary.

2.2.11 **WORK AREA**: A specific isolated area in which universal/hazardous waste materials are required to be handled. The area is designated as a work area from the time that the area is secured and access restrictions are in place. The area remains designated as a work area until the time that it has been cleaned in accordance with any requirements applicable to the operations conducted.

2.3 EXISTING CONDITIONS

2.3.1 Building Owner and Contractor shall agree on building conditions prior to commencement of work. It shall be the Contractor's responsibility to replace or repair to the Owner's satisfaction, prior to close-out of the project, all damaged items caused by the Contractor and not proven otherwise. All items damaged prior to remediation shall be noted during preconstruction walk-through.

3.1 PERSONNEL PROTECTION REQUIREMENTS

3.1.1 Prior to commencement of work, the workers shall be instructed and shall be knowledgeable on the hazards of the universal hazardous materials involved and other environmental exposures, use and fitting of respirators, protective clothing, decontamination procedures, and all aspects of remediation work procedures; workers shall have medical examinations.

3.1.2 The Contractor acknowledges that he alone is responsible for enforcing personnel protection requirements and that these specifications provide only a minimum acceptable standard for each phase of operation.

3.1.3 If required or requested of the workers, provide workers with personally issued and marked respiratory equipment approved by NIOSH and accepted by OSHA.

3.1.4 No visitors shall be allowed in work areas, except as authorized.

3.1.5 Where required or if requested by the workers, provide workers with sufficient sets of disposable protective full-body clothing. Such clothing shall consist of full-body coveralls, footwear, and head gear, one-piece coveralls or equal. Provide eye protection and hard hats as required by applicable safety regulations. Disposable clothing shall not be allowed to accumulate and shall be disposed of as contaminated waste.

3.1.6 Provide authorized visitors with suitable protective clothing, headgear, footwear, and gloves as described above whenever they are required to enter the work area.

3.2 **MATERIALS**

3.2.1 Deliver all materials in the original packages, containers, or bundles bearing the name of the manufacturer and the brand name.

3.2.1.1 Store all materials subject to damage off the ground, away from wet or damp surfaces, and under cover sufficient to prevent damage or contamination.

3.2.1.2 Damaged or deteriorating materials shall not be used and shall be removed from the premises.

3.2.2 **PLASTIC SHEETING**: A minimum 6-mil (or as specified).

3.2.3 **TAPE**: Capable of sealing joints of adjacent sheets of polyethylene and for attachment of polyethylene sheets to finished or unfinished surfaces of dissimilar materials and capable of adhering under both dry and wet conditions, including use of amended water, duct tape, poly prep tapes or approved equal.

3.2.4 **ADHESIVES**: Capable of sealing joints of adjacent sheets of polyethylene and for attachment of polyethylene sheet to finished or unfinished surfaces of dissimilar materials and capable of adhering under both dry and wet conditions, including use of amended water.

3.2.5 **IMPERMEABLE CONTAINERS**: Suitable to receive and retain any hazardous materials until disposal by the owners rep. The containers shall be labeled as required by owner. Containers must be resistant to damage and rupture.

3.2.6 **WARNING LABELS AND SIGNS**: As required by owner.

3.2.7 **OTHER MATERIALS**: Provide all other materials, such as, but not limited to lumber, plywood, nails, and hardware, which may be required to properly prepare and complete this project.

3.3 **TOOLS AND EQUIPMENT**

3.3.1 Provide suitable tools for universal/hazardous waste removal and disposal.

3.3.1.1 Water Sprayer: Airless or a low pressure sprayer for amended water application as applicable.

3.3.1.2 Air-Purifying Equipment: High Efficiency Particulate Air Filtration Systems (HEPA) shall comply with ANSI Z9.2-91. No air movement system or air equipment should discharge particulates outside the work area. Thus, the negative air unit shall be equipped with a three-filter bank with the last being the HEPA filter capable of removing 99.97% of fibers/particulates >0.3 microns.

3.3.1.3 Scaffolding: As required to accomplish the specified work and meet all applicable safety regulations.

2.3.1.4 Vacuums: Use HEPA type from a known manufacturer.

2.3.1.5 Other tools and equipment as necessary.

3.4 SUPERVISION OF UNIVERSAL/HAZARDOUS Material REMOVAL

3.4.1 The contractor shall designate a competent supervisor subject to the approval of the Owner's C.I.H. and the Owner's Representative. The supervisor shall be the Contractor's representative on the project, shall meet the requirements of all applicable regulations, and perform or meet the following minimum requirements:

3.4.1.1 Be knowledgeable in all aspects of removal, cleanup and proper disposal of universal hazardous materials as listed in the Scope of Work.

3.4.1.2 Be onsite and supervise all removal, cleanup and disposal activities.

3.4.1.3 Maintain a daily log on the project documenting events, violations, problems, equipment failures, accidents, and inspections.

3.4.1.4 Be responsible for implementation of first aid, safety training, respiratory protection, and ensuring all workers are trained in emergency procedures.

3.4.1.5 Be responsible for conducting a visual inspection of the work area prior to a visual inspection by the Owner's Certified Industrial Hygienist. Inspection shall be documented.

3.5 WORKER PROTECTION / TRAINING

3.5.1 The contractor shall be responsible for providing his employees with proper respiratory protection, respiratory training, a written respirator program, medical examinations, maintaining medical records, protective clothing and equipment to comply with OSHA requirements, if necessary

3.5.2 All workers shall be trained in the dangers inherent in handling universal waste, and hazardous materials, in proper work procedures, and personal protective measures.

3.6 OWNER'S CERTIFIED INDUSTRIAL HYGIENIST

3.6.1 It will be the Owner's responsibility to hire a Certified Industrial Hygienist. The Certified Industrial Hygienist will also be required to perform the following duties as a minimum:

3.6.1.1 Approval of the Contractor's work plan and methods of remediation to meet regulatory requirements and ensure the health and safety of University faculty, staff, and students.

3.6.1.2 Verify that the Contractor is satisfactorily performing the work in accordance with OSHA regulations.

3.6.1.3 Visual inspection of the work areas.

3.6.1.4 Certify in writing that the Contractor's procedures, methods, and practices were, to the best of his/her knowledge and belief, in compliance with current EPA, OSHA, State, and Local applicable regulations, that the work areas meet the requirements for a final visual inspection prior to re-occupancy, and an accounting of any known deviations.

3.7 SEPARATION OF WORK AREAS FROM NONWORK AREAS

3.7.1 Visual separation shall be accomplished at all "see-through" locations using opaque polyethylene. This separation shall not be incorporated within the other seals involved on this project.

3.8 **EMERGENCY PROTECTION PLAN / FIRE EXITS**

3.8.1 The contractor shall be responsible for developing a written Emergency Protection Plan and shall maintain this plan onsite. The plan shall include considerations of fire, explosion, toxic atmospheres, electrical hazards, slips, falls, and heat related injury. All employees shall be instructed and trained in the procedures.

3.8.2 The Emergency Protection Plan shall also include written notification of police, fire, and medical personnel of the planned remediation activities, work schedule, and layout of the work area, particularly barriers that may affect response capabilities.

3.8.3 Designate and maintain emergency and fire exits from the work area in accordance with local codes and regulations. All exits shall be clearly marked with fluorescent tape or red paint and shall be clearly visible from any part of the work area.

3.9 **LOCAL AREA PROTECTION / SITE SECURITY**

3.9.1 The contractor shall secure the work areas to make sure of no inadvertent entry. Any breach to the exterior of the building shall be secured by the hazard remediation contractor. The Contractor shall be responsible for maintaining security of the remediation areas throughout the contract period.

3.9.2 The contractor shall be responsible for all areas of the building used by contractor and/or subcontractors in the performance of the work. Contractor shall exert full control over the actions of all employees and other persons with respect to the use and preservation of the existing building, except such controls as may be specifically reserved to the owner.

3.9.3 Contractor has the right to exclude from the work area all persons who have no purpose related to the work or its inspection, and shall require all persons in the work area to observe the same regulations required of Contractor’s employees.

3.9.4 The contractor shall have control of site security during remediation operations in order to protect the work environment and equipment. Contractor shall have the owner’s assistance in notifying building occupants of impending activity and enforcement of restricted access by owner’s employees.

3.9.5 The contractor shall keep a minimum of two (2) 10lb type ABC fire extinguishers onsite. One shall be maintained outside the work area and one inside each work area. Contractor employees shall be trained in the operation of fire extinguishers.

3.9.6 The contractor shall maintain the work area free from rubbish, debris, and dirt, and keep a clean, safe working area.

3.10 **UNIVERSAL WASTE/HAZARDOUS MATERIALS REMOVAL OPERATIONS**

3.10.1 Any light fixtures, housings, etc. concealing items considered to be universal waste/hazardous material shall be removed, containerized, labelled, and left on site for disposal by MU EHS. This does not include refrigerant or CHC/HCFC-containing equipment which are being replaced by the contractor. It does not include TCLP ceramic tile, which should be handled by the contractor.

3.10.2 **MATERIALS PAINTED WITH RCRA-Metals PAINT –**

It is anticipated that these items will be removed as part of the demolition process and will be segregated from the remainder of the demolition debris. It is anticipated that these items will be hauled away and disposed of in a sanitary landfill approved by the State of Missouri to accept construction and demolition waste. These areas should be sealed off with polyethylene

sheeting over the doors, vents, windows, or any other openings into/out of the area.

3.10.3 **FLUORESCENT LIGHT TUBES** may contain small amounts of Mercury. This can potentially be harmful to human health and the environment. The bulbs should be placed in fiberboard boxes provided by MU EHS to minimize breakage. MU EHS will manage disposal of this material.

3.10.4 **POLYCHLORINATED BIPHENYL (PCBS)** are a known carcinogenic material. Its use was discontinued January 1, 1979. Due to the age of the building, it should be assumed that any ballast can contain PCBs unless it is labeled as PCB free by the manufacturer. Due to this, any light ballasts presumed to contain PCBs should be properly disposed of. MU Environmental Health Safety will provide collection container for this purpose. Non-PCB ballasts will also be managed by MU Environmental Health Safety. Collection containers will be provided to the contractor upon their request.

3.10.5 **SMOKE DETECTORS** are typically ionization smoke detectors that may contain a small amount of radioactive material. MU Environmental Health and Safety will provide collection containers for this material and will also be responsible for the disposal of this material.

3.10.6 **FIRE ALARMS (STROBE LIGHT)** are typically not considered a universal or hazardous waste. However, for the purposes of this project, these items should be collected by the contractor and managed by MU Environmental Health and Safety. Collection containers will be provided to the contractor upon their request.

3.10.7 **EXIT SIGNS AND EMERGENCY LIGHTS** typically have backup batteries that may contain small amounts of lead. Some exit signs are powered by a small amount of radioactive material. Powered exit signs and emergency lights should have the battery removed and disposed of by MU Environmental Health and Safety. Non powered exit signs should be assumed to contain radioactive material and should be collected for disposal via MU Environmental Health and Safety. MU Environmental Health and Safety will provide collection containers for these items.

3.10.8 **DRINKING FOUNTAINS**: Some drinking fountains have reservoirs that may contain lead and a CFC/HCFC refrigerant that must be recovered. The lead reservoirs should be removed and recycled. The CFC/HCFC refrigerant must be recovered by a contractor licensed and trained in this type of work. The remainder of the unit should be managed as scrap metal.

3.10.9 **DOOR CLOSURES**: Some of the older door closures have oil reservoirs for lubrication. These oils may contain small amounts of PCBs. MU Environmental Health and Safety will provide a collection container for this material, and will be responsible for disposal.

3.10.10 **THERMOSTATS** may contain Mercury. This can potentially be harmful to human health and the environment. Mercury containing thermostats shall be disposed of as a hazardous waste. MU EHS will provide a collection container for this material, and will be responsible for disposal.

3.10.11 **WINDOW AIR CONDITIONING UNITS**: Where possible, these window units should be removed and stored for use elsewhere. Otherwise these units may contain CFC/HCFC refrigerants that must be recovered. CFC/HCFC refrigerants are suspected to damage the atmosphere. The CFC/HCFC refrigerant must be recovered by a contractor licensed and trained in this type of work. The remainder of the unit should be managed as scrap metal.

3.10.12 **CERAMIC TILE:** are made from clay bodies that contain high concentrations of silica.

Respirable crystalline silica is a “known human carcinogen.” When ceramic tiles are cut, abraded, shattered, or crushed, hazardous silica dust can be generated. Ceramic tiles can also have high concentrations of toxic metals, in the clay body and in the glazing, and potentially be classified as Hazardous Waste.

3.12 **REESTABLISHMENT OF THE WORK AREA**

3.1 2.1 Reestablishment of the work area shall only occur after the Contractor has received a final visual inspection from the Owner’s C.I.H. documenting that the universal/hazardous waste materials have been removed from the project site.

END OF SECTION

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SECTION 02 4119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 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 1.E "Special Conditions" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
2. Section 03 3000 “Cast-in-Place Concrete” for coordination with concrete patching.

1.2 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.

1.3 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

1.4 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.

1.5 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.

1. Before selective demolition, Building Owner will remove the following items:

a. Furniture, except for what is designated on the drawings to be removed by the contractor.

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. 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. Storage or sale of removed items or materials on-site is not permitted.

F. 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.

1.6 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 ANSI/ASSP 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.

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.

1. Refer to sections 21 0500 Common Work Results for Fire Suppression, 22 0500 Basic Plumbing Materials and Methods, 23 0500 Basic Mechanical Materials and Methods, 26 0500 Common Work Results for Electrical, and 26 0600 Electrical Demolition for additional requirements.

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. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.
    a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
    c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
    d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
    e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
    f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
    g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.
4. Refer to sections 21 0500 Common Work Results for Fire Suppression, 22 0500 Basic Plumbing Materials and Methods, 23 0500 Basic Mechanical Materials and Methods, 26 0500 Common Work Results for Electrical, and 26 0600 Electrical Demolition for additional requirements.

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 1.E "Special Conditions."

B. 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 Two (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.

B. Removed and Salvaged Items:

1. Clean salvaged items.
2. Transport items to Owner's storage area designated by Owner.
3. Protect items from damage during transport and storage.

C. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Protect items from damage during transport and storage.
3. 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.

D. 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 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 Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.

C. 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.

D. Carpet Tile: Remove floor coverings and adhesive according to recommendations in RFCI's “Recommended Work Practices for the Removal of Carpet Tile”. Do not use methods requiring solvent-based adhesive strippers.

E. Ceramic Tile Floor Coverings: Remove floor coverings, grout, and adhesive by scraping and grinding to expose existing concrete, and in agreement with requirements for the new floor finishes in that area.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Coordinate first subparagraph below with use of elevators, stairs, or building entries permitted by building manager.
4. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
5. Comply with requirements specified in Section 1.E "Special Conditions”, Construction Waste Management.

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 02 4119

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TECHNICAL SPECIFICATIONS
ASBESTOS-CONTAINING MATERIALS
REMOVAL AND DISPOSAL

For

UNIVERSITY OF MISSOURI
Lottes Health Sciences Library Renovation
CP211852

Prepared for
UNIVERSITY OF MISSOURI
Campus Facilities
Columbia, Missouri 65211

Prepared by
UNIVERSITY OF MISSOURI
ENVIRONMENTAL HEALTH AND SAFETY

SECTION 02 8233
FRIABLE AND NON-FRIABLE ASBESTOS REMOVAL

PART 1 - GENERAL

Provisions of the General Conditions and Special Conditions are part of this Division.

1.1 SCOPE OF WORK

1. General: The work specified herein shall be the abatement of asbestos containing materials by certified and registered persons who are knowledgeable, qualified and trained in the abatement, handling, and disposal of asbestos containing material, and subsequent cleaning of the affected environment.

2. The Contractor shall furnish all labor, material, equipment, testing, services, permits, insurance, notifications, necessary or required to perform the work in accordance with applicable local, state, and federal regulations for the abatement of asbestos containing materials and for other work as specified in this section or as indicated in associated drawings, sketches, or reports of the work.

All fees required for notification requirements, renotifications, and/or inspections by the regulatory agencies shall be paid by the Contractor. Bulk sample analysis information required by the Department of Natural Resources, U.S. Environmental Protection Agency or loc twenty) linear feet of asbestos-containing thermal system insulation.
al authority having jurisdiction in conjunction with the notification shall also be provided by the Contractor unless provided within this section.

3. The work shall include the removal and legal disposal of friable and non-friable asbestos containing materials including.

1. Non-friable Asbestos:
The contractor shall remove and legally dispose of:

1. One (1) Sink within room HSL210, white spray on undercoating present on the sink is positive for Asbestos.

2. Gray Caulking present on HVAC Duct sections above suspended ceilings and gypsum board soffits within the project area.

   * Other Asbestos containing caulking / sealants may also be present on VAVs and duct sections withing the project area.

1.2 DEFINITIONS

1. Abatement - Procedures to decrease or eliminate the source of fiber release from asbestos containing building materials. Includes encapsulation, enclosure, and removal.

2. Adequately Wet - To sufficiently mix or penetrate with liquid to prevent the release of particulate.

3. Aggressive Air Sampling - Sweeping of floors, ceilings and walls and other surfaces with the exhaust of a minimum of one (1) horsepower leaf blower or equivalent immediately prior to air monitoring.

4. Approved Waste Disposal Site - A solid waste disposal area that is authorized by the Department of Natural Resources to receive asbestos containing solid wastes.

5. Asbestos - The asbestiform varieties of serpentine (chrysotile, antigorite), riebeckite (crocidolite), cummintonite-grumerite (amosite), anthophyllite, and actinolite-tremolite.

6. Asbestos Abatement Supervisor - An individual who directs, controls, or supervises others in asbestos abatement projects.

7. Asbestos Containing Building Material (ACBM) - Surfacing ACM, thermal system insulation ACM, or miscellaneous ACM that is found in or on interior structural members or other parts of a building.

8. Asbestos Containing Material (ACM) - Any material containing more than 1 percent asbestos by weight.

9. Barrier - Any surface that seals off the work area to inhibit the movement of fibers.

10. Category I Nonfriable ACM - Asbestos-containing packings, gaskets, resilient floor covering and asphalt roofing products containing more than one percent (1%) asbestos as determined using the method specified in 40 CFR part 763, subpart F, Appendix A, section 1, Polarized Light Microscopy.

11. Category II Nonfriable ACM - Any material, excluding category I nonfriable ACM, containing more than one percent (1%) asbestos as determined using the methods specified in 40 CFR part 763, subpart F, Appendix A, section 1, Polarized Light Microscopy that, when dry, cannot be crumbled, pulverized or reduced to powder by hand pressure.

12. Containment - Area where asbestos abatement project is conducted. Area must be enclosed either by a glove bag or plastic sheeting barrier.

13. Contractor's Competent Person (Qualified Person) - One who is capable of identifying existing asbestos hazards in the workplace and selecting the appropriate control strategy for asbestos exposure, who has the authority to take prompt corrective measures to eliminate them, as specified in 29 CFR 1926.32 (f); in addition, for Class I, II, III, and IV work, who is specially trained in training courses which meet the criteria of EPA's Model Accreditation Plan (40 CFR Part 763) for project designer or supervisor, or its equivalent.

14. Decontamination Area - Enclosed area adjacent and connected to the regulated area which is used for decontamination of workers, materials, and equipment that are contaminated with asbestos.

15. Demolition - the wrecking or taking out of any load bearing structural member of a facility together with any related handling operations.

16. Disposal Bag - A properly labeled 6 mil. thick leak-tight plastic bag used for transporting asbestos waste from work area to disposal site.

17. Encapsulant (Sealant) - A liquid material which can be applied to asbestos-containing material and which prevents the release of asbestos fibers from the material either by creating a membrane over the surface or by penetrating into the material and binding its components together.

18. Encapsulation - Treatment of asbestos containing materials with an encapsulant.

19. Enclosure - The construction of an airtight, impermeable, permanent barrier around asbestos containing material to control the release of asbestos fibers into the air.

20. Friable Asbestos Material - Any material containing more than one percent asbestos as determined using the method specified in appendix A, subpart F, 40 CFR part 763 section 1, Polarized Light Microscopy, that, when dry, can be crumbled, pulverized, or reduced to powder by hand pressure.

21. Glove Bag - A manufactured or fabricated device, typically constructed of six (6) mil transparent polyethylene or polyvinyl chloride plastic. This device consist of two (2) inward projecting long sleeves, an internal tool pouch and an attached, labeled receptacle for asbestos waste.

22. Homogeneous Work Site - Continuous areas with the same type of ACM and in which one type of abatement process is performed.

23. Negative Initial Exposure Assessment - An assessment by a "Competent Person" in which it is concluded that employee exposures during the job are likely to be consistently below the Permissible Exposure Levels.

24. Outside Air - Air outside of the containment.

25. Owner's Air Monitoring Firm - Air Monitoring conducted by a person who is not under the direct control of the person carrying out the asbestos abatement project and who has been selected by the Owner.

26. Owner's Air Sampling Professional - An individual who holds a valid certification from the State of Missouri. The individual shall conduct, oversee, or be responsible for air monitoring of asbestos abatement projects before, during, and after the project has been completed. The air sampling professional must hold a 40 hour AHERA Asbestos Contractor/Supervisor Certificate, and supervised by the Owner's Certified Industrial Hygienist (C.I.H.).

27. Owner's Air Sampling Technician - An individual who has been trained by and is under the supervision of an air sampling professional to do air monitoring before, during, and after the asbestos abatement project. The air sampling technician must hold a 40 hour AHERA Asbestos Contractor/Supervisor Certificate, and be supervised by the Owner's Certified Industrial Hygienist (C.I.H.).

28. Owner's Certified Industrial Hygienist (C.I.H.) - an Industrial Hygienist, Certified in Comprehensive Practice by the American Board of Industrial Hygiene. The Owner's C.I.H. must also be certified by the Missouri Department of Natural Resources as an air sampling professional and hold a 40 hour AHERA Asbestos Contractor/Supervisor Certificate. The Owner will identify C.I.H. before application for permit.

29. Personal Monitoring - Sampling of the asbestos fiber concentrations within the breathing zone.

30. Regulated Asbestos Containing Material (RACM) - Friable asbestos material; Category I nonfriable ACM that has become friable; Category I nonfriable ACM that will be or has been subjected to sanding, grinding, cutting, or abrading; Category II nonfriable ACM that has a high probability of becoming or has become crumbled, pulverized or reduced to powder by the forces expected to act on the material in the course of demolition or renovation operations.

31. Remove - To take out RACM or facility components that contain or are covered with RACM from any facility.

32. Renovation - Altering a facility or one or more facility components in any way, including the stripping or removal of RACM from a facility component.

33. Repair - The restoration of asbestos material that has been damaged. Repair consists of the application of rewettable glass cloth, canvas, cement or other suitable material. It may also involve filling damaged areas with non-asbestos substitutes and re-encapsulating or painting previously encapsulated materials.

34. Strip - To take off RACM from any part of a facility or facility components.

35. Waste Shipment Record - The shipping document, required to be originated and signed by the waste generator, used to track and substantiate the disposition of asbestos containing waste material.

36. Work Area - A specific isolated area, other than the space enclosed within a glove bag, in which friable asbestos-containing materials is required to be handled. The area is designated as a work area from the time that the area is secured and access restrictions are in place. The area remains designated as a work area until the time that it has been cleaned in accordance with any requirements applicable to the operations conducted.

1.3 CODES AND REGULATIONS

1. General Applicability Of Codes, Regulations and Standards - All applicable codes, regulations, standards, statutes, laws, and rules have the same force and effect (and are made a part of the contract documents by reference) as if copied directly into the contract documents, or as if published copies are bound herewith. Where conflicts arise, the most stringent specification shall apply.

2. Contractor Responsibility - The Contractor shall assume full responsibility and liability for the compliance with all applicable federal, state, and local regulations pertaining to work practices, hauling, disposal and protection of workers, visitors to the site, and persons occupying areas adjacent to the site. The Contractor is responsible for providing medical examinations and maintaining medical records of personnel as required by the applicable federal, state, and local regulations. The Contractor shall hold the owner harmless for failure to comply with any applicable work, hauling, disposal, safety, health, or other regulations on the part of the contractor, contractor's employees, or contractor's subcontractors.

3. Federal and State requirements which govern asbestos abatement work or hauling and disposal of asbestos waste materials include but are not limited to the following:

1. U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) including but not limited to:

1. Title 29, Part 1910, Section 1001 and Part 1926, Section 1101 of the Code of Federal Regulations.

2. Respiratory Protection, Title 29, Part 1910, Section 134 of the Code of Federal Regulations.

3. Construction Industry, Title 29. Part 1926, of the Code of Federal Regulations.

4. Access to Employee Exposure and Medical Records, Title 29, Part 1910, Section 2 of the Code of Federal Regulations.

5. Hazard Communication, Title 29, Part 1910, Section 1200 of the Code of Federal Regulations.

6. Specifications for Accident Prevention Signs and Tags, Title 29, Part 1910, Section 145 of the Code of Federal Regulations.

2. U.S. Environmental Protection Agency (EPA) including but not limited to:

1. National Emission Standards for Hazardous Air Pollutants (NESHAPS) Title 40, Part 61, Subpart M, Code of Federal Regulations.

3. U.S. Department of Transportation (DOT) including but not limited to:

1. Title 49, Part 172, Section 101 of the Code of Federal Regulations.

4. State of Missouri including but not limited to:

1. H.B. 77, 85th General Assembly.

2. Missouri Air Conservation Law Chapter 643.

3. Missouri Department of Natural Resources, Division 10, Chapter 6 of the Code of State Regulations as follows:

(1) 10 CSR 10-6.020, Definitions

(2) 10 CSR 10-6.080, Emission Standards for Hazardous Air Pollutants

(3) 10 CSR 10-6.230, Administrative Penalties

(4) Volume 18, Missouri Register, Page 44

(5) 10 CSR 10-6.250, Asbestos Abatement Projects - Certification, Accreditation, and Business Exemption Requirements

1.4 NOTIFICATIONS

1. Notifications meeting the requirements of Volume 18, Missouri Register, page 44, shall be completed and sent by the Contractor not less than ten (10) days before the intended starting date of the project. Send notification to the following:

1. Department of Natural Resources
Air Pollution Control Program (Asbestos)
P.O. Box 176
Jefferson City, Missouri 65102

2. U.S. Environmental Protection Agency
Region VII
Air & Toxic Division, Air Branch
ATTN: Air Compliance
726 Minnesota Avenue
Kansas City, Kansas 66101

3. Provide a copy to the Owner's Representative. Five (5) day notification to the Owner's Representative is required on jobs less than the reportable quantity.

4. If the project is under the jurisdiction of the Kansas City Air Quality Section, St. Louis County Air Pollution Control Branch, or the Springfield-Green County Air Pollution Control Authority, send notification directly to the appropriate agency.

1.5 SUBMITTALS

1. The following will be submitted by contractor prior to commencement of work for approval by the Owner's Certified Industrial Hygienist (one copy for the Owner's Representative). Owner's C.I.H. will return reviewed copies to contractor and Owner's Representative.

    1. One copy of material safety data sheets (MSDS) for products to be used by the Contractor in the performance of his work. Contractor will also maintain copies of MSDS on site per OSHA.

    2. One copy of the notifications to, or any correspondence with, the regulatory agencies. Submit a listing of all prior regulatory violations.

2. Friable Abatement:

    1. Current Certificates of training and statement of qualifications for the project asbestos abatement supervisor and the Missouri Asbestos Occupational Certificates for all project personnel. List a summary of project personnel and contact phone numbers.

    2. Name, address, and contact person's name of testing laboratory or laboratories to be utilized analyzing samples for bulk analysis or air samples.

    3. Submit a detailed plan of the procedures proposed for use in complying with requirements of this specification and Volume 18, Missouri Register, page 44, and 29 CFR 1926.1101. Include in the plan the layout and location of barriers, decontamination units, route of ingress and egress for work area, methods used to assure safety of building occupants and visitors, methods used to isolate or closing out of HVAC system, personal air monitoring strategy, method of removal of material, and engineering controls utilized to prevent emissions from the work area.

    4. Provide a disposal plan to detail type of disposal container, method of transportation to disposal site, waste hauler, and disposal site.

    5. Copy of notifications required as part of the emergency notification plan.

3. Non-Friable Abatement:

    1. Submit a detailed plan of the procedures proposed to minimize emissions and to prevent the material from becoming friable during removal.

    2. Copy of emergency protection plan to be used if the nonfriable material should become friable during removal.

    3. Current Certificates of training and statement of qualifications for the "Competent Person".

    4. One copy of the Negative Initial Exposure Assessment.

4. Upon completion of the abatement work, the following information shall be submitted to the Owner's Representative.

1. Waste disposal receipts and waste shipment record on all asbestos waste removed from the project.

5. Upon completion of the abatement work, the following information shall be submitted by the Owner's C.I.H. to the Contractor.

1. Air sampling test results for personal (non-OSHA) and final clearance air samples taken under the supervision of Owner's Certified Industrial Hygienist. Results must be in writing in final report form.

2. Written certification from the Owner's Certified Industrial Hygienist.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 SUPERVISION OF ABATEMENT

1. The Contractor shall designate a competent supervisor subject to the approval of the Owner's C.I.H. and the Owner's Representative. The supervisor shall be the Contractor's representative on the project and shall meet the requirements of all applicable regulations and perform the following minimum requirements.

1. Be Certified by the State of Missouri as an Asbestos Abatement Supervisor, a minimum of one year prior full time experience in asbestos abatement work and a minimum of two years experience as a supervisor, and be qualified as a Competent Person in accordance with OSHA regulation 1926.1101.

2. Be on site and supervise all abatement work in accordance with OSHA and Volume 18, Missouri Register, page 44.

3. Conduct all OSHA required air monitoring.

4. Maintain a daily log on the project documenting events, visitations, problems, equipment failures, accidents, and inspections.

5. Be responsible for implementation of first aid, safety training, respiratory protection, and ensuring all workers are trained in emergency procedures.

6. Be responsible for conducting a visual inspection of the work area prior to a visual inspection by the Owner's Certified Industrial Hygienist. Inspection shall be documented.

3.2 NEGATIVE INITIAL EXPOSURE ASSESSMENT

1. The Contractor must conduct a Negative Initial Exposure Assessment (non-friable asbestos) prior to removal of the asbestos material. The Negative Initial Exposure Assessment shall be performed by a "Competent Person" to determine whether the material may be removed and maintained in a nonfriable condition. If the material cannot be removed without becoming friable then the contractor shall comply to the requirements in this specification at no additional cost to the Owner.

2. The method of removal is the Contractor's option. However, in the event of any of the following:

    1. Visible emissions are observed

    2. Sanding, grinding, cutting, or abrading of the material

    3. Air samples exceed 0.1 f/cc

The contractor shall immediately stop work, implement corrective work practices, make any necessary notifications to all regulatory agencies of the changes in work practices and material conditions, and comply with the requirements as set forth in this specification.

3.3 WORKER PROTECTION & TRAINING

1. The Contractor shall be responsible for providing his employees with proper respiratory protection, respiratory training, written respirator program, medical examinations, maintaining medical records, and protective clothing and equipment to comply with OSHA requirements.

2. The Contractor shall be responsible for all testing and costs incurred for complying with requirements of OSHA regulations for Personal Air Sampling.

3. All workers shall be trained in the dangers inherent in handling asbestos and breathing asbestos dust and in proper work procedures and personal and protective measures.

4. All workers shall hold valid diplomas as accredited Asbestos Abatement Workers as required by 10 CSR 10-6.250.

3.4 INDEPENDENT TESTING LABORATORY

1. Testing Laboratories utilized by the Contractor for sample analysis during the project shall meet the following minimum requirements and be approved by the Owner's C.I.H. This information shall be submitted to the Owner's Representative for review.

1. All air monitoring samples shall be analyzed by a testing laboratory accredited by the American Industrial Hygiene Association (AIHA) or by an individual who is currently on the Asbestos Analyst Registry.

2. All bulk samples shall be analyzed by a testing laboratory accredited by the National Voluntary Laboratory Accreditation Program (NVLAP).

3.5 OWNER'S AIR SAMPLING PROFESSIONAL & CERTIFIED INDUSTRIAL HYGIENIST

1. It will be the Owner's responsibility to hire an Air Sampling Professional & Certified Industrial Hygienist. The Air Sampling Professional & Industrial Hygienist will also be required to perform the following duties as a minimum:

1. Approval of the Contractor's work plan and methods of abatement to meet regulatory requirements and ensure the health and safety of University faculty, staff, and students.

2. Verify that the contractor is satisfactorily performing personal air monitoring as directed by OSHA regulations.

3. Visual inspection of the work area and final clearance air monitoring.

4. Certify in writing that the Contractor's procedures, methods and practices were, to the best of my knowledge and belief, in compliance with current EPA, OSHA, State and/or applicable local regulations and that the work areas meet the requirements for final clearance testing and account of any known deviations.

5. Issue final air clearance.

3.6 EMERGENCY PROTECTION PLAN

1. The contractor shall be responsible for developing a written Emergency Protection Plan and shall maintain this plan on site. The plan shall include considerations of asbestos leakage from the site, fire, explosion, toxic atmospheres, electrical hazards, slips, falls, and heat related injury. All employees shall be instructed and trained in the procedures.

2. Emergency protection plan shall also include written notification of police, fire and medical personnel of the planned abatement activities, work schedule, and layout of work area, particularly barriers that may affect response capabilities.

3.7 LOCAL AREA PROTECTION & SITE SECURITY

1. The contractor shall be responsible for all areas of the building used by him and/or subcontractors in the performance of the work. Contractor shall exert full control over the actions of all employees and other persons with respect to the use and preservation of the existing building, except such controls as may be specifically reserved to the owner.

2. Contractor has the right to exclude from the work area all persons who have no purpose related to the work or its inspection, and shall require all persons in the work area to observe the same regulations required of Contractor's employees.

3. The contractor shall have control of site security during abatement operations in order to protect work environment and equipment. Contractor shall have the owners assistance in notifying building occupants of impending activity and enforcement of restricted access by owners employees.

4. The contractor shall keep a minimum of two 10 lbs. type ABC fire extinguishers on site. One shall be maintained outside the work area and one inside the work area. The employees shall be trained in the operation of extinguishers.

5. Where areas cannot be isolated by existing walls and doors from employees, clients, or the public, barriers must be constructed of 1/2" plywood and 2"x4" framing 16" o.c. to isolate the area. The barriers must be installed in such a manner to prevent damage to existing walls, floors, or ceilings. Barrier may have a lockable door.

6. The contractor shall maintain the work area free from rubbish, debris, and dirt and keep a clean, safe working area.

7. The Contractor shall provide warning signage around the regulated area as required by OSHA.

8. The Contractor shall isolate any and all air supply and returns to the abatement space as required by OSHA. Contractor shall coordinate with the Owner's Representative.

9. The Contractor shall keep all areas where adhesive stripper is in use (such as mastic removal) under negative pressure and exhausted to the outside ambient air.

3.8 FINAL CLEARANCE REQUIREMENTS (FRIABLE ASBESTOS)

1. Upon completion of the abatement work, the supervisor shall perform a visual inspection of the work area. If satisfactory, the supervisor shall then request the Owner's C.I.H. or the C.I.H.'s air sampling technician to perform a visual inspection. When the Owner's C.I.H. feels the area is ready based on the results of their visual inspection, the Contractor shall apply a lockdown encapsulant. Following application of lockdown encapsulant, the Owner's C.I.H. shall perform the final clearance sampling for airborne fiber concentrations.

2. The Owner's C.I.H. or designee will perform final clearance testing per the following requirements:

    1. Aggressive sampling shall be required for all areas where removal has taken place with the exception of glove bag projects where nonaggressive sampling is permitted.

    2. P.C.M. samples analyzed on site shall be counted by an accredited registered microscopist.

3. For areas specifically specified for clearance by Transmission Electron Microscopy, the method shall be NIOSH 7402.

3. Any work areas failing to meet the clearance requirements of this section shall be recleaned and retested at the contractor's expense until satisfactory levels are obtained.

4. The Owner's C.I.H. shall provide a written report of the air monitoring activities to the contractor within 7 days after the final clearance testing.

3.9 REESTABLISHMENT OF THE WORK AREA AND SYSTEMS

1. Reestablishment of the work area shall only occur after the contractor has received final clearance in writing from the Owner's C.I.H.

2. All damage to finishes, equipment, and/or the area affected by the abatement shall be repaired by the contractor to equal or better condition as it was prior to the work, at no cost to the owner.

3.10 WASTE DISPOSAL

1. All asbestos containing waste and/or asbestos contaminated debris shall as a minimum be double bagged in approved 6 mil. disposal bags. Each bag shall be tagged to meet requirements of NESHAPS with an asbestos caution label and a source identification label.

2. Transportation shall meet the requirements of all regulatory agencies for asbestos containing materials and shall be transported in an enclosed truck.

3. The waste disposal site shall be approved by the Missouri Department of Natural Resources for asbestos disposal. A chain of custody letter/waste shipment record and disposal receipts shall be provided to the owner for all materials disposed of.

3.11 DRAWINGS

1. Drawings, when provided, are not intended to be used for anything but a "reference" to the work area. Information is not specific to quantities or to exact location of ACM unless explicitly noted. Contractor will be required to field verify the conditions and quantities.

3.12 REPORTS

1. Reports, when provided, are intended to be used as a basis for the type and composition of the asbestos present for both bidding purposes and for the information required for the notifications to the governing agencies.

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SECTION 03 3000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Design Mixtures: For each concrete mixture.

C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement.

1.3 INFORMATIONAL SUBMITTALS

A. Material certificates.

B. Material test reports.

C. Floor surface flatness and levelness measurements.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

B. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

C. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

D. Concrete Testing Service: Owner will engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

E. Moisture Vapor Reduction Admixture Warranty

1. Manufacturer’s Warranty: Submit, for the owner’s acceptance, the manufacturer’s standard warranty document executed by an authorized company official. The

manufacturer's warranty is in addition to, and not a limitation of, other rights the Owner may have under provisions of the contract documents.

2. Warranty Period: Ten years commencing on the date of acceptance of the project by the Owner or Notice of Completion whichever is earliest.

    a. Warranty Terms: Terms to include moisture related failures, including all finish floor materials and labor. Admixture warranty issued on completion of ASTM-D-5084 or ASTM-D-4263 test and results submitted to a Concure Systems Representative.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

2.2 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

B. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.

C. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.

D. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice.

2.3 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150 Type I/II, gray. Supplement with the following:

    a. Fly Ash: ASTM C 618, Class F or C.
    b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

B. Normal-Weight Aggregates: ASTM C 33, graded.

1. Maximum Coarse-Aggregate Size: 1-1/2 inches (38 mm) nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Water: ASTM C 94/C 94M and potable.

2.4 ADMIXTURES

A. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
7. Moisture Vapor Reduction Admixture:

    a. Acceptable Products:

        1) Concure Systems 1618 E. Briarwood Terrace, Phoenix, AZ 85048

            a) Contact: Emil Pikula Cell – (480) 820-7171, Fax (480) 820-7787, E-mail: epikula@cox.net

        2) Barrier One MVRA manufactured by Barrier One

            a) Contact: 522 S. Hunt Club Blvd, #303, Apopka, FL 32703, www.barrierone.com

2.5 WATERSTOPS

A. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch (19 by 25 mm).

B. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic polymer modified chloroprene rubber, for adhesive bonding to concrete, 3/8 by 3/4 inch (10 by 19 mm).

2.6 VAPOR RETARDERS

A. Sheet Vapor Retarder: ASTM E 1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape.

2.7 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.

G. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

1. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

H. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

1. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.8 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.

B. Concure Systems Crack Fill Binder

1. Acceptable Products:

a. Concure Systems 1618 E. Briarwood Terrace, Phoenix, AZ 85048

1) Contact: Emil Pikula Cell – (480) 820-7171, Fax (480) 820-7787, E-mail: epikula@cox.net

2.9 CONCRETE MIXTURES

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

B. Cementitious Materials: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 20 percent.

C. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing admixture in concrete, as required, for placement and workability.

D. Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: As required by prints at 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.50 – footings; 0.45 – all other mixes
3. Slump Limit: 4 inches(125 mm) or8 inches (200 mm for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch (25 mm).
4. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

5. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended by manufacturer.

    a. Add water vapor reducing admixture per manufacturers specified dosage rate to ready mix truck at the batch plant, or jobsite before discharge, mix rapidly for 7 minutes. (Follow Manufacturer's Instructions).

2.10 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.11 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Chamfer exterior corners and edges of permanently exposed concrete.

3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.3 VAPOR RETARDERS

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.

1. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended tape.

3.4 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

3.5 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

E. Waterstops: Install in construction joints and at other joints indicated according to manufacturer's written instructions.

3.6 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.

C. Cold-Weather Placement: Comply with ACI 306.1.

D. Hot-Weather Placement: Comply with ACI 301.

3.7 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view.

C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.8 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
2. Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.- (3.05-m-) long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch (3.2 mm) at the gymnasium floor and 1/4" (6.4mm) at all other locations.

3.9 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days.
2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

    a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written

instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.10 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

3.11 FIELD QUALITY CONTROL

A. Testing and Inspecting: Contractor will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

END OF SECTION 03 3000

SECTION 05 1200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes structural steel and grout.

1.2 DEFINITIONS

A. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

B. Moment Connections: Type FR, fully restrained.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show fabrication of structural-steel components.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer, fabricator, and testing agency.

B. Welding certificates.

C. Mill test reports for structural steel, including chemical and physical properties.

D. Source quality-control reports.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Comply with applicable provisions of the following specifications and documents:

1. AISC 303.
2. AISC 360.
3. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A 572/A 572M, Grade 50 (345).

B. Channels, Angles, M, S-Shapes: ASTM A 36/A 36M.

C. Plate and Bar: ASTM A 36/A 36M.

D. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.

E. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.

F. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, (ASTM A 563M, Class 8S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers; all with plain finish.

1. Direct-Tension Indicators: ASTM F 959, Type 325 (ASTM F 959M, Type 8.8), compressible-washer type with plain finish.

B. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy-hex head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.

1. Finish: Plain.

C. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

D. Unheaded Anchor Rods: ASTM F 1554, Grade 36.

1. Configuration: Straight.
2. Finish: Plain.

E. Headed Anchor Rods: ASTM F 1554, Grade 36, straight.

1. Finish: Plain.

F. Threaded Rods: ASTM A 36/A 36M.

1. Finish: Plain.

2.3 PRIMER

A. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

2.4 GROUT

A. Metallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.

2.5 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.

B. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

2.6 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

2.7 SHOP PRIMING

A. Shop prime steel surfaces except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
2. Surfaces to be field welded.
3. Surfaces to be high-strength bolted with slip-critical connections.
4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
5. Galvanized surfaces.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:

1. SSPC-SP 2, "Hand Tool Cleaning."
2. SSPC-SP 3, "Power Tool Cleaning."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

2.8 SOURCE QUALITY CONTROL

A. Testing Agency: Contractor will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.

1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

C. Bolted Connections: Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

1. Liquid Penetrant Inspection: ASTM E 165.
2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
3. Ultrasonic Inspection: ASTM E 164.
4. Radiographic Inspection: ASTM E 94.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with steel Erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

B. Base Bearing and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials and roughen surfaces prior to setting plates. Clean bottom surface of plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of baseplate.
3. Snug-tighten Pretension anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

3.3 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.

B. Bolted Connections: Bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Welded Connections: Field welds will be visually inspected according to AWS D1.1/D1.1M.

D. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

END OF SECTION 05 1200

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SECTION 05 3100 - STEEL DECKING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof deck.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.

B. Shop Drawings:

1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product certificates.

C. Evaluation reports.

D. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. ASC Profiles, Inc.; a Blue Scope Steel company.
2. Canam United States; Canam Group Inc.
3. CMC Joist & Deck.
4. Consolidated Systems, Inc.; Metal Dek Group.
5. Cordeck.
6. DACS, Inc.
7. Epic Metals Corporation.
8. Marlyn Steel Decks, Inc.
9. New Millennium Building Systems, LLC.
10. Nucor Corp.; Vulcraft Group.
11. Roof Deck, Inc.
12. Valley Joist; Subsidiary of EBSCO Industries, Inc.
13. Verco Manufacturing Co.
14. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.

C. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:

1. Prime-Painted Steel Sheet: ASTM A 1008/A 1008M, Structural Steel (SS), Grade 33 (230) minimum, shop primed with manufacturer's standard baked-on, rust-inhibitive primer.

    a. Color: Per Architect.

2. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33 (230) G30 (Z90)zinc coating.
3. Galvanized and Shop-Primed Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33 (230) G60 (Z180)zinc coating; cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer.

    a. Color: Per Architect.

4. Deck Profile: As indicated.
5. Profile Depth: As indicated.
6. Design Uncoated-Steel Thickness: As indicated.

2.2 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 (4.8-mm) minimum diameter.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), not less than 0.0359-inch (0.91-mm) design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch (1.90 mm) thick, of same material and finish as deck. For drains, cut holes in the field.

G. Galvanizing Repair Paint: ASTM A 780.

H. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.

B. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

C. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

D. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

E. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

F. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

G. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

H. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and mechanically fasten flanges to top of deck. Space mechanical fasteners not more than 12 inches (305 mm) apart with at least one fastener at each corner.

1. Install reinforcing channels or zees in ribs to span between supports and mechanically fasten.

I. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Mechanically fasten to substrate to provide a complete deck installation.

1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.

J. Pour Stops and Girder Fillers: Weld steel-sheet pour stops and girder fillers to supporting structure according to SDI recommendations unless otherwise indicated.

K. Floor-Deck Closures: Weld steel-sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

3.2 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Field welds will be subject to inspection.

C. Testing agency will report inspection results promptly and in writing to Contractor and Architect.

D. Remove and replace work that does not comply with specified requirements.

E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.3 PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on [both surfaces] [top surface] of prime-painted deck immediately after installation, and apply repair paint.

END OF SECTION 05 3100

SECTION 05 5200 - HANDRAILS AND RAILINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Free-standing, non-penetrating modular aluminum railings for roof edge fall protection for membrane roofing.

1.2 REFERENCES

A. American National Standards Institute (ANSI):
   1. ANSI A21.l - Safety Requirements for Floor and Wall Openings, Railings and Toe Boards.

B. ASTM International (ASTM):
   1. ASTM F593 Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
   2. ASTM F606/F606M Standard Test Methods for Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, Direct Tension Indicators and Rivets.

C. Occupational Safety & Health Administration (OSHA):
   1. 29 CFR 1910.23 - Guarding Floor and Wall Openings and Holes.
   2. 29 CFR 1926.502 - Fall Protection Systems Criteria and Practices.

1.3 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.

B. Shop Drawings: Provide plan, section, elevation, and perspective view drawings as necessary to depict appropriate installation procedures including location, mounting, attachment, and penetration flashing as applicable.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: All primary products specified in this section will be supplied by a single manufacturer with a minimum of ten years experience.

B. Installer Qualifications: All products listed in this section are to be installed by a single installer with a minimum of five years demonstrated experience in installing products of the same type and scope as specified.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation. Protect all components off the ground, away from standing water on a hard, level surface.

1.6 PROJECT CONDITIONS

A. Field Measurements: Where handrails and railings are indicated to fit to other construction, check actual dimensions of other construction by accurate field measurements before fabrication.

B. 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 recommended limits.

1.7 WARRANTY

A. Warranty: At project closeout, submit an executed copy of the manufacturer's five year standard limited warranty against manufacturing defect, outlining its terms, conditions, and exclusions from coverage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: FIXFAST USA, or comparable product from one of the following:
   1. Kee Safety, Inc.; KeeGuard Fall protection Safety Railing System
   2. Safety Rail Company; SRC360

2.2 FREE-STANDING, NON-PENETRATING MODULAR ALUMINUM RAILINGS FOR ROOF EDGE FALL PROTECTION FOR MEMBRANE ROOFING

A. Basis of Design: KATTGUARD GR34 Series by FIXFAST USA.
   1. Standards compliance:
      a. ANSI A21.l: Railings and Toe Boards.
      b. Top and mid rail: OSHA standards - 29 CFR 1910.23 (a)(2).
      c. Structural Load: OSHA Regulation 29 CFR 1926.502. 200 lbs. (90.7 kg), minimum, in any direction to all components.
   2. Height: 42 inches (1067 mm), minimum.
   3. Railings: Distance between top rail and mid rail cannot exceed 19 inches (483 mm). Distance between mid rail and walking surface cannot exceed 19 inches (483 mm).
      a. Top rail: 2 inch (51 mm) O.D. high tensile aluminum tubing, mill finish, free of sharp edges and snag points.
      b. Mid rail: 1-5/8 inch (41 mm) O.D. high tensile aluminum, mill finish tubing, free of sharp edges and snag points. Distance between top rail/mid rail and mid rail/walking surface cannot exceed 19 inches
   4. Mounting posts: 2-1/4 x 1-1/2 x 1/8 inch thick (57 x 38 x 3 mm thick). high tensile aluminum rectangular hollow section, mill finish, free of sharp edges and snag points.
   5. Weighted Bases (H x W x L): 5/8 x 23 x 23 inches (16 x 584 x 584 mm) hot rolled galvanized steel. .
      a. Pre-tapped holes for post mounting.
      b. Membrane protection under base.
   6. Splice Joins: Connecting the top and mid rails together in a continuous railing system free of sharp edges and snag points.
   7. Adjustable Elbows: Accommodating angles and elevation changes.
   8. Connecting Hardware: ASTM F593-13a and ASTM F606/F606M-14a. 304 stainless steel. Includes fasteners, rivets (where required) and anchors.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions, approved submittals and in proper relationship with adjacent construction.

3.4 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 055200

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SECTION 06 1000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood blocking and nailers.
2. Wood furring.
3. Plywood backing panels.

1.2 DEFINITIONS

A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.

B. Dimension Lumber: Lumber of 2 inches nominal size or greater but less than 5 inches nominal size in least dimension.

C. Exposed Framing: Framing not concealed by other construction.

D. OSB: Oriented strand board.

E. Lumber grading agencies, and abbreviations used to reference them, include the following:

1. NeLMA: Northeastern Lumber Manufacturers' Association.
2. NLGA: National Lumber Grades Authority.
3. SPIB: The Southern Pine Inspection Bureau.
4. WCLIB: West Coast Lumber Inspection Bureau.
5. WWPA: Western Wood Products Association.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: Comply with DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.

2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry wood products.
3. Dress lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber:

1. Boards: 15 percent.
2. Dimension Lumber: 15 percent for 2-inch nominal thickness or less; 19 percent for more than 2-inch nominal thickness unless otherwise indicated.
3. Timber. .

C. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.

1. Allowable design stresses, as published by manufacturer, are to meet or exceed those indicated. Manufacturer's published values are to be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.2 FIRE-RETARDANT TREATMENT

A. General: Where fire-retardant-treated materials are indicated, materials are to comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.

1. Treatment is not to promote corrosion of metal fasteners.
2. Exterior Type: Treated materials are to comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D2898. Use for exterior locations and where indicated.
3. Interior Type A: Treated materials are to have a moisture content of 28 percent or less when tested according to ASTM D3201/D3201M at 92 percent relative humidity. Use where exterior type is not indicated.
4. Design Value Adjustment Factors: Treated lumber is to be tested according to ASTM D5664 and design value adjustment factors are to be calculated according to ASTM D6841.

C. Kiln-dry lumber after treatment to maximum moisture content of 19 percent. Kiln-dry plywood after treatment to maximum moisture content of 15 percent.

D. Application: Treat all rough carpentry unless otherwise indicated.

2.3 MISCELLANEOUS LUMBER

A. Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Furring.

B. Dimension Lumber Items: Construction or No. 2 grade lumber of any species. any of the following species:

1. Hem-fir (north); NLGA.
2. Mixed southern pine or southern pine; SPIB.
3. Spruce-pine-fir; NLGA.
4. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.

C. Concealed Boards: 15 percent maximum moisture content and any of the following species and grades:

1. Mixed southern pine or southern pine; No. 2 grade; SPIB.
2. Spruce-pine-fir (south) or spruce-pine-fir; Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
3. Northern species; No. 2 Common grade; NLGA.

D. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

E. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

F. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.4 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C , fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2-inch nominal thickness.

2.5 FASTENERS

A. General: Fasteners are to be of size and type indicated and comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches into wood substrate.

1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M or ASTM F2329 of Type 304 stainless steel.
2. For pressure-preservative-treated wood, use stainless steel fasteners.
3. For redwood, use fasteners.

B. Nails, Brads, and Staples: ASTM F1667.

2.6 METAL FRAMING ANCHORS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. MiTek Industries, Inc.

B. Allowable design loads, as published by manufacturer, are to meet or exceed those indicated . Manufacturer's published values are to be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Framing anchors are to be punched for fasteners adequate to withstand same loads as framing anchors.

C. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A653/A653M; structural steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 coating designation; and not less than 0.036 inch thick.

1. Use for wood-preservative-treated lumber and where indicated.

D. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, .

1. Use for exterior locations and where indicated.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

B. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking, and similar supports to comply with requirements for attaching other construction.

C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.

D. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

E. Do not splice structural members between supports unless otherwise indicated.

F. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.

G. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:

1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal thickness.
3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. and to solidly fill space below partitions.
4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet o.c.

H. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

I. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron for items that are continuously protected from liquid water.
2. Use copper naphthenate for items not continuously protected from liquid water.

J. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

K. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).
2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
3. ICC-ES evaluation report for fastener.

L. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully 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. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet enough that moisture content exceeds that specified, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 06 1000

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SECTION 06 4116 - PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plastic-laminate-clad architectural cabinets.
2. Cabinet hardware and accessories.
3. Miscellaneous materials.

B. Related Requirements:

1. Section 06 1000 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets that are concealed within other construction before cabinet installation.
2. Section 12 3623.13 "Plastic-Laminate-Clad Countertops."

1.2 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to support loads imposed by installed and fully loaded cabinets.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Plastic-laminate-clad architectural cabinets.
2. Cabinet hardware and accessories.
3. Miscellaneous materials.

B. Product Data Submittals: For each product.

1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

C. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Show large-scale details.
3. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
4. Show locations and sizes of cutouts and holes for items installed in plastic-laminate architectural cabinets.
5. Apply AWI Quality Certification Program label to Shop Drawings.

D. Samples for Verification: For the following:

1. Plastic Laminates: 12 by 12 inches, for each type, color, pattern, and surface finish required.

    a. Provide one sample applied to core material with specified edge material applied to one edge.

2. Thermally Fused Laminate (TFL) Panels: 12 by 12 inches, for each color, pattern, and surface finish.

    a. Provide edge banding on one edge.

3. Corner Pieces:

    a. Cabinet-front frame joints between stiles and rails and at exposed end pieces, 18 inches high by 18 inches wide by 6 inches deep.
    b. Miter joints for standing trim.

4. Exposed Cabinet Hardware and Accessories: One full-size unit for each type and finish.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and Installer.

1.5 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver cabinets until painting and similar finish operations that might damage architectural cabinets have been completed in installation areas. Store cabinets in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.7 FIELD CONDITIONS

A. Environmental Limitations without Humidity Control: Do not deliver or install cabinets until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.

B. Environmental Limitations with Humidity Control: Do not deliver or install cabinets until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during the remainder of the construction period.

C. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed/concealed by construction, and indicate measurements on Shop Drawings.

D. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of cabinets indicated for construction, finishes, installation, and other requirements.

1. The Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with requirements of Contract Documents in addition to those of the referenced quality standard.

B. Architectural Woodwork Standards Grade: Premium.

C. Type of Construction: Frameless .

D. Door and Drawer-Front Style: Flush overlay.

E. High-Pressure Decorative Laminate: ISO 4586-3, grades as indicated or if not indicated, as required by quality standard.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following as Listed in “Interior Finish Legend” in Drawings:

a. Formica
b. Wilsonart
c. Nevamar

F. Exposed Surfaces:

1. Plastic-Laminate Grade: HGS for horizontal surfaces and VGS for vertical surfaces.
2. Edges: PVC edge banding, 3.0 mm thick, matching laminate in color, pattern, and finish.
3. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels .

G. Semiexposed Surfaces:

1. Surfaces Other Than Drawer Bodies: Thermoset decorative material (melamine).

a. Edges of Plastic-Laminate Shelves: PVC edge banding, 3.0 mm thick, matching laminate in color, pattern, and finish.
b. Edges of Thermally Fused Laminate Panel Shelves: PVC or polyester edge banding.
c. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of Thermoset decorative material (melamine).

2. Drawer Sides and Backs: Thermally fused laminate panels with PVC or polyester edge banding.

3. Drawer Bottoms: Thermally fused laminate panels.

H. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, ISO 4583-3, grade to match exposed surface.

I. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.

1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.

J. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. As listed in the “Interior Finish Key” in Drawings.
2. As selected by Architect from laminate manufacturer's full range in the following categories:

a. Wood grains, matte finish.
b. Patterns, matte finish.

2.2 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.

1. Wood Moisture Content: 5 to 10 percent.

B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.

1. Particleboard (Medium Density): ANSI A208.1, Grade M-2-Exterior Glue.
2. Thermally Fused Laminate (TFL) Panels: Particleboard or MDF finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of ISO 4586.

2.3 CABINET HARDWARE AND ACCESSORIES

A. Cabinet Hardware: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 08 7100 "Door Hardware." Section 08 7111 "Door Hardware (Descriptive Specification)."

B. Butt Hinges: 2-3/4-inch, five-knuckle steel hinges made from 0.095-inch- thick metal, and as follows:

C. Back-Mounted Pulls: ANSI/BHMA A156.9, B02011.

D. Wire Pulls: Back mounted, solid metal, 5 inches long, 2-1/2 inches deep, and 5/16 inch in diameter.

E. Shelf Rests: ANSI/BHMA A156.9, B04013; plastic two-pin plastic with shelf hold-down clip.

F. Drawer Slides: ANSI/BHMA A156.9.

1. Standard Duty (Grade 1 and Grade 2): Side mount and extending under bottom edge of drawer.
2. Heavy-Duty (Grade 1HD-100 and Grade 1HD-200): Side mount.

    a. Type: Full extension.
    b. Material: Epoxy-coated polymer Zinc-plated ball bearing slides.
    c. Motion Feature: Push to open and Soft close dampener.

3. Pencil drawers not more than 3 inches high and not more than 24 inches wide, provide 50 lb load capacity.
4. General-purpose drawers more than 3 inches high, but not more than 6 inches high and not more than 24 inches wide, provide 75 lb load capacity.
5. File drawers more than 6 inches high or more than 24 inches wide, provide 100 lb load capacity.
6. Lateral file drawers more than 6 inches high and more than 24 inches but not more than 30 inches wide, provide 150 lb load capacity.
7. Lateral file drawers more than 6 inches high and more than 30 inches wide, provide 200 lb load capacity.
8. Computer keyboard tray, provide 75 lb load capacity.

G. Door Locks: ANSI/BHMA A156.11, E07121.

H. Drawer Locks: ANSI/BHMA A156.11, E07041.

I. False Front Connectors: Hafele Keku Push-In Fittings # 262.50.313.

1. For removal of aprons at sink and lavatories.

J. Grommets for Cable Passage: 2-inch OD, molded-plastic grommets and matching plastic caps with slot for wire passage.

1. Color: To be selected from manufacturers full range.

K. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with ANSI/BHMA A156.18 for ANSI/BHMA finish number indicated.

1. Satin Stainless Steel: ANSI/BHMA 630.

L. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in ANSI/BHMA A156.9.

M. Adjustable Shelf Standards and Supports (use in soiled and clean rooms): BHMA A156.9, B04071; with shelf rests, B04081 BHMA A156.9, B04102; with shelf brackets, B04112.

1. Basis-of-Design for all adjustable shelves: Heavy Duty Knape & Vogt 85/185 series steel double-slot wall standards (1 ¼" x ½" x length indicated on drawings) with 24" double-flange adjustable brackets. Finish to be selected from manufacturers full range.

2.4 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

2.5 FABRICATION

A. Fabricate architectural cabinets to dimensions, profiles, and details indicated.

B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Notify Architect seven days in advance of the dates and times architectural cabinet fabrication will be complete.
2. Trial fit assemblies at manufacturer's shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.

C. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

D. Install glass to comply with applicable requirements in Section 08 8000 "Glazing" and in GANA's "Glazing Manual."

1. For glass in frames, secure glass with removable stops.
2. For exposed glass edges, polish and grind smooth.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.

3.2 INSTALLATION

A. Architectural Woodwork Standards Grade: Install cabinets to comply with quality standard grade of item to be installed.

B. Assemble cabinets and complete fabrication at Project site to extent that it was not completed in the shop.

C. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with wafer-head cabinet installation screws.

D. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches using concealed shims.

1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
2. Install cabinets without distortion so doors and drawers fit openings and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
3. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects. Where not possible to repair, replace architectural cabinets. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean cabinets on exposed and semiexposed surfaces.

END OF SECTION 06 4116

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SECTION 07 5419 - POLYVINYL-CHLORIDE (PVC) ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Polyvinyl chloride (PVC) roofing system.
2. Accessory roofing materials.
3. Substrate board.
4. Vapor retarder.
5. Roof insulation.
6. Insulation accessories and cover board.
7. PVC Coated metal edge flashing.

B. Related Requirements:

1. Section 06 1000 "Rough Carpentry**"** for wood nailers, curbs, and blocking; and for wood-based, structural-use roof deck panels.
2. Section 07 9200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.

1.2 DEFINITIONS

A. Roofing Terminology: Definitions in ASTM D1079 and glossary in NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" apply to work of this Section.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Roofing Conference: Conduct conference at Project site .

1. Meet with Owner, Architect, Construction Manager, Owner's insurer if applicable, roofing Installer, roofing system manufacturer's representative, deck Installer, air barrier Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Polyvinyl chloride (PVC) roofing system.
2. Accessory roofing materials.
3. Substrate board.
4. Vapor retarder.
5. Roof insulation.
6. Insulation accessories and cover board.

B. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:

1. Layout and thickness of insulation.
2. Base flashings and membrane terminations.
3. Flashing details at penetrations.
4. Roof plan showing orientation of steel roof deck and orientation of roof membrane, fastening spacings, and patterns for mechanically fastened roofing system.
5. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
6. Tie-in with air barrier.

C. Samples for Verification: For the following products:

1. Roof membrane and flashing, of color required.

D. Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance requirements.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. Manufacturer Certificates:

1. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

C. Field Test Reports:

1. Owner will provide third-party fastener-pullout tests and results. Submit manufacturer's revised requirements for fastener patterns based on the results of the fastener-pullout tests and results.

D. Field quality-control reports.

E. Sample Warranties: For manufacturer's special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing system to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer: A qualified manufacturer that is FM Global approved for roofing system identical to that used for this Project.
2. Installers: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.

1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.9 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.

1. Special warranty includes roof membrane, base flashings, roof insulation, fasteners, substrate board, roof pavers, and other components of roofing system.
2. Warranty Period: 20 years from date of Substantial Completion.

B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of roofing system such as roof membrane, base flashing, roof insulation, fasteners, substrate boards, vapor retarders, and for the following warranty period:

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Installed roofing and base flashings to withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roof system and flashings to remain watertight.

1. Accelerated Weathering: Roof membrane to withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.
2. Impact Resistance: Roof membrane to resist impact damage when tested according to ASTM D3746, ASTM D4272/D4272M.

B. Material Compatibility: Roofing materials to be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roof membrane manufacturer based on testing and field experience.

C. Wind Uplift Resistance: Design roofing system to resist the following wind uplift pressures when tested according to FM Approvals 4474, UL 580, or UL 1897:

1. Zone 1 (Roof Area Field): 90 lbf/sq. ft. .
2. Zone 2 (Roof Area Perimeter): 150 lbf/sq. ft. .
3. Zone 3 (Roof Area Corners): 150 lbf/sq. ft. .

D. FM Approvals' RoofNav Listing: Roof membrane, base flashings, and component materials comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system, and are listed in FM Approvals' RoofNav for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals Certification markings.

1. Fire/Windstorm Classification: Class 1A-90.
2. Hail-Resistance Rating: FM Global Property Loss Prevention Data Sheet 1-34 SH.

2.2 POLYVINYL CHLORIDE (PVC) ROOFING SYSTEM

A. PVC Sheet Type II: ASTM D4434/D4434M, glass-fiber reinforced, felt backed.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Sika Sarnafil; Sarnafil G410 or comparable product by one of the following:

   a. Carlisle Syntec Systems; Sure-Flex Reinforced FRS-PVC .
   b. Duro-Last Roofing Inc.
   c. GAF.
   d. Soprema, Inc.; Sentinel G200 .
   e. Versico Roofing Systems.

2. Thickness: 60 mils .
3. Exposed Face Color: Lead gray .

B. PVC Batten Profile: Basis-of-Design Product: Sarnafil, Inc. Décor Roof System.

1. 1 ¼" x ¾" x 10 foot PVC extrusion, used to emulate the appearance of standing seam metal rib roof system.
   a. Color: Gray.
2. Other Manufacturers that make a similar profile are:
   a. Versico Roofing Systems, Versiflex.

b. Duro-Last Vinyl Rib System

C. Source Limitations: Obtain components for roofing system from roof membrane manufacturer or manufacturers approved by roof membrane manufacturer.

2.3 ACCESSORY ROOFING MATERIALS

A. General: Accessory materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.

1. Adhesives and Sealants: Comply with VOC limits of authorities having jurisdiction.

B. Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as PVC sheet.

1. Reinforced Securement Strip (RUSS) with pressure sensitive adhesive factory applied on both sides.

C. Bonding Adhesive: Manufacturer's standard.

D. Low-Rise, Urethane, Fabric-Backed Membrane Adhesive: Roof system manufacturer's standard spray-applied, low-rise, two-component urethane adhesive formulated for compatibility and use with fabric-backed membrane roofing.

E. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.

F. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing components to substrate, and acceptable to roofing system manufacturer.

G. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

H. PVC Coated metal: Provide the following:

1. PVC Coated stainless steel snap lock roof edge. 4” x 4”.

2.4 SUBSTRATE BOARD

A. Glass-Mat Gypsum Roof Substrate Board: ASTM C1177/C1177M, water-resistant gypsum board.

1. Thickness: Type X, 5/8 inch.
2. Surface Finish: Factory primed .

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate board to roof deck.

2.5 VAPOR RETARDER

A. Polyethylene Film: ASTM D4397, 6 mils thick, minimum, with maximum permeance rating of 0.13 perm .

1. Tape: Pressure-sensitive tape of type recommended by vapor retarder manufacturer for sealing joints and penetrations in vapor retarder.
2. Adhesive: Manufacturer's standard lap adhesive, listed by FM Approvals for vapor retarder application.

2.6 ROOF INSULATION

A. General: Preformed roof insulation boards manufactured or approved by PVC roof membrane manufacturer .

B. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1, Grade 2 , felt or glass-fiber mat facer on both major surfaces.

1. Compressive Strength: 20 psi .
2. Size: 48 by 48 inches .
3. Thickness:

    a. Base Layer: 1-1/2 inches .
    b. Upper Layer: 1-1/2 inches .

2.7 INSULATION ACCESSORIES AND COVER BOARD

A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with other roofing system components.

B. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:

1. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.

C. Glass-Mat Gypsum Cover Board: ASTM C1177/C1177M, water-resistant gypsum board.

1. Thickness: 5/8 inch .
2. Surface Finish: Fiberglass facer Factory primed .

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing system installation according to roofing system manufacturer's written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

3.3 INSTALLATION OF ROOFING, GENERAL

A. Install roofing system according to roofing system manufacturer's written instructions, listed roof assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.

B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

C. Install roof membrane and auxiliary materials to tie in to existing roofing to maintain weathertightness of transition and to not void warranty for existing roofing system.

3.4 INSTALLATION OF SUBSTRATE BOARD

A. Install substrate board with long joints in continuous straight lines, with end joints staggered not less than 24 inches in adjacent rows.

1. At steel roof decks, install substrate board at right angle to flutes of deck.

    a. Locate end joints over crests of steel roof deck.

2. Tightly butt substrate boards together.
3. Cut substrate board to fit tight around penetrations and projections, and to fit tight to intersecting sloping roof decks.
4. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to roofing system manufacturers' written instructions.

3.5 INSTALLATION OF VAPOR RETARDER

A. Polyethylene Film: Loosely lay polyethylene-film vapor retarder in a single layer over area to receive vapor retarder, side and end lapping each sheet a minimum of 2 and 6 inches, respectively.

1. Extend vertically up parapet walls and projections to a minimum height equal to height of the insulation and cover board.
2. Continuously seal side and end laps with adhesive.

B. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into roofing system.

3.6 INSTALLATION OF INSULATION

A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at end of workday.

B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.

C. Installation Over Metal Decking:

1. Install base layer of insulation with joints staggered not less than 24 inches in adjacent rows .

    a. Locate end joints over crests of decking.
    b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
    c. Make joints between adjacent insulation boards not more than 1/4 inch in width.
    d. Fill gaps exceeding 1/4 inch with insulation.
    e. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
    f. Loosely lay base layer of insulation units over substrate.

2. Install upper layers of insulation with joints of each layer offset not less than 12 inches from previous layer of insulation.

    a. Staggered end joints within each layer not less than 24 inches in adjacent rows.
    b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
    c. Make joints between adjacent insulation boards not more than 1/4 inch in width.
    d. Trim insulation so that water flow is unrestricted.
    e. Fill gaps exceeding 1/4 inch with insulation.
    f. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.

3.7 INSTALLATION OF ADHERED ROOF MEMBRANE

A. Adhere roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.

B. Unroll roof membrane and allow to relax before installing.

C. Start installation of roofing in presence of roofing system manufacturer's technical personnel.

D. Accurately align roof membrane, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

E. Bonding Adhesive: Apply to substrate and underside of roof membrane at rate required by manufacturer, and allow to partially dry before installing roof membrane. Do not apply to splice area of roof membrane.

F. Fabric-Backed Roof Membrane Adhesive: Apply to substrate at rate required by manufacturer, and install fabric-backed roof membrane.

G. In addition to adhering, mechanically fasten roof membrane securely at terminations, penetrations, and perimeter of roofing.

H. Apply roof membrane with side laps shingled with slope of roof deck where possible.

I. Seams: Clean seam areas, overlap roofing, and hot-air weld side and end laps of roof membrane and sheet flashings to ensure a watertight seam installation.

1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roof membrane and sheet flashings.
2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
3. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.

J. Spread sealant bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

3.8 INSTALLATION OF BASE FLASHING

A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.9 FIELD QUALITY CONTROL

A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion, in presence of Architect, and to prepare inspection report.

B. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.10 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.11 ROOFING INSTALLER'S WARRANTY

A. WHEREAS _____ of _____, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:

1. Owner: <**Insert name of Owner>**.
2. Owner Address: <**Insert address>**.
3. Building Name/Type: <**Insert information>**.
4. Building Address: <**Insert address>**.
5. Area of Work: <**Insert information>**.
6. Acceptance Date: _____.
7. Warranty Period: Two (2) years.
8. Expiration Date: _____.

B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,

C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period Roofing Installer will, at Roofing Installer's own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.

D. This Warranty is made subject to the following terms and conditions:

1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:

    a. lightning;
    b. peak gust wind speed exceeding 72 MPH;
    c. fire;
    d. failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
    e. faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
    f. vapor condensation on bottom of roofing; and
    g. activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.

2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.

5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.
6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this _____ day of _____, _____.

1. Authorized Signature: _____.
2. Name: _____.
3. Title: _____.

END OF SECTION 07 5419

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SECTION 07 8100 - APPLIED FIRE PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sprayed fire-resistive materials.

1.2 DEFINITIONS

A. SFRM: Sprayed fire-resistive materials.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site .

1. Review products, design ratings, restrained and unrestrained conditions, densities, thicknesses, bond strengths, and other performance requirements.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Sprayed fire-resistive materials.
2. Substrate primers.
3. Bonding agent.
4. Metal lath.
5. Reinforcing fabric.
6. Reinforcing mesh.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer .

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by sprayed fire-resistive material manufacturer as experienced and with sufficient trained staff to install manufacturer's products in accordance with specified requirements.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not apply fire protection when ambient or substrate temperature is 44 deg F or lower unless temporary protection and heat are provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.

B. Ventilation: Ventilate building spaces during and after application of fire protection, providing complete air exchanges in accordance with manufacturer's written instructions. Use natural means or, if they are inadequate, forced-air circulation until fire protection dries thoroughly.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Assemblies: Provide fire protection, including auxiliary materials, in accordance with requirements of each fire-resistance design and manufacturer's written instructions.

B. Fire-Resistance Design: Indicated on Drawings, tested in accordance with ASTM E119 or UL 263 ; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Steel members are to be considered unrestrained unless specifically noted otherwise.

C. Asbestos: Provide products containing no detectable asbestos.

2.2 SPRAYED FIRE-RESISTIVE MATERIALS

A. Sprayed Fire-Resistive Material: UL G701, 2-Hour Manufacturer's standard, factory-mixed, lightweight, dry formulation, complying with indicated fire-resistance design, and mixed with water at Project site to form a slurry or mortar before conveyance and application or .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Carboline Company; a subsidiary of RPM International.
    b. GCP Applied Technologies Inc.
    c. Isolatek International.
    d. Southwest Fireproofing Products Co.

2. Density: Not less than density specified in the approved fire-resistance design, in accordance with ASTM E605.
3. Thickness: As required for fire-resistance design indicated, measured in accordance with requirements of fire-resistance design or ASTM E605, whichever is thicker, but not less than 0.5 inch.
4. Combustion Characteristics: ASTM E136.
5. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

    a. Flame-Spread Index: 10 or less.
    b. Smoke-Developed Index: 10 or less.

2.3 AUXILIARY MATERIALS

A. Provide auxiliary materials that are compatible with sprayed fire-resistive material and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated.

B. Substrate Primers: Primers approved by sprayed fire-resistive material manufacturer and complying with one or both of the following requirements:

1. Primer and substrate are identical to those tested in required fire-resistance design by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
2. Primer's bond strength in required fire-resistance design complies with specified bond strength for sprayed fire-resistive material and with requirements in UL's "Fire Resistance Directory" or in the listings of another qualified testing agency acceptable to authorities having jurisdiction, based on a series of bond tests in accordance with ASTM E736.

C. Bonding Agent: Product approved by sprayed fire-resistive material manufacturer and complying with requirements in UL's "Fire Resistance Directory" or in the listings of another qualified testing agency acceptable to authorities having jurisdiction.

D. Metal Lath: Expanded metal lath fabricated from material of weight, configuration, and finish required, in accordance with fire-resistance designs indicated and sprayed fire-resistive material manufacturer's written instructions. Include clips, lathing accessories, corner beads, and other anchorage devices required to attach lath to substrates and to receive sprayed fire-resistive material.

E. Reinforcing Fabric: Glass- or carbon-fiber fabric of type, weight, and form required to comply with fire-resistance designs indicated; approved and provided by sprayed fire-resistive material manufacturer.

F. Reinforcing Mesh: Metallic mesh reinforcement of type, weight, and form required to comply with fire-resistance design indicated; approved and provided by sprayed fire-resistive material manufacturer. Include pins and attachment.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of the Work and in accordance with each fire-resistance design.

1. Verify that substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, paints, and encapsulants, or other foreign substances capable of impairing bond of fire protection with substrates under conditions of normal use or fire exposure.
2. Verify that objects penetrating fire protection, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
3. Verify that substrates receiving fire protection are not obstructed by ducts, piping, equipment, or other suspended construction that will interfere with fire protection application.

B. Verify that concrete work on steel deck is complete before beginning Work.

C. Conduct tests in accordance with sprayed fire-resistive material manufacturer's written instructions to verify that substrates are free of substances capable of interfering with bond.

D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Cover other work subject to damage from fallout or overspray of fire protection materials during application.

B. Clean substrates of substances that could impair bond of fire protection.

C. Prime substrates where included in fire-resistance design and where recommended in writing by sprayed fire-resistive material manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive fire protection.

D. For applications visible on completion of Project, repair substrates to remove surface imperfections that could affect uniformity of texture and thickness in finished surface of fire protection. Remove minor projections and fill voids that would telegraph through fire-resistive products after application.

3.3 APPLICATION

A. Construct fire protection assemblies that are identical to fire-resistance design indicated and products as specified, tested, and substantiated by test reports; for thickness, primers, sealers, topcoats, finishing, and other materials and procedures affecting fire protection Work.

B. Comply with sprayed fire-resistive material manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fire protection; as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.

C. Coordinate application of fire protection with other construction to minimize need to cut or remove fire protection.

1. Do not begin applying fire protection until clips, hangers, supports, sleeves, and other items penetrating fire protection are in place.
2. Defer installing ducts, piping, and other items that would interfere with applying fire protection until application of fire protection is completed.

D. Metal Decks:

1. Do not apply fire protection to underside of metal deck substrates until concrete topping, if any, is completed.
2. Do not apply fire protection to underside of metal roof deck until roofing is completed; prohibit roof traffic during application and drying of fire protection.

E. Install auxiliary materials as required, as detailed, and in accordance with fire-resistance design and sprayed fire-resistive material manufacturer's written instructions for conditions of exposure and intended use. For auxiliary materials, use attachment and anchorage devices of type recommended in writing by sprayed fire-resistive material manufacturer.

F. Spray apply fire protection to maximum extent possible. After the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by sprayed fire-resistive material manufacturer.

G. Extend fire protection in full thickness over entire area of each substrate to be protected.

H. Install body of fire protection in a single course unless otherwise recommended in writing by sprayed fire-resistive material manufacturer.

I. Where sealers are used, apply products that are tinted to differentiate them from fire protection over which they are applied.

J. Provide a uniform finish complying with description indicated for each type of fire protection material and matching finish approved for required mockups.

K. Cure fire protection in accordance with sprayed fire-resistive material manufacturer's written instructions.

L. Do not install enclosing or concealing construction until after fire protection has been applied, inspected, and tested and corrections have been made to deficient applications.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Test and inspect as required by the IBC, Subsection 1705.13, "Sprayed Fire-Resistant Materials.

B. Perform the tests and inspections of completed Work in successive stages. Do not proceed with application of fire protection for the next area until test results for previously completed applications of fire protection show compliance with requirements. Tested values must equal or exceed values as specified and as indicated and required for approved fire-resistance design.

C. Fire protection will be considered defective if it does not pass tests and inspections.

1. Remove and replace fire protection that does not pass tests and inspections, and retest.
2. Apply additional fire protection, in accordance with manufacturer's written instructions, where test results indicate insufficient thickness, and retest.

D. Prepare test and inspection reports.

3.5 CLEANING

A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.

3.6 PROTECTION

A. Protect fire protection, according to advice of manufacturer and Installer, from damage resulting from construction operations or other causes, so fire protection is without damage or deterioration at time of Substantial Completion.

3.7 REPAIRS

A. As installation of other construction proceeds, inspect fire protection and repair damaged areas and fire protection removed due to work of other trades.

B. Repair fire protection damaged by other work before concealing it with other construction.

C. Repair fire protection by reapplying it using same method as original installation or using manufacturer's recommended trowel-applied product.

END OF SECTION 07 8100

SECTION 07 8413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Penetration firestopping systems.

B. Related Requirements:

1. Section 07 8443 "Joint Firestopping" for joints in or between fire-resistance-rated construction.

1.2 ACTION SUBMITTALS

A. Product Data: Penetration firestopping systems.

B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly developed in accordance with current International Firestop Council (IFC) guidelines. Obtain approval of authorities having jurisdiction prior to submittal.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Listed System Designs: For each penetration firestopping system, for tests performed by a qualified testing agency.

1.4 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Approvals according to FM Approvals 4991, "Approval Standard for Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

1.6 PROJECT CONDITIONS

A. 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.

B. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.7 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test in accordance with testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:

    a. Penetration firestop systems installed with products bearing the classification marking of a qualified product certification agency in accordance with listed system designs published by a qualified testing agency.

        1) UL in its online directory "Product iQ."
        2) Intertek Group in its "Directory of Building Products."
        3) FM Approvals in its "Approval Guide."

2.2 PENETRATION FIRESTOPPING SYSTEMS

A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems are to be compatible with one another, with the substrates forming openings, and with penetrating items if any.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. 3M Building and Construction.
    b. Hilti, Inc.
    c. Specified Technologies, Inc.
    d. Tremco Incorporated.

B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined in accordance with ASTM E814 or UL 1479.

1. F-Rating: Not less than the fire-resistance rating of the wall penetrated.
2. Membrane Penetrations: Install recessed fixtures such that the required fire resistance will not be reduced.

C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined in accordance with ASTM E814 or UL 1479.

1. F-Rating: At least one hour, but not less than the fire-resistance rating of the floor penetrated.

D. Accessories: Provide components for each penetration firestopping system that are needed 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.

1. Permanent forming/damming/backing materials.
2. Substrate primers.
3. Collars.
4. Steel sleeves.

2.3 FILL MATERIALS

A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.

C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.

E. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.

F. Intumescent Wrap Strips: Single-component intumescent elastomeric strips for use around combustible penetrants.

G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

H. Pillows/Bags: Compressible, removable, and reusable intumescent pillows encased in fire-retardant polyester or glass-fiber cloth. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.

I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.

K. Fire-Rated Cable Sleeve Kits: Complete kits designed for new or existing cable penetrations through walls to accept standard accessories.

L. Thermal Wrap: Flexible protective wrap tested and listed for up to 2-hour fire ratings in accordance with ASTM E814 or UL 1479 for membrane penetrations or ASTM E1725 or UL 1724 for thermal barrier and circuit integrity protection.

M. Fire-Rated Cable Pathways: Single or gangable device modules composed of a steel raceway with integral intumescent material and requiring no additional action in the form of plugs, twisting closure, putty, pillows, sealant, or otherwise to achieve fire and air-leakage ratings.

N. Retrofit Device for Cable Bundles: Factory-made, intumescent, collar-like device for firestopping existing over-filled cable sleeves and capable of being installed around projecting sleeves and cable bundles.

O. Wall-Opening Protective Materials: Intumescent, non-curing putty pads or self-adhesive inserts for protection of electrical switch and receptacle boxes.

P. Fire-Rated HVAC Retaining Angles: Steel angle system with integral intumescent firestop gasket for use around rectangular steel HVAC ducts without fire dampers.

Q. Firestop Plugs: Flexible, re-enterable, intumescent, foam-rubber plug for use in blank round openings and cable sleeves.

R. Fire-Rated Cable Grommet: Molded two-piece grommet made of plenum-grade polymer and foam inner core for sealing small cable penetrations in gypsum walls up to 1/2 inch in diameter.

S. Closet Flange Gasket: Molded, single-component, flexible, intumescent gasket for use beneath a water closet (toilet) flange in floor applications.

T. Endothermic Wrap: Flexible, insulating, fire-resistant, endothermic wrap for protecting membrane penetrations of utility boxes, critical electrical circuits, communications lines, and fuel lines.

2.4 MIXING

A. Penetration Firestopping Materials: 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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. 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.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. 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.

B. 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.

3.3 INSTALLATION OF PENETRATION FIRESTOPPING SYSTEMS

A. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.

B. 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.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.

C. 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.

3.4 IDENTIFICATION

A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches high and with minimum 0.375-inch strokes.

1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet from end of wall and at intervals not exceeding 30 feet.

B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."

2. Contractor's name, address, and phone number.
3. Designation of applicable testing and inspecting agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.5 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E2174.

B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.

C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

A. 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.

B. 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.

END OF SECTION 07 8413

SECTION 07 8443 - JOINT FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Joints in or between fire-resistance-rated construction.

B. Related Requirements:

1. Section 07 8413 "Penetration Firestopping" for penetrations in fire-resistance-rated walls, horizontal assemblies, and smoke barriers and for wall identification.
2. Section 07 9513.13 "Interior Expansion Joint Cover Assemblies" for fire-resistive manufactured expansion-joint cover assemblies for interior floors, walls, and ceilings.
3. Section 09 2216 "Non-Structural Metal Framing" for firestop tracks for metal-framed partition heads.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Joints in or between fire-resistance-rated construction.

B. Product Schedule: For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing agency's illustration for a particular joint firestopping system condition, submit illustration, with modifications marked, approved by joint firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly developed in accordance with current International Firestop Council (IFC) guidelines.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Listed System Designs: For each joint firestopping system, for tests performed by a qualified testing agency.

1.4 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that joint firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Approvals according to FM Approvals 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements."

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install joint firestopping systems when ambient or substrate temperatures are outside limits permitted by joint firestopping system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Install and cure joint firestopping systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.7 COORDINATION

A. Coordinate construction of joints to ensure that joint firestopping systems can be installed according to specified firestopping system design.

B. Coordinate sizing of joints to accommodate joint firestopping systems.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain joint firestop systems for each type of joint opening indicated from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:

    a. Joint firestop systems installed with products bearing the classification marking of a qualified product certification agency in accordance with Listed System Designs published by a qualified testing agency.

        1) UL in its online directory "Product iQ."
        2) Intertek Group in its "Directory of Building Products."

2.3 JOINT FIRESTOPPING SYSTEMS

A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems must accommodate building movements without impairing their ability to resist the passage of fire and hot gases.

1. Joint firestopping systems that are compatible with one another, with the substrates forming openings, and with penetrating items, if any.
2. Provide products that, upon curing, do not re-emulsify, dissolve, leach, breakdown, or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture.
3. Provide firestop products that do not contain ethylene glycol.

B. Intumescent Gypsum Wall Framing Gaskets (Applied to Steel Tracks, Runners, and Studs prior to Framing Installation): Provide products with fire, smoke, and acoustical ratings that allow movement up to 100 percent compression and/or extension in accordance with UL 2079 or ASTM E1966; have an L Rating less than 1 cfm/ft. in accordance with UL 2079; and a minimum Sound Transmission Class (STC) rating of 56 in accordance with ASTM E90 or ASTM C919.

C. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E1966 or UL 2079.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. 3M Building and Construction.
   b. ClarkDietrich.
   c. Hilti, Inc.

2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.

2.4 ACCESSORIES

A. Provide components of joint firestopping systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Before installing joint firestopping systems, clean joints immediately to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:

1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of elastomeric fill materials or compromise fire-resistive rating.
2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with elastomeric fill materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Prime substrates where recommended in writing by joint firestopping system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Apply a suitable bond-breaker to prevent three-sided adhesion in applications where this condition occurs, such as the intersection of a gypsum wall to floor or roof assembly where the joint is backed by a steel ceiling runner or track.

3.3 INSTALLATION

A. General: Install joint firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.

C. Install elastomeric fill materials for joint firestopping systems by proven techniques to produce the following results:

1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.
3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Wall Identification: Permanently label walls containing firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches high and with minimum 0.375-inch strokes.

1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 ft. from end of wall and at intervals not exceeding 30 ft..

B. Joint Identification: Identify joint firestopping systems with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of joint edge so labels are visible to anyone seeking to remove or joint firestopping system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Joint Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.5 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections in accordance with ASTM E2393.

B. Where deficiencies are found or joint firestopping systems are damaged or removed due to testing, repair or replace joint firestopping systems so they comply with requirements.

C. Proceed with enclosing joint firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

A. Clean off excess elastomeric fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by joint firestopping system manufacturers and that do not damage materials in which joints occur.

B. Provide final protection and maintain conditions during and after installation that ensure joint firestopping systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated joint firestopping systems immediately and install new materials to produce joint firestopping systems complying with specified requirements.

3.7 JOINT FIRESTOPPING SYSTEM SCHEDULE

A. Where UL-classified systems are indicated, they refer to system numbers in UL's online directory "Product iQ" under product Category XHBN or Category XHDG.

B. Floor-to-Floor, Joint Firestopping Systems: .

1. Assembly Rating: 2 hours .

C. Wall-to-Wall, Joint Firestopping Systems: .

1. Assembly Rating: 2 hours .

D. Floor-to-Wall, Joint Firestopping Systems: .

1. Assembly Rating: 2 hours .

E. Head-of-Wall, Fire-Resistive Joint Firestopping Systems: .

1. Assembly Rating: 2 hours .

F. Bottom-of-Wall, Joint Firestopping Systems: .

1. Assembly Rating: 2 hours .

END OF SECTION 07 8443

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SECTION 07 9200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Mildew-resistant joint sealants.
2. Latex joint sealants.

B. Related Requirements:

1. Section 07 9219 "Acoustical Joint Sealants" for sealing joints in sound-rated construction.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Mildew-resistant joint sealants.
2. Latex joint sealants.

B. Samples for Initial Selection: Manufacturer's standard color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Samples for Verification: For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

D. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.3 FIELD CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 MILDEW-RESISTANT JOINT SEALANTS

A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.

B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. GE Construction Sealants; Momentive Performance Materials Inc.
    b. Pecora Corporation.
    c. Sika Corporation - Building Components.
    d. The Dow Chemical Company.
    e. Tremco Incorporated.

2.3 LATEX JOINT SEALANTS

A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Adfast.
    b. Pecora Corporation.
    c. Tremco Incorporated.

2.4 JOINT-SEALANT BACKING

A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin) , and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

    a. Metal.
    b. Glass.
    c. Glazed surfaces of ceramic tile.

B. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.

D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.

3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants in accordance with requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile in accordance with Figure 8A in ASTM C1193 unless otherwise indicated.

3.4 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION 07 9200

SECTION 07 9513.13 - INTERIOR EXPANSION JOINT COVER ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Floor expansion joint covers.

1.2 ACTION SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for expansion joint cover assemblies.

1. Floor expansion joint covers.

B. Shop Drawings: For each expansion joint cover assembly.

1. Include plans, elevations, sections, details, splices, block-out requirement, attachments to other work, and line diagrams showing entire route of each expansion joint.
2. Where expansion joint cover assemblies change planes, provide isometric or clearly detailed drawing depicting how components interconnect.

C. Samples for Initial Selection: For each type of exposed finish.

1. Include manufacturer's color charts showing the full range of colors and finishes available for each exposed metal and elastomeric-seal material.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

A. Furnish units in longest practicable lengths to minimize field splicing.

B. Include factory-fabricated closure materials and transition pieces, T-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous expansion joint cover assemblies.

2.2 PERFORMANCE REQUIREMENTS

2.3 FLOOR EXPANSION JOINT COVERS

A. Dual-Elastomeric-Seal Floor Joint Cover: Assembly consisting of dual-elastomeric seals and center plate anchored to frames fixed to sides of joint gap.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Architectural Art Manufacturing; a division of Pittcon Architectural Metals, LLC.
b. Balco; a CSW Industrials Company.
c. Construction Specialties, Inc.
d. inpro Corporation.
e. MM Systems Corporation.
f. Nystrom, Inc.

2. Application: Floor to floor .
3. Installation: Recessed.
4. Load Capacity:

a. Uniform Load: 50 lb/sq. ft. .
b. Concentrated Load: 300 lb .
c. Maximum Deflection: 0.0625 inch .

5. Center-Plate Design: Plain .
6. Exposed Metal:

a. Aluminum: Color anodic, Class I Manufacturer's standard .

7. Seal: Preformed elastomeric membranes or extrusions.

a. Color: As selected by Architect from manufacturer's full range .

2.4 ACCESSORIES

A. Manufacturer's standard attachment devices. Include anchors, clips, fasteners, set screws, spacers, and other accessories compatible with material in contact, as indicated or required for complete installations.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces where expansion joint cover assemblies will be installed for installation tolerances and other conditions affecting performance of the Work.

B. Notify Architect where discrepancies occur that will affect proper expansion joint cover assembly installation and performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to expansion joint cover assembly manufacturer's written instructions.

B. Coordinate and furnish anchorages, setting drawings, and instructions for installing expansion joint cover assemblies. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of expansion joint cover assemblies.

3.3 INSTALLATION

A. Comply with manufacturer's written instructions for storing, handling, and installing expansion joint cover assemblies and materials unless more stringent requirements are indicated.

B. Metal Frames: Perform cutting, drilling, and fitting required to install expansion joint cover assemblies.

1. Repair or grout block out as required for continuous frame support using nonmetallic, shrinkage-resistant grout.
2. Install frames in continuous contact with adjacent surfaces.

    a. Shimming is not permitted.

3. Install in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
4. Adjust for differences between actual structural gap and nominal design gap due to ambient temperature at time of installation.
5. Cut and fit ends to accommodate thermal expansion and contraction of metal without buckling of frames.
6. Locate anchors at interval recommended by manufacturer, but not less than 3 inches from each end and not more than 24 inches o.c.

C. Seals: Install elastomeric seals and membranes in frames to comply with manufacturer's written instructions. Install with minimum number of end joints.

1. Provide in continuous lengths for straight sections.
2. Seal transitions. Vulcanize or heat-weld field-spliced joints as recommended by manufacturer.
3. Installation: Mechanically lock seals into frames or adhere to frames with adhesive or pressure-sensitive tape as recommended by manufacturer.

D. Install with hairline mitered corners where expansion joint cover assemblies change direction or abut other materials.

E. Terminate exposed ends of expansion joint cover assemblies with field- or factory-fabricated termination devices.

3.4 PROTECTION

A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.

B. Protect the installation from damage by work of other Sections. Where necessary due to heavy construction traffic, remove and properly store cover plates or seals and install temporary protection over expansion joint cover assemblies. Reinstall cover plates or seals prior to Substantial Completion.

END OF SECTION 07 9513.13

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SECTION 08 1213 - HOLLOW METAL FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior standard steel frames.
2. Borrowed lites.

B. Related Requirements:

1. 08 7100 "Door Hardware" for door hardware.
2. 08 8000 "Glazing" for hollow metal frames and borrowed lites.

1.2 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.3 COORDINATION

A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Interior standard steel frames.
2. Borrowed lites.

B. Shop Drawings: Include the following:

1. Elevations of each frame type.
2. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
3. Locations of reinforcement and preparations for hardware.
4. Details of each different wall opening condition.
5. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
6. Details of anchorages, joints, field splices, and connections.
7. Details of accessories.
8. Details of moldings, removable stops, and glazing.

C. Product Schedule: For hollow-metal frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

1. Provide additional protection to prevent damage to factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow-metal frames vertically under cover at Project site with head up. Place on minimum 4-inch- high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 HOLLOW METAL FRAMES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ceco Door; AADG, Inc.; ASSA ABLOY.
2. Curries, AADG, Inc.; ASSA ABLOY Group.
3. Mesker Door; Mesker Openings Group.
4. Republic Doors and Frames; a Allegion brand.
5. Security Metal Products; a brand of ASSA ABLOY.
6. Steelcraft; Allegion plc.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Rated Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated on Drawings, based on testing at positive pressure according to NFPA 252 or UL 10C.

2.3 STANDARD STEEL FRAMES

A. Construct hollow-metal frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Interior Standard Steel Frames: SDI A250.8. At locations indicated in the Door and Frame Schedule on Drawings .

1. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch .
2. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
3. Construction: Face welded .
4. Exposed Finish: Prime .

2.4 BORROWED LITES

A. Fabricate of metallic-coated steel sheet, minimum thickness of 0.053 inch .

B. Construction: Face welded .

C. Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as metal as frames.

D. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

2.5 FRAME ANCHORS

A. Jamb Anchors:

1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
3. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches of frame height above 7 feet.
4. Postinstalled Expansion Anchor: Minimum 3/8-inch- diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.

B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.

C. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized according to ASTM A153/A153M, Class B.

2.6 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.

D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A153/A153M.

E. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

F. Glazing: Comply with requirements in Section 08 8000 "Glazing."

2.7 FABRICATION

A. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.

1. Sidelite and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by welding.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.

    a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

B. Hardware Preparation: Factory prepare hollow-metal frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule on Drawings, and templates.

1. Reinforce frames to receive nontemplated, mortised, and surface-mounted door hardware.
2. Comply with BHMA A156.115 for preparing hollow-metal frames for hardware.

C. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted hairline joints.

1. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
2. Provide fixed frame moldings on outside of exterior and on secure side of interior frames. Provide loose stops and moldings on inside of hollow-metal frames.
3. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
4. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

2.8 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.

B. Drill and tap frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

A. General: Install hollow-metal frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions. Comply with SDI A250.11 .

B. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.

1. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
2. Install frames with removable stops located on secure side of opening.

C. Fire-Rated Openings: Install frames according to NFPA 80.

D. Floor Anchors: Secure with postinstalled expansion anchors.

1. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

E. Solidly pack mineral-fiber insulation inside frames.

F. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:

1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
4. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

G. Glazing: Comply with installation requirements in Section 08 8000 "Glazing" and with hollow-metal manufacturer's written instructions.

3.3 CLEANING AND TOUCHUP

A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

C. Factory-Finish Touchup: Clean abraded areas and repair with same material used for factory finish according to manufacturer's written instructions.

D. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 08 1213

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SECTION 08 1416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid-core five-ply flush wood veneer-faced doors and transom panels for transparent finish.

B. Related Requirements:

1. Section 08 8000 "Glazing" for glass view panels in flush wood doors.

1.2 ACTION SUBMITTALS

A. Product Data Submittals: For each product, including the following:

1. Door core materials and construction.
2. Door edge construction
3. Door face type and characteristics.
4. Door trim for openings.
5. Door frame construction.
6. Factory-machining criteria.
7. Factory- finishing specifications.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each type of door; construction details not covered in Product Data; and the following:

1. Door schedule indicating door location, type, size, fire protection rating, and swing.
2. Door elevations, dimension and locations of hardware, lite and louver cutouts, and glazing thicknesses.
3. Details of frame for each frame type, including dimensions and profile.
4. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
5. Dimensions and locations of blocking for hardware attachment.
6. Dimensions and locations of mortises and holes for hardware.
7. Clearances and undercuts.
8. Requirements for veneer matching.
9. Doors to be factory finished and application requirements.
10. Apply AWI Quality Certification Program label to Shop Drawings.

C. Samples for Initial Selection: For factory-finished doors .

D. Samples for Verification:

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish.

1.3 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Special warranties.

1.5 QUALITY ASSURANCE

1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually in cardboard cartons, and wrap bundles of doors in plastic sheeting.

C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.7 FIELD CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install doors until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and HVAC system is operating and maintaining temperature and relative humidity at levels designed for building occupants for the remainder of construction period.
2. Do not deliver or install doors until building is enclosed and weathertight, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during remainder of construction period.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Delamination of veneer.
    b. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
    c. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.

2. Warranty also includes installation and finishing that may be required due to repair or replacement of defective doors.
3. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Wood Door and Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated on Drawings, based on testing at positive pressure in accordance with UL 10C or NFPA 252.

2.2 FLUSH WOOD DOORS AND FRAMES, GENERAL

A. Quality Standard: In addition to requirements specified, comply with AWI/AWMAC/WI's "Architectural Woodwork Standards."

1. The Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with the Contract Documents in addition to those of the referenced quality standard.

2.3 SOLID-CORE FIVE-PLY FLUSH WOOD VENEER-FACED DOORS FOR TRANSPARENT FINISH

A. Interior Doors, Solid-Core Five-Ply Veneer-Faced (SCWD):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Eggers Industries.
    b. Masonite Architectural.
    c. Oshkosh Door Company.
    d. VT Industries, Inc.

2. Performance Grade: ANSI/WDMA I.S. 1A Heavy Duty .
3. ANSI/WDMA I.S. 1A Quality Grade: Premium .
4. Faces: Single-ply wood veneer not less than 1/50 inch thick.

    a. Species: Select white birch .
    b. Cut: Plain sliced (flat sliced) .
    c. Match between Veneer Leaves: Book match.
    d. Assembly of Veneer Leaves on Door Faces: Balance match.
    e. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
    f. Room Match:

        1) Match door faces within each separate room or area of building. Corridor-door faces do not need to match where they are separated by 20 feet or more.
        2) Provide door faces of compatible color and grain within each separate room or area of building.

5. Exposed Vertical and Top Edges: Applied wood edges of same species as faces and covering edges of crossbands - Architectural Woodwork Standards edge Type D.

    a. Fire-Rated Single Doors: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed vertical edges.

6. Core for Non-Fire-Rated Doors:

    a. ANSI A208.1, Grade LD-2 particleboard.

        1) Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware.

            a) 5-inch top-rail blocking, in doors indicated to have closers.
            b) 5-inch bottom-rail blocking, in exterior doors and doors indicated to have kick, mop, or armor plates.
            c) 5-inch midrail blocking, in doors indicated to have exit devices.

        2) Provide doors with glued-wood-stave or WDMA I.S. 10 structural-composite-lumber cores instead of particleboard cores for doors scheduled to receive exit devices in Section 08 7100 "Door Hardware."

    b. Glued wood stave.
    c. WDMA I.S. 10 structural composite lumber.

        1) Screw Withdrawal, Door Face: 475 lbf .
        2) Screw Withdrawal, Vertical Door Edge: 475 lbf .

    d. Either glued wood stave or WDMA I.S. 10 structural composite lumber.

7. Core for Fire-Rated Doors: As required to achieve fire-protection rating indicated on Drawings.

    a. Blocking for Mineral-Core Doors: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated on Drawings as needed to eliminate through-bolting hardware.

8. Construction: Five plies, hot-pressed bonded (vertical and horizontal edging is bonded to core), with entire unit abrasive planed before veneering.

2.4 LIGHT FRAMES AND LOUVERS

A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads unless otherwise indicated.

1. Wood Species: Same species as door faces.
2. Profile: Flush rectangular beads.
3. At wood-core doors with 20-minute fire-protection ratings, provide wood beads and metal glazing clips approved for such use.

B. Wood-Veneered Beads for Light Openings in Fire-Rated Doors: Manufacturer's standard wood-veneered noncombustible beads matching veneer species of door faces and approved for use in doors of fire-protection rating indicated on Drawings. Include concealed metal glazing clips where required for opening size and fire-protection rating indicated.

2.5 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated.

1. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
2. Comply with NFPA 80 requirements for fire-rated doors.

B. Factory machine doors for hardware that is not surface applied.

1. Locate hardware to comply with DHI-WDHS-3.
2. Comply with final hardware schedules, door frame Shop Drawings, ANSI/BHMA-156.115-W, and hardware templates.
3. Coordinate with hardware mortises in metal frames, to verify dimensions and alignment before factory machining.
4. For doors scheduled to receive electrified locksets, provide factory-installed raceway and wiring to accommodate specified hardware.
5. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.

C. Openings: Factory cut and trim openings through doors.

1. Light Openings: Trim openings with moldings of material and profile indicated.
2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 08 8000 "Glazing."

2.6 FACTORY FINISHING

A. Comply with referenced quality standard for factory finishing.

1. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
2. Finish faces, all four edges, edges of cutouts, and mortises.
3. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.

B. Factory finish doors.

C. Transparent Finish:

1. ANSI/WDMA I.S. 1A Grade: Premium .

a. TR-6 Catalyzed Polyurethane.

2. Staining: As selected by Architect from manufacturer's full range .
3. Sheen: Semigloss.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames, with Installer present, before hanging doors.

1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Hardware: For installation, see Section 08 7100 "Door Hardware."

B. Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.

C. Job-Fitted Doors:

1. Align and fit doors in frames with uniform clearances and bevels as indicated below.

    a. Do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors.

2. Machine doors for hardware.
3. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
4. Clearances:

    a. Provide 1/8 inch at heads, jambs, and between pairs of doors.
    b. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated on Drawings.
    c. Where threshold is shown or scheduled, provide 1/4 inch from bottom of door to top of threshold unless otherwise indicated.
    d. Comply with NFPA 80 for fire-rated doors.

5. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.
6. Bevel fire-rated doors 1/8 inch in 2 inches at lock edge; trim stiles and rails only to extent permitted by labeling agency.

D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

E. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 08 1416

SECTION 08 3113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Access doors and frames.

B. Related Requirements:

1. Section 23 3300 "Air Duct Accessories" for heating and air-conditioning duct access doors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details material descriptions, dimensions of individual components and profiles, and finishes.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

2.2 ACCESS DOORS AND FRAMES

A. Flush Access Doors with Concealed Flanges :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Babcock-Davis.
   b. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
   c. Larsen's Manufacturing Company.
   d. Milcor; Hart & Cooley, Inc.
   e. Nystrom, Inc.

2. Description: Face of door flush with frame; with concealed flange for gypsum board installation and concealed hinge.
3. Locations: Wall and ceiling .
4. Door Size: 24" x 24", or as indicated on drawings .
5. Metallic-Coated Steel Sheet for Door: Nominal 0.064 inch , 16 gage factory primed .
6. Frame Material: Same material and thickness as door .
7. Latch and Lock: Cam latch, key operated with interior release.

2.3 MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A879/A879M, with cold-rolled steel sheet substrate complying with ASTM A1008/A1008M, Commercial Steel (CS), exposed.

C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with minimum G60 or A60 metallic coating.

D. Aluminum Extrusions: ASTM B221, Alloy 6063.

E. Aluminum Sheet: ASTM B209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

F. Frame Anchors: Same material as door face.

G. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329.

2.4 FABRICATION

A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.

B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.

1. For concealed flanges with drywall bead, provide edge trim for gypsum panels securely attached to perimeter of frames.
2. For concealed flanges with plaster bead for full-bed plaster applications, provide zinc-coated expanded-metal lath and exposed casing bead welded to perimeter of frames.

D. Latch and Lock Hardware:

1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.
2. Keys: Furnish two keys per lock and key all locks alike.

E. Aluminum: After fabrication, apply manufacturer's standard protective coating on aluminum that will come in contact with concrete.

2.5 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Factory Primed: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates for compliance with requirements for 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. Comply with manufacturer's written instructions for installing access doors and frames.

3.3 ADJUSTING

A. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION 08 3113

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SECTION 08 4113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Aluminum-framed entrance and storefront systems.

B. Related Requirements:

1. Section 08 4126 "All-Glass Entrances and Storefronts" for systems without aluminum support framing.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site .

1.3 ACTION SUBMITTALS

A. Product Data:

1. Aluminum-framed entrance and storefront systems.

B. Shop Drawings:

1. Plans, elevations, sections, full-size details, and attachments to other work.
2. Full-size isometric details of each type of vertical-to-horizontal intersection of aluminum-framed entrance and storefront systems, showing the following:

    a. Joinery, including concealed welds.
    b. Anchorage.
    c. Expansion provisions.
    d. Flashing and drainage.

3. Point-to-point wiring diagrams showing the following:

    a. Power requirements for each electrically operated door hardware.
    b. Location and types of switches, signal device, conduit sizes, and number and size of wires.

C. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranties: For aluminum-framed entrance and storefront systems.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For aluminum-framed entrance and storefront systems.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:

1. Fabricator of products.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of aluminum-framed entrance and storefront systems that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two 10 years from date of Substantial Completion.

B. Special Finish Warranty, Anodized Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of anodized finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D 4214.
b. Cracking, peeling, or chipping.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain all components of aluminum-framed entrance and storefront system, including framing and accessories, from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrance and storefront systems representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Aluminum-framed entrance and storefront systems to withstand movements of supporting structure, including, but not limited to, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
2. Failure also includes the following:

a. Thermal stresses transferring to building structure.
b. Glass breakage.
c. Noise or vibration created by wind and thermal and structural movements.

d. Loosening or weakening of fasteners, attachments, and other components.
e. Failure of operating units.

2.3 ALUMINUM-FRAMED ENTRANCE AND STOREFRONT SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. EFCO Corporation.
2. Kawneer Company, Inc.; Arconic Corporation.
3. Manko Window Systems, Inc.
4. OldCastle BuildingEnvelope (OBE).
5. Tubelite Inc.

B. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Interior Vestibule Framing Construction: Nonthermal .
2. Finish: High-performance organic finish .
3. Fabrication Method: Field-fabricated stick system.
4. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
5. Steel Reinforcement: As required by manufacturer.

C. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.

D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

E. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing or automatic operation.

1. Door Construction: 1-3/4-inch overall thickness, with minimum 0.125-inch- thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
2. Door Design: Medium stile; 3-1/2-inch nominal width and to match existing adjacent exterior entrance doors .
3. Glazing Stops and Gaskets: Square , snap-on, extruded-aluminum stops and preformed gaskets.
4. Finish: Match adjacent storefront framing finish.

2.4 ENTRANCE DOOR HARDWARE

A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 08 7100 "Door Hardware."

B. General: Provide entrance door hardware and entrance door hardware sets indicated in "Entrance Door Hardware Sets" Article for each entrance door, to comply with requirements in this Section.

1. Entrance Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and products equivalent in function and comparable in quality to named products .
2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.

3. Opening-Force Requirements:

    a. Egress Doors: Not more than 15 lbf to release the latch and not more than 30 lbf to set the door in motion.
    b. Accessible Interior Doors: Not more than 5 lbf to fully open door.

C. Designations: Requirements for design, grade, function, finish, quantity, size, and other distinctive qualities of each type of entrance door hardware are indicated in "Entrance Door Hardware Sets" Article. Products are identified by using entrance door hardware designations as follows:

1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in "Entrance Door Hardware Sets" Article.
2. References to BHMA Standards: Provide products complying with these standards and requirements for description, quality, and function.

D. Butt Hinges: BHMA A156.1, Grade 1, radius corner.

1. Nonremovable Pins: Provide setscrew in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while entrance door is closed.
2. Exterior Hinges: Stainless steel, with stainless steel pin .

E. Panic Exit Devices: BHMA A156.3, Grade 1, listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing in accordance with UL 305.

F. Cylinders:

1. As specified in Section 08 7100 "Door Hardware."

G. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing.

H. Operating Trim: BHMA A156.6.

I. Removable Mullions: BHMA A156.3 extruded aluminum.

1. When used with panic exit devices, provide keyed removable mullions listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing in accordance with UL 305. Use only mullions that have been tested with exit devices to be used.

J. Closers: BHMA A156.4, Grade 1, with accessories required for a complete installation, sized as required by door size, exposure to weather, and anticipated frequency of use; adjustable to comply with field conditions and requirements for opening force.

2.5 MATERIALS

A. Sheet and Plate: ASTM B209.

B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221.

C. Structural Profiles: ASTM B308/B308M.

2.6 ACCESSORIES

A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.

2.7 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
5. Provisions for field replacement of glazing from interior .
6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

C. Structural-Sealant-Glazed Framing Members: Include accommodations for using temporary support device to retain glazing in place while structural sealant cures.

D. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

1. At interior and exterior doors, provide compression weather stripping at fixed stops.

E. Entrance Doors: Reinforce doors as required for installing entrance door hardware.

1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
2. At exterior doors, provide weather sweeps applied to door bottoms.

F. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

G. After fabrication, clearly mark components to identify their locations in Project in accordance with Shop Drawings.

2.8 ALUMINUM FINISHES

A. High-Performance Organic Finish, Two-Coat PVDF: Fluoropolymer finish complying with AAMA 2604 and containing not less than 50 percent PVDF resin by weight in color coat.

1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Color and Gloss: As indicated by manufacturer's designations Match Architect's sample Black, semi-gloss .

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF ALUMINUM-FRAMED ENTRANCE AND STOREFRONT SYSTEMS

A. Comply with manufacturer's written instructions.

B. Do not install damaged components.

C. Fit joints to produce hairline joints free of burrs and distortion.

D. Rigidly secure nonmovement joints.

E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.

F. Seal perimeter and other joints watertight unless otherwise indicated.

G. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

H. Install joint filler behind sealant as recommended by sealant manufacturer.

I. Install components plumb and true in alignment with established lines and grades.

J. Install entrance doors to produce smooth operation and tight fit at contact points.

1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware in accordance with entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

K. Install glazing as specified in Section 08 8000 "Glazing."

3.3 ERECTION TOLERANCES

A. Install aluminum-framed entrance and storefront systems to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
3. Alignment:

a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch.
b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch.

4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

3.4 ENTRANCE DOOR HARDWARE SETS

Group A (SUITE ACCESS DOORS - PAIR)

3 pr	Butts	BB1168 x 4 ½ x 4 ½ x NRP x 626	Hager
2 ea.	Exit Device	98-L17- x US26D	Von Duprin
2 ea.	Offset Pulls	BF158 x 630	Rockwood
1 ea.	Electrified Removable mullion	4754 x KR x Black	Von Duprin
1 ea.	Electric Strike	6111	Von Duprin
1 ea.	Strike	299	Von Duprin
2 ea.	Door Edge	306-RKW x BSP	Rockwood
1 ea.	Power Supply		
2 ea.	Hold-open Closer	4040 x Alumn.	LCN
2 ea.	Position Switch	679-05WD	Locknetics
1 ea.	Reader	(By Owner)	

(see Section 08 7100 Door Hardware for cylinders)

Note: Reader Power Supply by Owner. Electric Strike Power Supply by General Contractor. Sequence of Operations: Door will remain unlocked during business hours. After hour access will be by presentation of credentials which will release the electric strike and allow access either by manual operations or by activating the operator. At all times exiting from space will be available by turning lever on lockset.

END OF SECTION 08 4113

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SECTION 08 4126.23 - INTERIOR ALL-GLASS ENTRANCES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior, manual-swinging, all-glass entrance systems.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site .

1.3 ACTION SUBMITTALS

A. Product Data:

1. Interior, manual-swinging, all-glass entrance systems.

B. Shop Drawings:

1. Plans, elevations, and sections.
2. Details of fittings and glazing, including isometric drawings of fittings.
3. Door hardware locations, mounting heights, and installation requirements.

C. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate final door hardware schedule with door components, assemblies, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranties: For interior all-glass entrance systems.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For interior all-glass entrance systems. Furnish a complete set of specialized tools and maintenance instructions as required for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

1.6 QUALITY ASSURANCE

A. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of interior all-glass entrance systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain all components of interior all-glass entrance systems, including accessories, from single manufacturer.

2.2 INTERIOR, MANUAL-SWINGING, ALL-GLASS ENTRANCE SYSTEMS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Dormakaba.

B. Fitting Configuration:

1. Door Fittings: Patch fittings at head and sill on pivot side only (A-Style) .
2. Sidelight Fittings: Continuous rail fitting at top and bottom .

C. Fitting Material: Aluminum Brass-clad aluminum .

D. Accessory Fittings:

1. Overhead doorstop.
2. U-channel.

E. Anchors and Fastenings: Concealed.

F. Door Hardware: In sizes, quantities, and types recommended by manufacturer for interior all-glass entrance systems indicated. For exposed parts, match metal and finish of fittings.

1. Swing: Double acting.
2. Opening-Force Requirements:

a. Egress Doors: Not more than 15 lbf to release the latch and not more than 30 lbf to set the door in motion and not more than 15 lbf to open the door to its minimum required width.
b. Accessible Interior (Swinging) Doors: Not more than 5 lbf to fully open door.

3. Push-Pull Set: As indicated .

2.3 GLASS

A. Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated surfaces), Type I (transparent), Quality-Q3, tested for surface and edge compression in accordance with ASTM C1048 and for impact strength in accordance with 16 CFR 1201 for Category II materials.

1. Class 1: Clear monolithic.

   a. Thickness: 10 mm.
   b. Locations: As indicated .

2. Exposed Edges: Machine ground and flat polished.
3. Butt Edges: Flat ground.
4. Corner Edges: Lap-joint corners with exposed edges polished.

2.4 MATERIALS

A. Aluminum: ASTM B221 with strength and durability characteristics of not less than Alloy 6063-T5 for extruded bars, rods, profiles, and tubes. ASTM B209 for sheet and plate.

1. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

B. Stainless Steel Cladding: ASTM A240/A240M or ASTM A666, Type 304.

1. Finish: ASTM A480/A480M No. 4 directional satin finish .

C. Structural Shapes, Plates, and Bars: ASTM A36/A36M.

2.5 FABRICATION

A. Provide holes and cutouts in glass to receive hardware, fittings, and accessory fittings before tempering glass. Do not cut, drill, or make other alterations to glass after tempering.

1. Fully temper glass using horizontal (roller-hearth) process, and fabricate so that when glass is installed, roll-wave distortion is parallel with bottom edge of door or lite.

B. Factory assemble components and factory install hardware and fittings to greatest extent possible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install interior all-glass entrance systems and associated components in accordance with manufacturer's written instructions.

B. Set units level, plumb, and true to line, with uniform joints.

C. Maintain uniform clearances between adjacent components.

D. Lubricate hardware and other moving parts in accordance with manufacturer's written instructions.

E. Set, seal, and grout floor closer cases as required to suit hardware and substrate indicated.

3.3 ADJUSTING AND CLEANING

A. Adjust all-glass doors and hardware to function smoothly and fit tightly at contact points.

1. For interior all-glass, swinging entrance doors accessible to people with disabilities, adjust closers to provide a three-second closer sweep period for doors to move from a 70-degree open position to 3 inches from the latch measured to the leading door edge.

B. Remove excess sealant and glazing compounds and dirt from surfaces.

3.4 DOOR HARDWARE SCHEDULE

Group 11 (ALL GLASS PASSAGE)

1 Ea	Mechanical Channel	807.059 X Length As Needed	Dormakaba
	(Run across entire span of glazed wall. Through-bolt glass to channel and into header above. Manufacturer engineer to review.)		
1 Ea	Mechanical Channel Cover	207.153	Dormakaba
1 Ea	Channel End Cap	807.065	Dormakaba
1 Ea	PT 20 Top Patch Fitting	833.111	Dormakaba
1 Ea	PT 10 Bottom Patch	833.101	Dormakaba
1 Ea	Floor Pivot	901.106	Dormakaba
2 Ea	1x1 Sidelight U Channel	925.071 X Length As Needed	Dormakaba
1 Ea	Back To Back Pull	TG9387x42" 905.371	Dormakaba
1 Ea	3/8" Glass Mounting Pack	905.385	Dormakaba

Group 12 (ALL GLASS CLASSROOM)

1 Ea	Mechanical Channel	807.059 X Length As Needed	Dormakaba
	(Run across entire span of glazed wall. Through-bolt glass to channel and into header above. Manufacturer engineer to review.)		
1 Ea	Mechanical Channel Cover	207.153	Dormakaba
1 Ea	Channel End Cap	807.065	Dormakaba
1 Ea	PT 22 Top Patch Fitting	833.113	Dormakaba
1 Ea	PT 10 Bottom Patch	833.101	Dormakaba
1 Ea	Floor Pivot	901.106	Dormakaba
2 Ea	1x1 Sidelight U Channel	925.071 X Length As Needed	Dormakaba
1 Ea	Locking Back To Back Pull	TG138x72"	Dormakaba
1 Ea	Floor recessed deadbolt		Dormakaba
1 Ea	Header Closer	RTS 88	
1 Ea	3/8" Glass Mounting Pack	905.385	Dormakaba

END OF SECTION 08 4126.23

SECTION 08 4413 - GLAZED ALUMINUM CURTAIN WALLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Glazed aluminum curtain wall systems:

a. Conventionally glazed.

B. Related Requirements:

1. Section 08 8000 "Glazing" for curtain wall glazing.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site .

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For glazed aluminum curtain walls. Include plans, elevations, sections, full-size details, and attachments to other work.

1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
2. Include full-size isometric details of each type of vertical-to-horizontal intersection of glazed aluminum curtain walls, showing the following:

a. Joinery, including concealed welds.
b. Anchorage.
c. Expansion provisions.
d. Glazing.
e. Flashing and drainage.

3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.

C. Delegated-Design Submittal: For glazed aluminum curtain walls, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data:

1. For Installer and laboratory mockup testing agency .
2. For professional engineer's experience with providing delegated-design engineering services of the kind indicated, including documentation that engineer is licensed in the jurisdiction in which Project is located.

B. Product Test Reports: For glazed aluminum curtain walls, for tests performed by a qualified testing agency.

C. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For glazed aluminum curtain walls to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer and that employs a qualified glazing contractor for this Project who is certified under the North American Contractor Certification Program (NACC) for Architectural Glass & Metal (AGM) contractors.

B. Structural-Sealant Glazing: Comply with ASTM C1401 for design and installation of structural-sealant-glazed curtain wall assemblies.

1.7 WARRANTY

A. Special Assembly Warranty: Installer agrees to repair or replace components of glazed aluminum curtain wall that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Structural failures including, but not limited to, excessive deflection.
   b. Noise or vibration created by wind and thermal and structural movements.
   c. Deterioration of metals and other materials beyond normal weathering.
   d. Water penetration through fixed glazing and framing areas.
   e. Failure of operating components.

2. Warranty Period: Two 10 years from date of Substantial Completion.

B. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of baked enamel, powder coat, or organic finishes within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

C. Special Finish Warranty, Anodized Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of anodized finishes within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 "Quality Requirements," to design glazed aluminum curtain walls.

B. General Performance: Comply with performance requirements specified, as determined by testing of glazed aluminum curtain walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Glazed aluminum curtain walls shall withstand movements of supporting structure, including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
2. Failure also includes the following:

    a. Thermal stresses transferring to building structure.
    b. Glass breakage.
    c. Noise or vibration created by wind and thermal and structural movements.
    d. Loosening or weakening of fasteners, attachments, and other components.
    e. Failure of operating units.

C. Structural Loads:

1. Wind Loads: As indicated on Drawings.

D. Deflection of Framing Members Supporting Glass: At design wind load, as follows:

1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans of up to 13 feet 6 inches and to 1/240 of clear span plus 1/4 inch for spans of greater than 13 feet 6 inches .
2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch .

E. Structural: Test in accordance with ASTM E330/E330M as follows:

1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

F. Water Penetration under Static Pressure: Test in accordance with ASTM E331 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested in accordance with a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 10 lbf/sq. ft. .

G. Water Penetration under Dynamic Pressure: Test in accordance with AAMA 501.1 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. 10 lbf/sq. ft. .

2. Maximum Water Leakage: No uncontrolled water penetrating assemblies or water appearing on assemblies' normally exposed interior surfaces from sources other than condensation. Water leakage does not include water controlled by flashing and gutters or water that is drained to exterior.

H. Energy Performance: Certified and labelled by manufacturer for energy performance as follows:

1. Thermal Transmittance (U-factor):

a. Fixed Glazing and Framing Areas: U-factor for the system of not more than 0.29 Btu/sq. ft. x h x deg F as determined in accordance with NFRC 100.

2. Solar Heat Gain Coefficient (SHGC):

a. Fixed Glazing and Framing Areas: SHGC for the system of not more than 0.16 as determined in accordance with NFRC 200.

3. Air Leakage:

a. Fixed Glazing and Framing Areas: Air leakage for the system of not more than 0.06 cfm/sq. ft. at a static-air-pressure differential of 6.24 lbf/sq. ft. when tested in accordance with ASTM E283.

4. Condensation Resistance Factor (CRF):

a. Fixed Glazing and Framing Areas: CRF for the system of not less than 55 as determined in accordance with AAMA 1503.

I. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
2. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested in accordance with AAMA 501.5.

a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F .
b. Low Exterior Ambient-Air Temperature: 0 deg F .

2.2 SOURCE LIMITATIONS

A. Obtain all components of curtain-wall system and storefront system, including framing and accessories, from single manufacturer.

2.3 GLAZED ALUMINUM CURTAIN WALL SYSTEMS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Kawneer North America; 1600 LR or comparable product by one of the following:

1. EFCO Corporation; 5500X system.
2. OldCastle BuildingEnvelope (OBE).
3. Tubelite Inc.; 300ES system.

B. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Construction: Thermally improved .
2. Glazing System: Retained mechanically with gaskets on four sides .

3. Glazing Plane: Front .
4. Finish: Clear anodic finish .
5. System: Either stick or unitized system .
6. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
7. Steel Reinforcement: As required by manufacturer.

C. Pressure Caps: Manufacturer's standard aluminum components that mechanically retain glazing.

1. Include snap-on aluminum trim that conceals fasteners.

D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

2.4 GLAZING

A. Glazing: Comply with Section 08 8000 "Glazing."

B. Glazing Gaskets: ASTM C509 or ASTM C864. Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers .

C. Glazing Sealants: As recommended by manufacturer.

2.5 MATERIALS

A. Sheet and Plate: ASTM B209.

2.6 ACCESSORIES

A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.

B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.

C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials .

D. Bituminous Paint: Cold-applied asphalt-mastic paint containing no asbestos, formulated for 30-mil thickness per coat.

2.7 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
5. Provisions for field replacement of glazing from exterior .
6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
7. Components curved to indicated radii.

C. Fabricate components to resist water penetration as follows:

1. Internal guttering system or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
2. Pressure-equalized system or double barrier design with primary air and vapor barrier at interior side of glazed aluminum curtain wall and secondary seal weeped and vented to exterior.

D. Curtain-Wall Framing: Fabricate components for assembly using manufacturer's standard assembly method .

E. Factory-Assembled Frame Units:

1. Rigidly secure nonmovement joints.
2. Prepare surfaces that are in contact with structural sealant in accordance with sealant manufacturer's written instructions, to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.
3. Seal joints watertight unless otherwise indicated.
4. Install glazing to comply with requirements in Section 08 8000 "Glazing."

F. After fabrication, clearly mark components to identify their locations in Project in accordance with Shop Drawings.

2.8 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Comply with manufacturer's written instructions.

B. Do not install damaged components.

C. Fit joints to produce hairline joints free of burrs and distortion.

D. Rigidly secure nonmovement joints.

E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.

F. Where welding is required, weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.

G. Seal joints watertight unless otherwise indicated.

H. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with primer, applying sealant or tape, or installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

I. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.

J. Install components plumb and true in alignment with established lines and grades.

3.3 INSTALLATION OF GLAZING

A. Install glazing as specified in Section 08 8000 "Glazing."

3.4 ERECTION TOLERANCES

A. Install glazed aluminum curtain walls to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
3. Alignment:

    a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch.
    b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
    c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch.

4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Test Area: Perform tests on one bay at least 30 feet, by one story representative areas of glazed aluminum curtain walls mockups .

C. Field Quality-Control Testing: Perform the following test on representative areas of glazed aluminum curtain walls .

1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested in accordance with AAMA 501.2 and shall not evidence water penetration.

    a. Perform a minimum of three tests in areas as directed by Architect.

2. Water Penetration: ASTM E1105 at a minimum uniform and cyclic static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft., and shall not evidence water penetration.

D. Glazed aluminum curtain walls will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION 08 4413

SECTION 08 4523 - FIBERGLASS-SANDWICH-PANEL ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes aluminum-framed assemblies incorporating fiberglass-sandwich panel systems as follows:

1. Roof assemblies.
2. Skylight assemblies.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, profiles, and finishes for aluminum components of panel assemblies.

B. Shop Drawings: For panel assemblies.

1. Include plans, elevations, sections, details, and attachments to other work.

C. Samples for Initial Selection: Manufacturer's standard color sheets, indicating full range of available colors for each type of exposed finish.

D. Samples for Verification: Actual sample of finished products for each type of exposed finish.

1. 7 by 12-inch of each type of fiberglass-sandwich panel.
2. 3-inch long of each type of exposed finish for framing members.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each fiberglass-sandwich-panel assembly, for tests performed by a qualified testing agency.

1. Flame spread and smoke developed UL card in accordance with UL 723.
2. Burn extent in accordance with ASTM D635.
3. Color difference in accordance with ASTM D2244.
4. Impact strength in accordance with UL 972.
5. Bond tensile strength in accordance with ASTM C297 after aging by ASTM D1037.
6. Bond shear strength in accordance with ASTM D1002.
7. Beam bending strength" in accordance with ASTM E72.
8. U-Factor in accordance with NFRC 100.
9. Visible light transmittance in accordance with NFRC 202.

10. Solar heat gain coefficient" (SHGC) in accordance with NFRC 201 or using calculations.
11. Condensation resistance factor for thermally broken, insulated panels in accordance with AAMA 1503.
12. Air leakage in accordance with ASTM E283.
13. Structural performance in accordance with ASTM E330.
14. Water penetration in accordance with ASTM E331.
15. Fire penetration of exterior wall assemblies using a direct flame impingement exposure in accordance with ASTM E2707.
16. Daylight modeling report to suit Project.
17. Fall-through resistance for skyroof/unit skylight/canopy only in accordance with ASTM E661.
18. UL-listed Class A, roof covering burning brand test for skyroof/unit skylight/canopy only in accordance with UL 790.

C. Evaluation Reports: AC177 for fiberglass-sandwich-panel assemblies from ICC-ES.

D. Field quality-control reports.

E. Sample Warranties: For warranties.

F. Daylight Autonomy

1. Demonstrate through computer modeling (RADIANCE) that average illuminance levels for the regularly occupied floor area at 12 p.m. on a clear-sky day at the equinox.
2. Demonstrate Useful Daylight Illuminance (UDI) through computer modeling (RADIANCE) that shows percentage of regularly occupied floor area achieves between 10 footcandles and 300 footcandles for 50% of the designated time.
3. Demonstrate Spatial Daylight Autonomy (sDA) through computer modeling (RADIANCE) that shows percentage of regularly occupied floor area exceeds 30 footcandles for 50% of the designated time.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For panel assemblies to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: For fiberglass-sandwich panels, a qualified manufacturer whose facilities, processes, and products are monitored by an independent, ANSI-accredited quality-control agency for compliance with applicable requirements in ICC-ES AC177.

B. Installer Qualifications: Entity that employs experienced installers and supervisors who can indicate evidence of satisfactory completion of projects of similar size, scope, and type installing manufacturer's panel assemblies.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of panel assemblies that fail in materials or workmanship within specified warranty period.

1. Panel Assembly Warranty Period: Five years from date of delivery and provided to Owner on date of Substantial Completion.

B. Manufacturer's Extended Warranty: Manufacturer agrees to repair or replace fiberglass-sandwich panels that exhibit defects in materials or workmanship within specified warranty period.

1. Defects include, but are not limited to, the following:

a. Noticeable surface fiber exposure of the exterior face.
b. Color change of exterior face exceeding 8 Delta E.
c. Delamination of panel face sheets from panel cores affecting structural strength.

2. Face Separation from Grid Core Warranty Period: 10 years from date of delivery and provided to Owner on date of Substantial Completion.
3. Glass Fiber External Exposure Warranty Period: 10 years from date of delivery and provided to Owner on date of Substantial Completion.

C. Aluminum Paint Coating Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period. Warranty does not include normal weathering.

1. Failures include, but are not limited to, cracking, peeling, and adhesion failure of paint coating finishes.
2. Warranty Period: 10 years from date of delivery and provided to Owner on date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Loads: As indicated on Drawings.

B. Deflection Limits:

1. Overhead Panel Assemblies: Limited to 1/60 of clear span for each assembly component.

C. Structural-Test Performance: Provide panel assemblies tested in accordance with ASTM E330, as follows:

1. When tested at positive and negative wind-load design pressures, assemblies do not indicate evidence of deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not indicate evidence of material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

D. Water Penetration under Static Pressure: Provide panel assemblies that do not evidence water penetration through fixed glazing and framing areas when tested in accordance with ASTM E331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 15 lbf/sq. ft..

E. Thermal Movements: Allow for thermal movements from ambient- and surface-temperature changes. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 110 deg F, ambient; 150 deg F, material surfaces.

F. Energy Performance: Provide panel with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. Thermal Transmittance (U-Factor): Fixed translucent panels to have U-factor of not more than 0.23 Btu/sq. ft. x h x deg F as determined in accordance with NFRC 100.
2. Visible Light Transmittance (VLT): No greater than 26 percent as determined in accordance with NFRC 202.
3. Solar Heat Gain Coefficient (SHGC): Fixed glazing and framing areas to have a SHGC of no greater than 0.30 as determined in accordance with NFRC 201 or calculation.
4. Air Infiltration: Maximum air leakage through fixed glazing and framing areas of 0.01 cfm/sq. ft. of fixed wall area as determined in accordance with ASTM E283 at a minimum static-air-pressure differential of 6.24 lbf/sq. ft..
5. Condensation Resistance Factor (CRF): CRF for panel of not less than 80 as determined in accordance with AAMA 1503 and measured on the bond line of thermally broken panels with translucent insulation.

G. Fall-Through Resistance: Complying with OSHA 1910.22 as tested in accordance with ASTM E661; supplemental screens or railings not required.

2.2 FIBERGLASS-SANDWICH-PANEL ASSEMBLIES

A. Fiberglass-Sandwich-Panel Assemblies: Translucent assemblies of insulated composite-structural-sandwich panels made using specially formulated fiberglass reinforced translucent face sheets bonded to grid-core, aluminum-closure system and stiffeners, sized for spans; with insulation fill.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Kalwall Corporation; Skylights or comparable product by one of the following:

    a. Major Industries, Inc.

2.3 FIBERGLASS-SANDWICH PANELS

A. Fiberglass-Sandwich Panels: Uniformly colored, translucent, thermoset, fiberglass-reinforced-polymer face sheets bonded to both sides of a grid core.

1. Grid Core Insulation: Fill panel cores with fiberglass batt.

B. Panel Thickness: 2-3/4 inches.

C. Grid Core: Mechanically interlocked muntin, mullion, and perimeter, extruded-aluminum I-beams, with a minimum flange width of 7/16 inch.

1. Extruded Aluminum: ASTM B221, in Alloy 6063-T5 or T6 as recommended in writing by manufacturer.
2. I-Beam Construction: Curved , extruded aluminum.
3. Grid Pattern: Shoji
    a. Grid Size: Nominal 12 by 24 inches

D. Fiberglass-Sandwich-Panel Laminate Adhesive: Heat and pressure resin type adhesive engineered for structural sandwich panel use and complying with ICC "Acceptance Criteria for Sandwich Panel Adhesives."

1. Tensile Strength: Minimum 750 lbf/sq. in. when panel assembly is tested by ASTM C297, after two exposures to six cycles each of aging conditions prescribed by ASTM D1037.

2. Shear Strength: Minimum values in accordance with ASTM D1002, after exposure to four separate conditions:

    a. 540 lbf/sq. in. at 50 percent relative humidity (RH) at 68 deg F.
    b. 100 lbf/sq. in. at 182 deg F.
    c. 800 lbf/sq. in. when tested for accelerated aging in accordance with ASTM D1037 at room temperature.
    d. 250 lbf/sq. in. when tested for accelerated aging in accordance with ASTM D1037 at 182 deg F.

E. Face Sheet:

1. Material: Glass-fiber-reinforced thermoset resins, formulated explicitly for architectural use.

    a. Thermoplastic or polycarbonate and acrylic faces are unacceptable.
    b. Face sheets to not deform, deflect, or drip when subjected to fire or flame.

2. Exterior Face Sheet:

    a. Basis-of-Design Product: Subject to compliance with requirements, provide Kalwall Corporation; UL Class A Roof, Type A or comparable product.
    b. Color Change of Exterior Face Sheet: Not more than 3.0 units Delta E, when measured in accordance with ASTM D2244, after five years of outdoor South Florida weathering compliant with procedures in ASTM D1435. Test material to not use protective film or coating for long-term color stability. Color stability to be unaffected by abrasion or scratching.

        1) Outdoor Weathering Conditions: Sixty months in southern Florida.

    c. Impact Resistance of Exterior Face Sheet: No fracture or tear at impact of 70 ft. x lbf by a 3-1/4-inch- diameter, 5 lb freefalling ball in accordance with UL 972 test procedure.
    d. Thickness: Nominal 0.070.
    e. Color: Crystal.
    f. Erosion Protection Surface: Integral, embedded-glass erosion barrier.

3. Interior Face Sheet:

    a. Basis-of-Design Product: Subject to compliance with requirements, provide Kalwall Corporation; Standard S-171, ~~Crystal~~ or comparable product.
    b. Flame-Spread: 50 or less in accordance with ASTM E84 or UL 723.
    c. Smoke-Developed Index: 250 or less in accordance with ASTM E84, or 75 or less in accordance with ASTM D2843.
    d. Interior Finish Classification of Interior Face Sheet: Class B based on testing in accordance with ASTM E84.
    e. Combustibility Classification of Interior Face Sheet: Class CC1 based on testing in accordance with ASTM D635.
    f. Thickness: Nominal 0.045 inch .
    g. Color: White.

F. Panel Strength:

1. Maximum Panel Deflection: 1.9 inches in 10 ft. span when a standard panel is tested in accordance with ASTM E72 at 30 lbf/sq. ft..
2. Panel Support Strength: Capable of supporting, without failure, a 300 lbf concentrated load when applied to a 3-inch- diameter disk in accordance with ASTM E661.

G. Panel Performance:

1. Fire Penetration Resistance of Wall Assembly: Panels comply with ASTM E2707.

   a. Absence of flame penetration through wall assembly.
   b. Absence of glowing combustion on interior surface of assembly at end of 60-minute observation period.
   c. Absence of flame, glow, and smoke when test is terminated prior to completion of 60-minute observation period.

2. Roof-Covering Classification of Exterior Face Sheet: UL-Listed, Class A Roof in accordance with ASTM E108 or UL 790.

2.4 ALUMINUM CLOSURE SYSTEMS

A. General: Comply with manufacturer's fabrication drawings and written instructions for clamp-tite with screw-type closure system.

B. Components: Manufacturer's standard extruded-aluminum members of thickness required and reinforced as required to support imposed loads.

1. Construction: Standard, curved extruded aluminum Alloy 6063-T6 and T5 clamp-tite and screw closure system.

C. Aluminum: Alloy and temper recommended in writing by manufacturer for type of use and finish indicated.

1. Sheet and Plate: ASTM B209.
2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221.
3. Extruded Structural Pipe and Tubes: ASTM B429/B429M.
4. Structural Profiles: ASTM B308/B308M.

D. Sealing Tape: Manufacturer's standard tape factory-applied to closure system under controlled conditions.

E. Fasteners and Accessories: Manufacturer's standard, corrosion-resistant, nonstaining, and nonbleeding fasteners and accessories; compatible with adjacent materials.

1. At closures, retaining caps, or battens, use ASTM A193/A193M, 300 series stainless steel screws.
2. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
3. At movement joints, use slip-joint linings, spacers, and sleeves of material and type recommended in writing by manufacturer.

F. Exposed Flashing and Closures: Aluminum sheet not less than 0.063 inch thick, finished to match framing.

G. Frame-System Sealants: As recommended in writing by manufacturer.

2.5 FABRICATION

A. Sheet Fabrication:

1. Tolerances: Sheets manufactured to plus or minus 10 percent of thickness.

B. Frame System Fabrication:

1. Fabricate components that, when assembled fully welded, have the following characteristics:

a. Profiles that are sharp, straight, and free of defects or deformations.
b. Accurately fitted joints with ends coped or mitered.
c. Internal guttering systems or other means to drain water passing through joints, and moisture migrating within assembly to exterior.

2. Fabricate sill closures with weep holes and for installation as continuous component.
3. Reinforce components as required to receive fastener threads.

C. Panel Fabrication: Factory assemble and seal panels.

1. Laminate face sheets to grid core under a controlled process using heat and pressure to produce straight adhesive bonding lines that cover width of core members and that have sharp edges.

a. White spots indicating lack of bond at intersections of grid-core members are limited in number to four for every 40 sq. ft. of panel and limited in diameter to 3/64 inch.

2. Fabricate with grid pattern that is symmetrical about centerlines of each panel.
3. Fabricate panel to allow condensation within panel to escape.
4. Reinforce panel corners.

2.6 ALUMINUM FINISHES

A. High-Performance Organic Finish: Two Three-coat fluoropolymer finish complying with the performance requirements of AAMA 2604 and containing not less than 50 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Comply with manufacturer's fabrication drawings and written instructions.

1. Do not install damaged components.
2. Fit joints between aluminum components to produce hairline joints free of burrs and distortion.
3. Rigidly secure nonmovement joints.

4. Install anchors with separators and isolators to prevent metal corrosion, electrolytic deterioration, and immobilization of moving joints.
5. Seal joints watertight unless otherwise indicated.

B. Metal Protection: Where aluminum components will contact dissimilar materials, protect against galvanic action by painting contact surfaces with corrosion-resistant coating or by installing nonconductive spacers as recommended in writing by manufacturer for this purpose.

C. Install components plumb and true in alignment with established lines and elevations.

D. Skylight Assemblies: Install continuous aluminum sill closures with weatherproof expansion joints and locked and sealed corners. Locate weep holes at rafters. Install components to drain water passing through joints and moisture migrating within assembly to exterior.

E. Erection Tolerances: Install panel assemblies to comply with the following maximum tolerances:

1. Alignment: Limit offset from true alignment to 1/32 inch where surfaces abut in line, edge to edge, at corners, or where a reveal or protruding element separates aligned surfaces by less than 3 inches; otherwise, limit offset to 1/8 inch.
2. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 ft., but no greater than 1/2 inch over total length.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

1. Water-Spray Test: Before installation of interior finishes has begun, panel assemblies to be tested in accordance with AAMA 501.2 and will not indicate evidence of water penetration.
2. Water Penetration under Static Pressure: Before installation of interior finishes has begun, areas to be tested in accordance with ASTM E1105.

    a. Test Procedures: Test under uniform and cyclic static-air pressure.
    b. Water Penetration: None.

B. Repair or remove work where test results and inspections indicate that it does not comply with specified requirements.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

D. Prepare test and inspection reports.

3.4 CLEANING

A. Clean interior and exterior of fiberglass-sandwich-panel assembly immediately after installation in accordance with manufacturer's written instructions.

END OF SECTION 08 4523

SECTION 08 7100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Hinges.
2. Bored locks.
3. Mortise locks.
4. Electric strikes.
5. Manual flush bolts.
6. Exit devices and auxiliary items.
7. Lock cylinders.
8. Surface closers.
9. Wall- and floor-mounted stops.
10. Auxiliary electrified door hardware.

B. Related Requirements:

1. Section 06 4116 "Plastic-Laminate-Clad Architectural Cabinets" for cabinet door hardware provided with cabinets.
2. Section 08 1213 "Hollow Metal Frames" for door silencers provided as part of hollow-metal frames.
3. Section 08 1416 "Flush Wood Doors" for provided as part of labeled fire-rated assemblies.
4. Section 08 4113 "Aluminum-Framed Entrances and Storefronts" for entrance door hardware, except cylinders.
5. Section 08 4126 "All-Glass Entrances and Storefronts" for entrance door hardware, except including cylinders.

1.2 COORDINATION

A. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

B. Security: Coordinate installation of door hardware, and access control with Owner's security consultant.

C. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

D. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field-verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site .

1. Conference participants must include Installer's Architectural Hardware Consultant and Owner's security consultant.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Hinges.
2. Bored locks.
3. Mortise locks.
4. Electric strikes.
5. Manual flush bolts.
6. Exit devices and auxiliary items.
7. Lock cylinders.
8. Surface closers.
9. Wall- and floor-mounted stops.
10. Auxiliary electrified door hardware.
11. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For electrified door hardware.

1. Include diagrams for power, signal, and control wiring.
2. Include details of interface of electrified door hardware and building safety and security systems.

C. Door Hardware Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant. Coordinate door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Submittal Sequence: Submit door hardware schedule concurrent with submissions of product data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.
2. Format: Use same scheduling sequence and format and use same door numbers as in door hardware schedule in the Contract Documents.
3. Content: Include the following information:

    a. Identification number, location, hand, fire rating, size, and material of each door and frame.
    b. Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
    c. Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
    d. Description of electrified door hardware sequences of operation and interfaces with other building control systems.
    e. Fastenings and other installation information.
    f. Explanation of abbreviations, symbols, and designations contained in door hardware schedule.
    g. Mounting locations for door hardware.
    h. List of related door devices specified in other Sections for each door and frame.

1.5 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of door hardware to include in maintenance manuals.

B. Schedules: Final door hardware schedule.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lockup for door hardware delivered to Project site.

B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures, including excessive deflection, cracking, or breakage.
b. Faulty operation of doors and door hardware.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period: Three years from date of Substantial Completion unless otherwise indicated below:

a. Electromagnetic and Delayed-Egress Locks: Five years from date of Substantial Completion.
b. Exit Devices: Two years from date of Substantial Completion.
c. Manual Closers: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain each type of door hardware from single manufacturer.

1. Provide electrified door hardware from same manufacturer as mechanical door hardware unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Rated Door Assemblies: Where fire-rated doors are indicated, provide door hardware complying with NFPA 80 that is listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.

B. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Means of Egress Doors: Latches do not require more than 15 lbf to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.

D. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the USDOJ's "2010 ADA Standards for Accessible Design" ICC A117.1 .

1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.
2. Comply with the following maximum opening-force requirements:

    a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.
    b. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.

3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch high.
4. Adjust door closer sweep periods so that, from an open position of 90 degrees, the door will take at least 5 seconds to move to a position of 12 degrees from the latch.
5. Adjust spring hinges so that, from an open position of 70 degrees, the door will take at least 1.5 seconds to move to the closed position.

2.3 HINGES

A. Hinges: ANSI/BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Allegion plc.
    b. Hager Companies.
    c. McKinney Products Company; ASSA ABLOY Accessories and Door Controls Group, Inc.; ASSA ABLOY.
    d. STANLEY; dormakaba USA, Inc.

2.4 MECHANICAL LOCKS AND LATCHES

A. Lock Functions: As indicated in door hardware schedule.

B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:

1. Bored Locks: Minimum 1/2-inch latchbolt throw.
2. Mortise Locks: Minimum 3/4-inch latchbolt throw.

C. Lock Backset: 2-3/4 inches unless otherwise indicated.

D. Lock Trim:

1. Description: as indicated in door hardware schedule .

E. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.

F. All locksets shall accept the Best 7-pin SFIC core

G. Bored Locks: ANSI/BHMA A156.2, Grade 1 , Series 4000.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. BEST Access Solutions, Inc., dormakaba USA Inc.; 93K series
b. Corbin Russwin; CL3300 Series
c. Sargent; 10 Line
d. Schlage; ND Series
e. Yale; 5400LN Series

H. Mortise Locks: ANSI/BHMA A156.13, Operational Grade 1 Security Grade 2; stamped steel case with steel or brass parts; Series 1000.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. SARGENT Manufacturing Company; ASSA ABLOY.

2.5 ELECTRIC STRIKES

A. Electric Strikes: ANSI/BHMA A156.31, Grade 1 ; with faceplate to suit lock and frame.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Adams Rite Manufacturing Company, an ASSA ABLOY Group company.
b. Allegion plc.
c. Hanchett Entry Systems (HES), Inc.; ASSA ABLOY Group.

2.6 MANUAL FLUSH BOLTS

A. Manual Flush Bolts: ANSI/BHMA A156.16; minimum 3/4-inch throw; designed for mortising into door edge.

2.7 EXIT DEVICES AND AUXILIARY ITEMS

A. Exit Devices and Auxiliary Items: ANSI/BHMA A156.3.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allegion plc.
b. Corbin Russwin
c. Hager Companies.
d. Precision
e. SARGENT Manufacturing Company; ASSA ABLOY.
f. Yale

g. Von Duprin

2. All rim and mortise cylinders shall accept the Best 7-pin SFIC core

2.8 LOCK CYLINDERS

A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver. Provide cylinder from same manufacturer of locking devices.

B. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

C. Permanent Cores will be provided and installed by Owner.

2.9 KEYING

A. Keying System: Factory registered, complying with guidelines in ANSI/BHMA A156.28, appendix. Provide one extra key blank for each lock.

1. Existing System:

a. Master key or grand master key locks to Owner's existing system.

2. Keyed Alike: Key all cylinders to same change key.

B. Keys: Brass.

1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:

a. Notation: Information to be furnished by Owner.

2.10 SURFACE CLOSERS

A. Surface Closers: ANSI/BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written instructions for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allegion plc.
b. Corbin Russwin, Inc.; an ASSA ABLOY Group company.
c. LCN
d. Norton Door Controls; ASSA ABLOY.
e. SARGENT Manufacturing Company; ASSA ABLOY.
f. STANLEY; dormakaba USA, Inc.

2.11 MECHANICAL STOPS AND HOLDERS

A. Wall- and Floor-Mounted Stops: ANSI/BHMA A156.16.

2.12 AUXILIARY ELECTRIFIED DOOR HARDWARE

A. Auxiliary Electrified Door Hardware: ANSI/BHMA A156.35.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Allegion plc.
   b. ASSA ABLOY Electronic Security Hardware; ASSA ABLOY.
   c. dormakaba USA Inc.
   d. Hager Companies.
   e. Precision Hardware, Inc.; dormakaba Group.
   f. Rutherford Controls Int'l. (RCI); dormakaba Group.
   g. SARGENT Manufacturing Company; ASSA ABLOY.

2.13 FABRICATION

A. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and ANSI/BHMA A156.18.

B. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended; however, aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware unless otherwise indicated.

1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
2. Fire-Rated Applications:

   a. Wood or Machine Screws: For the following:

      1) Hinges mortised to doors or frames.
      2) Strike plates to frames.
      3) Closers to doors and frames.

   b. Steel Through Bolts: For the following unless door blocking is provided:

      1) Surface hinges to doors.
      2) Closers to doors and frames.
      3) Surface-mounted exit devices.

3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
4. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.14 FINISHES

A. Provide finishes complying with ANSI/BHMA A156.18 as indicated in door hardware schedule.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance of the Work.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Steel Doors and Frames: For surface-applied door hardware, drill and tap doors and frames in accordance with ANSI/SDI A250.6.

B. Wood Doors: Comply with door and hardware manufacturers' written instructions.

3.3 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights indicated on Drawings to comply with the following unless otherwise indicated or required to comply with governing regulations.

1. Wood Doors: DHI's "Recommended Locations for Architectural Hardware for Wood Flush Doors."

B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.

1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.

C. Hinges: Install types and in quantities indicated in door hardware schedule, but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

D. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule, but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every 30 inches of door height greater than 90 inches.

E. Lock Cylinders: Install construction cores to secure building and areas during construction period.

F. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, in equipment room. Verify location with Architect.

1. Configuration: Provide least number of power supplies required to adequately serve doors with electrified door hardware.

G. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.

3.4 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.

3.5 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.6 MAINTENANCE SERVICE

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

3.7 DOOR HARDWARE SCHEDULE

Group 1 (OFFICES)

1 ½ pr.	Butts	BB1168 x 4 ½ x 4 ½ x 626	Hager
1 ea.	Entrance	93K-7-AB-14D-S3 x 626	Best
1 ea.	Wall Stop	409 x 626	Rockwood

Group 2 (PASSAGE)

1 ½ pr.	Butts	BB1168 x 4 ½ x 4 ½ x 626	Hager
1 ea.	Closer	4040 x Alumn.	LCN

1 ea.	Passage	93K-0-N-14D-S3 x 626	Best
1 ea.	Wall Stop	409 x 626	Rockwood

Group 3 (RESTROOMS)

1 ½ pr.	Butts	BB1168 x 4 ½ x 4 ½ x 626	Hager
1 ea.	Mortise Privacy	49-8265 x LE1L x US26D	Sargent
1 ea.	Wall Stop	409 x 630	Rockwood

Group 4 (JANITOR / STORAGE)

1 ½ pr.	Butts	BB1168 x 4 ½ x 4 ½ x 626	Hager
1 ea.	Storeroom	93K-7-D-14D-S3 x 626	Best
1 ea.	Closer w/ HO	4040 x Alumn.	LCN
1 ea.	Wall Stop	409 x 630	Rockwood

Group 5 (EXISTING EGRESS STAIR INT DOORS – 2ND)

Existing to Remain

1 ½ pr	Butts		
1 ea	Closer		
1 ea	Alarmed delayed egress device		
1 ea.	Cylinder		

Existing to Remove

None

New Hardware to add to existing panel

1 ea.	Position Switch	679-05WD	Locknetics
	* Connected to Access Control Panel		

Group 6 (SUITE ACCESS DOORS - PAIR)

1 ea.	Cylinder		Best (By Owner)

(see Section 08 4113 Aluminum-Framed Entrances and Storefronts for remaining hardware)

Group 7 (CLASSROOM)

1 ½ pr	Butts	BB1168 x 4 ½ x 4 ½ x NRP x 626	Hager
1 ea.	Exit Device	98-L17- x US26D	Von Duprin
1 ea.	Cylinder		Best (By Owner)
1 ea.	Closer w/ HO	4040 x Alumn.	LCN

Group 8 (NOT USED)

Group 9 (TELECOM)

1 ½ pr	Butts	BB1168 x 4 ½ x 4 ½ x 626	Hager
1 ea.	Closer	4040 x Paint	LCN
1 ea.	Storeroom	93K-7-D-14D-S x 626	Best
1 ea.	Electric Strike	7240-510-00 X [ELX]	Adams Rite
1 ea.	Position Switch	DPS-M or W - BK	Securitron
1 ea.	Reader	(By Owner)	
1 ea.	Request to Exit	XMS	Securitron

Note: Reader Power Supply by Owner. Electric Strike Power Supply by General Contractor.
Note: Operation: A valid card presentation will momentarily release the electric strike to allow authorized entry. Electric strike will remain fixed (Fail Secure) in the event of a fire alarm or power outage.

Group 10 (ELECTRICAL - PAIR)

3 pr.	Butts	BB1168 x 4 ½ x 4 ½ x 626	Hager
1 ea.	Storeroom	93K-7-D-14D-S x 626	Best
2 ea.	Flush Bolt	555 x US26D	Rockwood

END OF SECTION 08 7100

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SECTION 08 8000 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Glass products.
2. Glazing tapes.
3. Miscellaneous glazing materials.
4. Decorative Window Film.

B. Related Requirements:

1. Section 08 1213 “Hollow Metal Frames”
2. Section 08 1416 “Flush Wood Doors”
3. Section 08 4126.23 “Interior All-Glass Entrances”
4. Section 08 4113 Aluminum-Framed Entrances and Storefronts
5. Section 08 4413 “Glazed Aluminum Curtain Walls”

1.2 DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters in accordance with ASTM C1036.

C. IBC: International Building Code.

1.3 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances to achieve proper safety margins for glazing retention under each design load case, load case combination, and service condition.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Decorative Window Film

1. Manufacturer's data sheets on each product to be used, including:
   a. Preparation instructions and recommendations.
   b. Storage and handling requirements and recommendations.
   c. Installation methods.
2. Verification Samples: For each finish product specified, two samples, minimum 12"x 12" representing actual product, color, and patterns.

C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

1.5 QUALITY ASSURANCE

A. Installer Qualifications:

1. Window Glazing Contractor: A qualified glazing contractor for this Project who is certified under the North American Contractor Certification Program (NACC) for Architectural Glass & Metal (AG&M) contractors.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials in accordance with manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F.

1.8 WARRANTY

A. Manufacturer's Special Warranty for Heat-Soaked Tempered Glass: Manufacturer agrees to replace heat-soaked tempered glass units that spontaneously break due to nickel sulfide (NiS) inclusions at a rate exceeding 0.3 percent (3/1000) within specified warranty period. Coverage for any other cause is excluded.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Glazing Accessories: For each product and installation method, obtain from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

2.3 GLASS PRODUCTS, GENERAL

A. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC . Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

B. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than thickness indicated.

1. Minimum Glass Thickness for Interior Lites: 6 mm (Aluminum Storefront and door lites).
2. Minimum Glass Thickness for Interior Lites: 10 mm (Butt Glazed). .
3. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.

C. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.4 GLASS PRODUCTS

A. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

2.5 GLAZING SEALANTS

A. General:

1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range of industry colors.

B. Neutral-Curing Silicone Glazing Sealant, Class 25: Complying with ASTM C920, Type S, Grade NS, Use NT.

1. Basis-of-Design Product: Subject to compliance with requirements, provide C.R. Laurence Company; Water Clear Silicon Sealant or a comparable product by one of the following:
   a. Pecora Corporation.
   b. The Dow Chemical Company.
   c. Tremco Incorporated.
2. Applications: Butt jointed, Interior glazing.

2.6 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.7 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, recommended in writing by manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

2.8 SINGLE PATTERN FILM

A. Basis of Design:

1. **GF-1:** 60” tall locations: Solyx SXJ-0561 Fine Dots Gradient. 2 mil polyester with clear pressure sensitive adhesive.
2. **GF-2:** 90” tall locations: Solyx SXJ-0547 Feather Gradient. 2 mil polyester with clear pressure sensitive adhesive.

2.9 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.

    a. Temperature Change: 120 deg F , ambient; 180 deg F , material surfaces .

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

C. Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep systems.
3. Minimum required face and edge clearances.
4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

F. Provide spacers for glass lites where length plus width is larger than 50 inches.

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
2. Provide 1/8-inch- minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and in accordance with requirements in referenced glazing publications.

H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

3.4 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until right before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant.

G. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 CLEANING AND PROTECTION

A. Immediately after installation, remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.

1. If, despite such protection, contaminating substances do contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.

C. Remove and replace glass that is damaged during construction period.

D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.6 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 DECORATIVE WINDOW FILM

A. Install in accordance with manufacturer's instructions.

B. Cut film edges neatly and square at a uniform distance of 1/8 inch (3 mm) to 1/16 inch (1.5 mm) of window sealant. Use new blade tips after 3 to 4 cuts.

C. Spray the slip solution, composed of one capful of baby shampoo or dishwashing liquid to 1 gallon of water, on window glass and adhesive to facilitate proper positioning of film.

D. Apply film to glass and lightly spray film with slip solution.

E. Squeegee from top to bottom of window. Spray slip solution to film and squeegee a second time.

F. Bump film edge with lint-free towel wrapped around edge of a 5-way tool.

G. Upon completion of film application, allow 30 days for moisture from film installation to dry thoroughly, and to allow film to dry flat with no moisture dimples when viewed under normal viewing conditions.

3.8 MONOLITHIC GLASS SCHEDULE

A. Clear Glass Type 1 (GL-1): Fully tempered float glass for single lite, non-IGU, interior storefront and door lite applications.

1. Minimum Thickness: 6mm single lite.
2. Safety glazing required.

B. Clear Glass Type 2 (GL-2): Fully tempered clear float glass for U-Channel applications.

1. Minimum Thickness: 10 mm single lite, clear.
2. Safety glazing required.
3. Exposed Edges: Machine ground, micro-bevel edges (as shown in drawings), and flat polished.
4. Butt Edges: Machine ground, micro-bevel edges (as shown in drawings).
5. Corner Edges: Lap-joint corners, Machine ground, micro-bevel edges (as shown in drawings), with exposed edges polished.

C. (GL-3: NOT USED)

3.9 INSULATING GLASS SCHEDULE

A. Glass Type (GL-4): Low-E-coated, tinted insulating glass – Fully Tempered.

1. Basis-of-Design Product: PPG Solarban 90 on Solargray.
2. Overall Unit Thickness: 1 inch.
3. Minimum Thickness of Each Glass Lite: 6 mm.
4. Outdoor Lite: Tinted fully tempered float glass.
5. Tint Color: Gray.
6. Interspace Content: Air.
7. Indoor Lite: Clear fully tempered float glass.
8. Low-E Coating: sputtered on second surface.
9. Winter Nighttime U-Factor: .29 maximum.
10. Summer Daytime U-Factor: .27 maximum.
11. Shading Coefficient: .19 maximum
12. Visible Light Transmittance: 26 percent minimum.
13. Solar Heat Gain Coefficient: 0.17 maximum.
14. Safety glazing required.

END OF SECTION 08 8000

SECTION 09 2116.23 - GYPSUM BOARD SHAFT WALL ASSEMBLIES

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. Gypsum board shaft wall assemblies.

1.3 ACTION SUBMITTALS

A. Product Data: For each component of gypsum board shaft wall assembly.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and support them on risers on a flat platform to prevent sagging.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Comply with gypsum-shaftliner-board manufacturer's written instructions.

B. Do not install finish panels until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, moisture damaged, or mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.

B. STC-Rated Assemblies: Provide materials and construction identical to those of assemblies tested according to ASTM E90 and classified according to ASTM E413 by a testing and inspecting agency.

2.2 GYPSUM BOARD SHAFT WALL ASSEMBLIES

A. Fire-Resistance Rating: As indicated on Drawings .

B. Gypsum Shaftliner Board:

1. Type X: ASTM C1396/C1396M; manufacturer's proprietary fire-resistive liner panels with paper faces, 1 inch thick, with double beveled long edges.

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) CertainTeed; SAINT-GOBAIN.
        2) Continental Building Products Inc.
        3) Georgia-Pacific Gypsum LLC.
        4) PABCO Gypsum.
        5) USG Corporation.

2. Moisture- and Mold-Resistant Type X: ASTM C1396/C1396M; manufacturer's proprietary fire-resistive liner panels with ASTM D3273 mold-resistance score of 10 as rated according to ASTM D3274, 1 inch thick, and with double beveled long edges.

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) CertainTeed; SAINT-GOBAIN.
        2) Continental Building Products Inc.
        3) Georgia-Pacific Gypsum LLC.
        4) PABCO Gypsum.
        5) USG Corporation.

C. Non-Load-Bearing Steel Framing, General: Complying with ASTM C645 requirements for metal unless otherwise indicated and complying with requirements for fire-resistance-rated assembly indicated.

1. Protective Coating: ASTM A653/A653M, G60, hot-dip galvanized unless otherwise indicated.

D. Studs: Manufacturer's standard profile for repetitive, corner, and end members as follows:

1. Depth: As indicated .
2. Minimum Base-Metal Thickness: 0.030 inch.

E. Runner Tracks: Manufacturer's standard J-profile track with manufacturer's standard long-leg length, but at least 2 inches long and matching studs in depth.

1. Minimum Base-Metal Thickness: Matching steel studs .

F. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. ClarkDietrich.
    b. Fire Trak Corp.
    c. SCAFCO Steel Stud Company; Stone Group of Companies.
    d. Steel Network, Inc. (The).

G. Finish Panels: Gypsum board as specified in Section 09 2900 "Gypsum Board." .

2.3 AUXILIARY MATERIALS

A. Provide auxiliary materials that comply with shaft wall manufacturer's written instructions.

B. Trim Accessories: Cornerbead, edge trim, and control joints of material and shapes as specified in Section 09 2900 "Gypsum Board" that comply with gypsum board shaft wall assembly manufacturer's written instructions for application indicated.

C. Steel Drill Screws: ASTM C1002 unless otherwise indicated.

D. Track Fasteners: Power-driven fasteners of size and material required to withstand loading conditions imposed on shaft wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.

E. Acoustical Sealant: Section 07 9219 "Acoustical Joint Sealants."

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.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install gypsum board shaft wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated and manufacturer's written installation instructions.

B. Do not bridge building expansion joints with shaft wall assemblies; frame both sides of expansion joints with furring and other support.

C. Install supplementary framing in gypsum board shaft wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, wall-mounted door stops, and similar items that cannot be supported directly by shaft wall assembly framing.

    1. Reinforcing: Provide where items attach directly to shaft wall assembly as indicated on Drawings; accurately position and secure behind at least one layer of face panel.

D. Penetrations: At penetrations in shaft wall, maintain fire-resistance rating of shaft wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons and floor indicators, and similar items.

E. Isolate perimeter of gypsum panels from building structure to prevent cracking of panels while maintaining continuity of fire-rated construction.

F. Firestop Tracks: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.3 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, or mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 09 2116.23

SECTION 09 2216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Framing systems.
2. Suspension systems.
3. Grid suspension systems.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Framing systems.
2. Suspension systems.
3. Grid suspension systems.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Notify manufacturer of damaged materials received prior to installation.

B. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

C. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling as required by AISI S202, "Code of Standard Practice for Cold-Formed Steel Structural Framing."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, in accordance with ASTM E119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, in accordance with ASTM E90 and classified in accordance with ASTM E413 by an independent testing agency.

C. Design framing systems in accordance with AISI S220, "North American Specification for the Design of Cold-Formed Steel Framing - Nonstructural Members," unless otherwise indicated.

2.2 FRAMING SYSTEMS

A. Framing Members, General: Comply with ASTM C645 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C645 requirements for metal unless otherwise indicated
2. Protective Coating: Comply with ; ASTM A653/A653M, G40; or coating with equivalent corrosion resistance. Galvannealed products are unacceptable.

    a. Coating demonstrates equivalent corrosion resistance with an evaluation report acceptable to authorities having jurisdiction.

B. Slip-Type Head Joints: Where indicated, provide one of the following:

1. Clip System: Clips designed for use in head-of-wall deflection conditions that provide a positive attachment of studs to tracks while allowing 1-1/2-inch minimum vertical movement.
2. Single Long-Leg Track System: Top track with 2-inch- deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top track and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.
3. Double-Track System: Top outer tracks, inside track with 2-inch- deep flanges in thickness not less than indicated for studs and fastened to studs, and outer track sized to friction-fit over inner track.
4. Deflection Track: Steel sheet top track manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.

C. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Minimum Base-Steel Thickness: As indicated on Drawings, 0.0329 inch. .

D. Cold-Rolled Channel Bridging: Steel, 0.0538-inch minimum base-steel thickness, with minimum 1/2-inch- wide flanges.

1. Depth: 1-1/2 inches .
2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch- thick, galvanized steel.

E. Hat-Shaped, Rigid Furring Channels:

1. Minimum Base-Steel Thickness: As indicated on Drawings, 0.0329 inch
2. Depth: 7/8 inch .

2.3 SUSPENSION SYSTEMS

A. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch- diameter wire, or double strand of 0.048-inch- diameter wire.

B. Hanger Attachments to Concrete:

1. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 AC193 AC58 or AC308 as appropriate for the substrate.

    a. Uses: Securing hangers to structure.
    b. Type: Torque-controlled, expansion anchor torque-controlled, adhesive anchor or adhesive anchor.
    c. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.
    d. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless steel bolts, ASTM F593, and nuts, ASTM F594.

2. Power-Actuated Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

C. Wire Hangers: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.

D. Flat Hangers: Steel sheet, 1 by 3/16 inch by length indicated .

E. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-steel thickness of 0.0538 inch and minimum 1/2-inch- wide flanges.

1. Depth: 1-1/2 inches.

F. Furring Channels (Furring Members):

1. Cold-Rolled Channels: 0.0538-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges, 3/4 inch deep.
2. Steel Studs and Tracks:

a. Minimum Base-Steel Thickness: 0.0329 inch.
b. Depth: As indicated on Drawings .

3. Hat-Shaped, Rigid Furring Channels: 7/8 inch deep.

a. Minimum Base-Steel Thickness: As indicated on Drawings 0.0329 inch .

2.4 GRID SUSPENSION SYSTEMS

A. Grid Suspension Systems for Gypsum Board Ceilings: ASTM C645, direct-hung system composed of main beams and cross-furring members that interlock.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION, GENERAL

A. Installation Standard: ASTM C754.

1. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C841 that apply to framing installation.

B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.

C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

D. Install bracing at terminations in assemblies.

E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLATION OF FRAMING SYSTEMS

A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Single-Layer Application: 16 inches o.c. unless otherwise indicated.
2. Multilayer Application: 16 inches o.c. unless otherwise indicated.
3. Tile Backing Panels: 16 inches o.c. unless otherwise indicated.

B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

C. Install studs so flanges within framing system point in same direction.

D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.

    a. Install two studs at each jamb unless otherwise indicated.
    b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
    c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

3. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.

    a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

4. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.

E. Direct Furring:

1. Screw to wood framing.
2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.5 INSTALLATION OF SUSPENSION SYSTEMS

A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Hangers: 48 inches o.c.
2. Carrying Channels (Main Runners): 48 inches o.c.
3. Furring Channels (Furring Members): 16 inches o.c.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.

    a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.

    a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.

3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
5. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

3.6 INSTALLATION OF GRID SUSPENSION SYSTEMS

A. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

END OF SECTION 09 2216

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SECTION 09 2900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.
2. Tile backing panels.

B. Related Requirements:

1. Section 09 8100 “Acoustic Insulation & Sealant” for acoustical insulation joint sealants installed in gypsum board assemblies.
2. Section 09 2116.23 "Gypsum Board Shaft Wall Assemblies" for metal shaft-wall framing, gypsum shaft liners, and other components of shaft-wall assemblies.
3. Section 09 2216 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.
4. Section 09 3013 "Ceramic Tiling" for cementitious backer units installed as substrates for ceramic tile.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Gypsum wallboard.
2. Gypsum board, Type X.
3. Gypsum ceiling board.
4. Mold-resistant gypsum board.
5. Water-resistant gypsum backing board.
6. Interior trim.
7. Joint treatment materials.
8. Sound-attenuation blankets.

1.3 DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.4 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.

B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated in accordance with ASTM E119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated in accordance with ASTM E90 and classified in accordance with ASTM E413 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

A. Gypsum Board, Type X: ASTM C1396/C1396M.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. American Gypsum.
    b. CertainTeed; SAINT-GOBAIN.
    c. Georgia-Pacific Gypsum LLC.
    d. PABCO Gypsum.
    e. USG Corporation.

2. Thickness: 5/8 inch.
3. Long Edges: Tapered and featured (rounded or beveled) for prefilling.

B. Mold-Resistant Gypsum Board: ASTM C1396/C1396M. With moisture- and mold-resistant core and paper surfaces.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. American Gypsum.
    b. Georgia-Pacific Gypsum LLC.
    c. Gold Bond Building Products, LLC provided by National Gypsum Company.
    d. USG Corporation.

2. Core: 5/8 inch, Type X.
3. Long Edges: Tapered.
4. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.

2.4 TILE BACKING PANELS

A. Glass-Mat, Water-Resistant Backing Board: ASTM C1178/C1178M, with manufacturer's standard edges.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. CertainTeed; SAINT-GOBAIN.
    b. Georgia-Pacific Gypsum LLC.
    c. Gold Bond Building Products, LLC provided by National Gypsum Company.
    d. USG Corporation.

2. Core: 5/8 inch, Type X.
3. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.

2.5 TRIM ACCESSORIES

A. Interior Trim: ASTM C1047.

1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet.
2. Shapes:

    a. Cornerbead.
    b. L-Bead: L-shaped; exposed long flange receives joint compound.
    c. Expansion (control) joint.

B. Interior Hanging Track

1. Material: Aluminum extrusions: 6063 per ASTM B 221
2. Shapes:

    a. Wall to Ceiling corner: Gordon Inc., Final Forms 1, Series 907-HT-12 Track.
    b. Mid-wall: Gordon Inc., Final Forms 1, Series 926-HT-12 Track.

3. Hangers: Gordon Inc., Final Forms 1, Series 926 Hanger.

    a. Provide one (1) hanger for every 36” of track provided.

4. Fabrication
    a. Provide extruded aluminum trims of design, profile and function as indicated. Select trims to suit reveal width and depth in 10’ - 0” lengths to reduce the number of end joints.
    b. Provide pre-welded and soldered, mitered intersections where reveal changes direction or abuts other trim.
5. Finishes:
    a. All material shall be factory clear anodized 200-R1 (Interior Application).

2.6 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C475/C475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.
2. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.

    a. Use setting-type compound for installing paper-faced metal trim accessories.

3. Fill Coat: For second coat, use drying-type, all-purpose compound.
4. Finish Coat: For third coat, use setting-type, sandable topping compound.

D. Joint Compound for Tile Backing Panels:

1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.

2.7 AUXILIARY MATERIALS

A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

B. Steel Drill Screws: ASTM C1002 unless otherwise indicated.

1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch thick.

C. Sound-Attenuation Blankets: ASTM C665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

D. Acoustical Sealant: As specified in Section 09 8100 “Acoustic Insulation & Sealant.”

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION AND FINISHING OF PANELS, GENERAL

A. Comply with ASTM C840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
2. Fit gypsum panels around ducts, pipes, and conduits.
3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 INSTALLATION OF INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:

1. Type X: Vertical surfaces unless otherwise indicated.
2. Mold-Resistant Type: As indicated on Drawings.

B. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
2. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.

a. Stagger abutting end joints not less than one framing member in alternate courses of panels.

b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.

3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.

3.4 INSTALLATION OF TILE BACKING PANELS

A. Water-Resistant Backing Board: Install where indicated with 1/4-inch gap where panels abut other construction or penetrations.

B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.5 INSTALLATION OF TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints in accordance with ASTM C840 and in specific locations approved by Architect for visual effect.

C. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners unless otherwise indicated.
2. L-Bead: Use where indicated on Drawings.
3. Hanging Track: Use where indicated on Drawings.

3.6 FINISHING OF GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and in accordance with ASTM C840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 2: Panels that are substrate for tile.
3. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.

    a. Primer and its application to surfaces are specified in Section 09 9123 "Interior Painting."

3.7 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. Remove and replace panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 09 2900

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SECTION 09 3013 - CERAMIC TILING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Porcelain tile.
2. Cast metal tile.
3. Surface Preparation Materials.
4. Waterproof membranes.
5. Crack isolation membranes.
6. Setting material.
7. Grout materials.

B. Related Requirements:

1. Section 07 9200 "Joint Sealants" for sealing of movement joints in tile surfaces.
2. Section 09 2900 "Gypsum Board" for tile backing panels.

1.2 DEFINITIONS

A. General: Definitions in ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.

B. Face Size: Actual tile size, excluding spacer lugs.

C. Large Format Tile: Tile with at least one edge 15 inches or longer.

D. Module Size: Actual tile size plus joint width indicated.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site, Contractor to lead meeting.

1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.
2. Convene one week prior to commencing work of this section.
3. Require attendance of installation material manufacturer, tile supplier, tile installer and installers of related work. Review installation procedures and coordination required with related work.
4. Meeting agenda includes but is not limited to:
5. Tile and installation material compatibility.
    a. Grouting procedure.
    b. Maintenance and cleaning products and methods.
    c. Surface preparation.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Porcelain tile.
2. Cast metal tile.
3. Waterproof membranes.
4. Crack isolation membranes.
5. Setting material.
6. Grout materials.

B. Samples for Verification:

1. Full-size units of each type and composition of tile and for each color and finish required.
2. Metal flooring transitions 6-inch lengths.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Material: Furnish extra materials, from the same production run, to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Tile: Furnish quantity of one box of full-size units for each type, composition, color, pattern, and size.
2. Grout: Furnish quantity of grout one box per tile type for each type, composition, and color indicated.

1.7 QUALITY ASSURANCE

A. To ensure single-source warranty requirements and compatibility of products: Please provide cleaners, sealing and maintenance products as well as grout, setting materials, underlayments, additives, accessories and factory-prepared dry-set mortars from the same manufacturer.
B. Installer Qualifications:

a. Engage an experienced installer who has completed tile installations similar in material, design, and extent to that indicated for this project and with a record of successful in-service performance. Installer to have a minimum of 5 years' experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

D. Store liquid materials in unopened containers and protected from freezing.

1.9 FIELD CONDITIONS

A. Comply with requirements of referenced standards and recommendations of material manufacturers for environmental conditions before, during, and after installation.

B. Maintain environmental conditions and protect work during and after installation to comply with referenced standards and manufacturer's printed recommendations.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.

1. Provide tile complying with Standard Grade requirements unless otherwise indicated.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

C. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

D. Varying tile thicknesses: Where tile thicknesses vary, Tile to be installed so that face of all tiles are flush and even between tiles. Front of tile (WT-1 to WT-2) to be flush.

2.2 PORCELAIN TILE: (T-1, T-2)

A. Porcelain Tile Type:

1. Basis-of-Design Product: Subject to compliance with requirements, provide products As Listed in the “Interior Finish Legend” in Drawings or comparable product by one of the following:

    a. Marazzi USA
    b. Atlas Concorde
    c. Daltile

2. Certification: Tile certified by the Porcelain Tile Certification Agency.
3. Face Size: As Listed in the “Interior Finish Legend” in Drawings.
4. Face Size Variation: Rectified.
5. Thickness: 3/8 inch.
6. Product Use Classification: Interior, Wet (IW).
7. Tile Color, Glaze, and Pattern: As Listed in the “Interior Finish Legend” in Drawings.

8. Grout Color: As Listed in the “Interior Finish Legend” in Drawings.
9. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:

    a. Cove at Floor: As Listed in the “Interior Finish Legend” in Drawings.
    b. External Corners: As Listed in the “Interior Finish Legend” in Drawings.
    c. Internal Corners: As Listed in the “Interior Finish Legend” in Drawings.

2.3 CAST METAL TILE: (WT-1, WT-2)

A. Composite material of metal, resin and ceramic.

1. Basis-of-Design Product: Subject to compliance with requirements, provide products As Listed in the “Interior Finish Legend” in Drawings or comparable product by one of the following:

    a. Daltile
    b. Marazzi USA
    c. Atlas Concorde

2. Certification: Porcelain tile certified by the Porcelain Tile Certification Agency.
3. Module Size: As Listed on the “Interior Finish Key” in the Drawings.
4. Thickness: 5/16 inch.
5. Face: Pattern of design indicated, with cushion edges.
6. Tile Color and Pattern: As Listed on the “Interior Finish Key” in the Drawings.
7. Grout Color: As Listed on the “Interior Finish Key” in the Drawings.
8. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:

    a. Cove at Floor: As Listed in the “Interior Finish Legend” in Drawings.
    b. External Corners: As Listed in the “Interior Finish Legend” in Drawings.
    c. Internal Corners: As Listed in the “Interior Finish Legend” in Drawings.

2.4 SURFACE PREPARATION MATERIALS

A. Trowelable Floor/Wall Patch and Render Mortar: Quick-setting, polymer-modified, fiber-reinforced, cementitious rendering, patching, ramping and leveling mortar, can be applied from 1/8 inch to 1-1/4 inches (3 mm to 3.2 cm).
    a. Product: MAPEI, Planitop 330 Fast.

2.5 WATERPROOF AND CRACK ISOLATION MEMBRANES: FLOORS

A. General: Manufacturer's standard product that complies with ANSI A118.10 and ANSI A118.12 and is recommended by manufacturer for application indicated. Include reinforcement and accessories recommended by manufacturer.

B. Fluid-Applied Membrane: Liquid-latex rubber or elastomeric polymer.

1. Products: Subject to compliance with requirements, provide one of the following:

a. TEC, H.B. Fuller Construction Products Inc.: HydraFlex – Waterproofing Crack Isolation Membrane.
b. MAPEI Corporation; Mapelastic AquaDefense.

2.6 SETTING MATERIALS

A. Improved Modified Dry-Set Cement Mortar, Non-Sag, for Large and Heavy Tile: ANSI A118.4HTE, ANSI A118.11, ANSI A11815HTE, and ISO 13007 C2TES1P1. Provide product that is approved by manufacturer for application thickness of ½ inch.

1. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
2. Provide prepackaged, dry-mortar mix combined with acrylic resin or styrene-butadiene-rubber liquid-latex additive at Project site.

a. Products:

1) MAPEI, Ultraflex LFT.
2) TEC, Ultimate 6 Plus Mortar

2.7 GROUT MATERIALS

A. High-Performance Tile Grout: ANSI A118.3, ANSI A118.6 and ANSI 118.7.

B. Polymer Ready-to-Use Specialty Grout: Grout joints from 1/8 inch to 3/16 inch.

1. Product: MAPEI, MAPEI Flexcolor CQ
2. TEC, InColor Advanced Grout
3. Laticrete : Permacolor DS-250-0223

2.8 FLEXIBLE SEALANT

1. 100% Silicone Sealant: Heavy-traffic expansion and movement, joints, horizontal and vertical complying with ASTM standards: ASTM: Meets C920, Type S, Grade NS, Class 25, Use T1, T2, NT, I, M, G, A and O and conforms to C794 adhesion properties, (#23 Clear color meets ASTM C920, Type S, Grade NS, Class 50, Use NT).

a. Product: MAPEI, Mapesil T.

2.9 **GROUT RELEASE**: For WT-1 and WT-2

1. Grout Release: High-performance sacrificial coating that protects the tile surface from grout stains, improves cleanability and reduces the risk of grout have or film residue, interior and exterior applications on all-natural stone (such as marble, limestone, sandstone, slate, granite, travertine, etc), porcelain/ceramic tiles, masonry and quarry tiles.

a. Product: MAPEI, UltraCare Grout Release.

2.10 PENETRATING GROUT SEALERS

1. Water-Based Penetrating Sealer: Provides protection against staining for use with sanded and non-sanded cementitious grout joints and can also be used as a pre-grouting sealer.

    a. Product: MAPEI, UltraCare Grout Sealer.

2.11 MISCELLANEOUS MATERIALS

A. Metal Edge Strips: (TR-2, TR-3) Angle or L-shaped, height to match tile and setting-bed thickness, metal trim designed specifically for flooring applications; stainless steel, ASTM A276/A276M or ASTM A666, 300 Series exposed-edge material.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Schluter: As Listed in the “Interior Finish Legend” in the Drawings.
        1) Schienne (TR-2)
        2) Dilex (outside corner, inside corner, connector, inside corner system) (TR-3)

B. STONE, TILE AND GROUT MAINTENANCE, CLEANERS AND GROUT HAZE REMOVERS

1. Neutral-pH Cleaner: Highly concentrated, zero-VOC, for ceramic, porcelain and natural-stone surfaces. Helps prevent soap scum buildup and hard water deposits.

    a. Product: MAPEI, UltraCare Concentrated Tile & Grout Cleaner.

2. Epoxy Grout Haze Remover: Professional-strength, water-based formulation that helps remove epoxy grout haze from tile and natural-stone surfaces. Natural citrus scent, nonflammable and easy to use.

    a. Product: MAPEI, UltraCare Epoxy Grout Haze Remover.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
2. Verify that concrete substrates for tile floors installed with bonded mortar bed or thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.

    a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.

b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.

3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Do not proceed with tilework until surfaces and conditions comply with requirements indicated in reference tile installation standard and manufacturer's printed instructions.
2. When underlayment, patching, leveling and rendering materials are needed, they must be from the supplier of the setting materials. For improved warranty and single-source responsibility.
3. When using large-format tiles with at least one edge 15 inches (38 cm) in length, the maximum allowable variation in the substrate is 1/8 inch in 10 feet (3 mm in 3.05 m) from the required plane, and 1/16-inch variation in 24 inches (1.6 mm in 61 cm) when measured from the high points in the surface.
4. Face of tiles are to be flush: when tiles are differing thicknesses, mortar is to be built up so that face of tiles are flush on all edges.

3.2 PREPARATION

A. Remove coatings, including curing compounds or other coatings, that are incompatible with tile-setting materials.

B. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

C. Where indicated, prepare substrates to receive waterproof membrane by applying a reinforced mortar bed that complies with ANSI A108.1 and is sloped 1/4 inch per foot toward drains.

D. Substrate Flatness:

1. For tile shorter than 15 inches, confirm that structure or substrate is limited to variation of 1/4 inch in 10 ft. from the required plane, and no more than 1/16 inch in 12 inches when measured from tile surface high points.
2. For large format tile, tile with at least one edge 15 inches or longer, confirm that structure or substrate is limited to 1/8 inch in 10 ft. from the required plane, and no more than 1/16 inch in 24 inches when measured from tile surface high points.

E. Field-Applied Temporary Protective Coating: If indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.3 INSTALLATION OF CERAMIC TILE SYSTEM

A. Install tile backing panels and treat joints in accordance with ANSI A108.11 and manufacturer's written instructions for type of application indicated.

B. Install waterproof membrane to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.

1. Allow waterproof membrane to cure and verify by testing that it is watertight before installing tile or setting materials over it.

C. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.

1. Allow crack isolation membrane to cure before installing tile or setting materials over it.

D. Mix mortars and grouts to comply with "Referenced Standards" Article in the Evaluations and mortar and grout manufacturers' written instructions.

1. Add materials, water, and additives in accurate proportions.
2. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

E. Install tile in accordance with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of ANSI A108 series that are referenced in TCNA installation methods and specified in tile installation schedules, and apply to types of setting and grouting materials used.

1. For the following installations, follow procedures in ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:

    a. Exterior tile floors and walls.
    b. Tile floors in wet areas.
    c. Tile floors consisting of tiles 8 by 8 inches or larger.

2. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
3. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
4. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
5. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.
6. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

    a. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets, so joints between sheets are not apparent in finished Work.
    b. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
    c. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.

7. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

F. Movement Joints: Provide movement joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated on Drawings. Form joints during installation of setting materials, mortar beds, and tile. Keep joints free of dirt, debris, and setting materials prior to filling with sealants. Do not saw-cut joints after installing tiles.

1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.

G. Metal Flooring Transitions: Install at locations listed in the “Interior Finish Key” in the Drawings.

H. Metal Wall Trim: Install at locations indicated on Drawings.

I. Grout Sealer: Apply grout sealer to cementitious grout joints in tile floors in accordance with manufacturer's written instructions. As soon as sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.4 ADJUSTING AND CLEANING

A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.

B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove grout residue from tile as soon as possible.
2. Clean grout smears and haze from tile in accordance with tile and grout manufacturer's written instructions. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3.5 PROTECTION

A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.

B. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.6 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

A. Interior Floor Installations, Concrete Subfloor:

1. Ceramic Tile Installation: Tile to be installed On Ground Concrete: TCNA F122-20 Full; thinset mortar on waterproof and crack isolation membrane.

a. Ceramic Tile Type: T-1, T-2.

b. Floor prep: Concrete to have maximum allowable variation of 1/8” in 10’ from the required plane, with no more than 1/16” variation in 24”. If it does not meet requirements, additional floor prep in required. Such as Trowelable Floor/Wall Patch and Render Mortar or equal: Quick-setting, polymer-modified, fiber-reinforced, cementitious rendering, patching, ramping and leveling mortar: MAPEI, Planitop 330 Fast.

b. Waterproofing Crack Isolation Membrane: TEC Hydraflex or MAPEI, Mapelastic AquaDefense. Entire floor.
c. Thinset Mortar: Improved modified dry-set mortar: MAPEI, Ultraflex LFT.
d. Grout: High-performance grout: MEPEI, Flexcolor CQ.

2. Ceramic Tile Installation: Tile to be installed Above Ground Concrete: TCNA F122-20A Full; thinset mortar on waterproof and crack isolation membrane.

a. Ceramic Tile Type: T-1, T-2.
c. Floor prep: Concrete to have maximum allowable variation of 1/8” in 10’ from the required plane, with no more than 1/16” variation in 24”. If it does not meet requirements, additional floor prep in required. Such as Trowelable Floor/Wall Patch and Render Mortar: Quick-setting, polymer-modified, fiber-reinforced, cementitious rendering, patching, ramping and leveling mortar: MAPEI, Planitop 330 Fast or Equal.

b. Waterproofing Crack Isolation Membrane: TEC Hydraflex or MAPEI, Mapelastic AquaDefense. Entire floor.
c. Thinset Mortar: Improved modified dry-set mortar: MAPEI, Ultraflex LFT.
d. Grout: High-performance grout: MEPEI, Flexcolor CQ.

B. Interior Wall Installations, Metal Studs or Furring:

1. Ceramic Tile Installation: TCNA W244F; thinset mortar on cementitious backer units or fiber-cement backer board on waterproof and crack isolation membrane.

a. Ceramic Tile Type: WT-1, WT-2
b. Waterproofing Crack Isolation Membrane: TEC Hydraflex or MAPEI, Mapelastic AquaDefense. To be applied floor to 1’ above plumbing penetrations in wall.
c. Thinset Mortar: Improved modified dry-set mortar: MAPEI, Ultraflex LFT.
d. Grout: High-performance grout: MEPEI, Flexcolor CQ.

END OF SECTION 09 3013

SECTION 09 5113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Acoustical panels.
2. Metal suspension system.
3. Metal edge moldings and trim.

1.2 RELATED REQUIREMENTS:

A. Section includes acoustical panels and exposed suspension systems for interior ceilings.

B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Acoustical panels.
2. Metal suspension system.
3. Metal edge moldings and trim.

B. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:

1. Acoustical Panels: Set of 6-inch- square Samples of each type, color, pattern, and texture.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Acoustical Ceiling Units Full-size units equal to 1 box of ceiling tile.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage

from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: Class -A in accordance with ASTM E1264.
2. Smoke-Developed Index: 50 or less.

2.2 ACOUSTICAL PANELS: (ACT-1, ACT-2)

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Armstrong Ceiling & Wall Solutions.
2. CertainTeed Corporation.
3. Rockfon (Rockwool International).
4. USG Corporation.

B. Acoustical Panel Standard: Provide manufacturer's standard panels in accordance with ASTM E1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.

C. Classification: Provide fire-resistance-rated panels as follows:

1. Fire Rating: Class-A flame spread rating, ASTM standard E1264-08.
2. Type and Form, Type IV: Mineral base with painted finish; Form 2, water felted.
3. Pattern: E (Lightly Textured).

D. Color: White.

E. Ceiling Attenuation Class (CAC): Not less than 35.

F. Noise Reduction Coefficient (NRC): Not less than 0.75.

G. Edge/Joint Detail: Beveled, kerfed, and rabbeted long edges and square, butt-on short edges.

H. Thickness: As Listed in the 'Interior Finish Key' in Drawings.

I. Modular Size: As Listed in the 'Interior Finish Key' in Drawings.

2.3 METAL SUSPENSION SYSTEM

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Armstrong Ceiling & Wall Solutions.
2. CertainTeed Corporation.
3. Rockfon (Rockwool International).
4. USG Corporation.

B. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories in accordance with ASTM C635/C635M and designated by type, structural classification, and finish indicated.

C. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 coating designation; with prefinished 15/16-inch- wide metal caps on flanges.

1. Fire Rating: Class-A flame spread rating, ASTM standard E1264-08.
2. Structural Classification: Intermediate-duty system.
3. End Condition of Cross Runners: Override (stepped) or butt-edge type.
4. Face Design: Flat, flush.
5. Cap Material: Cold-rolled steel or aluminum.
6. Cap Finish: Painted white.

D. Wide-Face, Aluminum-Capped, Double-Web, Hot-Dip Galvanized, G60 (Z180), Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; hot-dip galvanized, G60 coating designation; with prefinished, 15/16-inch- wide aluminum caps on flanges.

1. Fire Rating: Class-A flame spread rating, ASTM standard E1264-08.
2. Structural Classification: Intermediate-duty system.
3. Face Design: Flat, flush.
4. Cap Finish: Painted white.

2.4 ACCESSORIES

A. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing in accordance with ASTM E488/E488M or ASTM E1512 as applicable, conducted by a qualified testing and inspecting agency.

a. Type: Cast-in-place anchors.
b. Corrosion Protection, Carbon Steel: Components zinc plated in accordance with ASTM B633, Class SC 1 (mild) service condition.

c. Corrosion Protection, Stainless Steel: Components complying with ASTM F593 and ASTM F594, Group 1 Alloy 304 or 316.
d. Corrosion Protection, Nickel-Copper Alloy: Components fabricated from nickel-copper-alloy rods complying with ASTM B164 for UNS No. N04400 alloy.

B. Wire Hangers, Braces, and Ties: Provide wires as follows:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.
2. Stainless Steel Wire: ASTM A580/A580M, Type 304, nonmagnetic.
3. Nickel-Copper-Alloy Wire: ASTM B164, nickel-copper-alloy UNS No. N04400.
4. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C635/C635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.106-inch- diameter wire.

C. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.

D. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.

E. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed with 0.04-inch- thick, galvanized-steel sheet complying with ASTM A 653/A 653M, G90 coating designation; with bolted connections and 5/16-inch- diameter bolts.

1. Hold-Down Clips: Manufacturer's standard hold-down.

2.5 METAL EDGE MOLDINGS AND TRIM

A. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.

1. Edge moldings to fit acoustical panel edge details and suspension systems indicated and match width and configuration of exposed runners unless otherwise indicated.
2. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
3. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated, and comply with layout shown on reflected ceiling plans.

B. Layout openings for penetrations centered on the penetrating items.

3.3 INSTALLATION OF ACOUSTICAL PANEL CEILINGS

A. Install acoustical panel ceilings in accordance with ASTM C636/C636M and manufacturer's written instructions.

1. Fire-Rated Assembly: Install fire-rated ceiling systems in accordance with tested fire-rated design.

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
8. Do not attach hangers to steel deck tabs.
9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
10. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.

D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends. Miter corners accurately and connect securely.
2. Do not use exposed fasteners, including pop rivets, on moldings and trim.

E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide precise fit.

1. Arrange directionally patterned acoustical panels as follows:

a. As indicated on reflected ceiling plans, coordinate with Electrical plans.

2. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
3. For reveal-edged panels on suspension-system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension-system surfaces and panel faces flush with bottom face of runners.
4. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
5. Install hold-down and clips in areas indicated; space in accordance with panel manufacturer's written instructions unless otherwise indicated.

a. Hold-Down Clips: Space 24 inches o.c. on all cross runners.

6. Protect lighting fixtures and air ducts in accordance with requirements indicated for fire-resistance-rated assembly.

3.4 ERECTION TOLERANCES

A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet, non-cumulative.

B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet, non-cumulative.

3.5 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.

B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09 5113

SECTION 09 6513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Thermoplastic-rubber base.
2. Rubber molding accessories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 12 inches long.

C. Product Schedule: For resilient base and accessory products. Use same designations indicated on Drawings.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Furnish one box of amount installed for each type, color, pattern, and size of resilient product installed.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

1.6 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following periods:

1. 48 hours before installation.
2. During installation.

3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within the range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 THERMOPLASTIC-RUBBER BASE: (RB-1, RB-2)

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Tarkett
2. Roppe
3. Flexco

B. Product Standard: ASTM F 1861, Type TP (rubber, thermoplastic).

1. Group: I (solid, homogeneous).
2. Style and Location:

a. Style B, Cove or with Toe.

C. Thickness: 0.125 inch.

D. Height: 4 inches.

E. Lengths: Coils in manufacturer's standard length.

F. Outside Corners: Job formed.

G. Inside Corners: Job formed.

H. Colors: As listed in ‘Interior Finish Key’ in Drawings.

2.2 RUBBER MOLDING ACCESSORY: (TR-1)

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Tarkett
2. Roppe
3. Flexco

B. Description: Rubber transition strips.

C. Profile and Dimensions: As listed in ‘Interior Finish Key’ in Drawings.

D. Locations: As listed in ‘Interior Finish Key’ in Drawings.

E. Colors and Patterns: As listed in ‘Interior Finish Key’ in Drawings.

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

C. Do not install resilient products until materials are the same temperature as space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.

D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Preformed Corners: Install preformed corners before installing straight pieces.

H. Job-Formed Corners:

1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 24 inches in length.

    a. Form without producing discoloration (whitening) at bends.

2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.

    a. Cope corners to minimize open joints.

3.4 RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.

B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.

B. Perform the following operations immediately after completing resilient-product installation:

1. Remove adhesive and other blemishes from surfaces.
2. Sweep and vacuum horizontal surfaces thoroughly.
3. Damp-mop horizontal surfaces to remove marks and soil.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 09 6513

SECTION 09 6519 - RESILIENT TILE FLOORING

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. Solid vinyl floor tile.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site, Contractor to lead meeting.

1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.
2. Convene one week prior to commencing work of this section.
3. Require attendance of installation material manufacturer, tile supplier, tile installer and installers of related work. Review installation procedures and coordination required with related work.
4. Meeting agenda includes but is not limited to:
5. Tile and installation material compatibility.
    a. Grouting procedure.
    b. Maintenance and cleaning products and methods.
    c. Surface preparation.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Verification: Full-size units of each color and pattern of floor tile required.

C. Provide Seam and Pattern Diagrams and Product Schedule with each product labeled to coordinate with the ‘Interior Finish Key’ in Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish one extra box of materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Floor Tile: Furnish one extra box of materials of each type, color, and pattern of floor tile installed.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.

1. Engage an installer who employs workers for this Project who are trained or certified by floor tile manufacturer for installation techniques required.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store floor tiles on flat surfaces.

1.10 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive floor tile during the following periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within the range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Close spaces to traffic during floor tile installation.

D. Close spaces to traffic for 48 hours after floor tile installation.

E. Install floor tile after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For resilient floor tile, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.2 **SOLID VINYL FLOOR TILE: (LVT-1)**

1. Basis-of-Design Product: Subject to compliance with requirements, provide products As Listed in the “Interior Finish Legend” in Drawings or comparable product by one of the following:

    a. Interface Commercial
    b. Bentley
    c. Mohawk Commercial

B. Tile Standard: ASTM F 1700.

1. Class: Class III, Printed Film Vinyl Tile.
2. Type: A, Smooth Surface.

C. Thickness: 4.5mm

D. Size: 18 by 18 inches.

E. Seamless-Installation Method: Non-Directional.

F. Colors and Patterns: As Listed in the “Interior Finish Key” in the Drawings.

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.

C. Examine luxury vinyl tile for type, color, pattern, and potential defects.

D. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

E. Do not install floor tiles until materials are the same temperature as space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.

F. Immediately before installation, sweep and vacuum clean substrates.

G. Concrete Substrates:

1. Verify that finishes comply with requirements specified in Section 03 3000 "Cast-in-Place Concrete" and that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits.
2. Prepare according to flooring manufacture requirements.

a. PH and Moisture levels to meet each Manufacturer’s requirements.

H. Proceed with installation only after unsatisfactory conditions have been corrected.

I. After installation, sweep and vacuum clean and covered resilient floor tile.

3.3 FLOOR TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

1. Lay tiles in pattern shown on the Interior Finish Plans.

C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

1. Lay tiles: Non-Directional.

D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.

G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.

H. Adhere floor tiles to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

I. Resilient Terrazzo Accessories: Install according to manufacturer's written instructions.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.

B. Perform the following operations immediately after completing floor tile installation:

1. Remove adhesive and other blemishes from surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover floor tile until Substantial Completion.

END OF SECTION 09 6519

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SECTION 09 6813 - TILE CARPETING

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. Modular carpet tile.

B. Related Requirements:

1. Section 02 4119 "Selective Demolition" for removing existing floor coverings.
2. Section 09 6513 "Resilient Base and Accessories"
3. Section 09 6519 "Resilient Tile Flooring" for resilient wall base and accessories installed with carpet tile.
4. Section 09 6816 "Sheet Carpeting" for carpet roll goods.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site, Contractor to lead meeting.

1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.
2. Convene one week prior to commencing work of this section.
3. Require attendance of installation material manufacturer, tile supplier, tile installer and installers of related work. Review installation procedures and coordination required with related work.
4. Meeting agenda includes but is not limited to:
5. Tile and installation material compatibility.
    a. Grouting procedure.
    b. Maintenance and cleaning products and methods.
    c. Surface preparation.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
2. Include manufacturer's written installation recommendations for each type of substrate.

B. Samples for Verification: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Carpet Tile: Full-size Sample.
2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- long Samples.

C. Provide Seam and Pattern Diagrams and Product Schedule with each product labeled to coordinate with the 'Interior Finish Key' in Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:

1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Carpet Tile: Furnish one box of each carpet type and colorway installed.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Comply with the Carpet and Rug Institute's CRI 104.

1.10 FIELD CONDITIONS

A. Comply with the Carpet and Rug Institute's CRI 104 for temperature, humidity, and ventilation limitations.

B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants during the remainder of the construction period.

C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.11 WARRANTY

A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.

1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
2. Failures include, but are not limited to, the following:

a. More than 10 percent edge raveling, snags, and runs.
b. Dimensional instability.
c. Excess static discharge.
d. Loss of tuft-bind strength.
e. Loss of face fiber.
f. Delamination.

3. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CARPET TILE: (CT-1, CT-2, CT-3)

A. Basis-of-Design Product: Subject to compliance with requirements, provide products As Listed in the “Interior Finish Legend” in Drawings or comparable product by one of the following:

1. Bentley
2. Mohawk Commercial
3. Interface Commercial

B. Color: As Listed in “Interior Finish Key” in the Drawings.

C. Pattern: As Listed in “Interior Finish Key” in the Drawings.

D. Fiber Content: 100 percent nylon 6, 6.

E. Pile Characteristic: Level-loop pile.

F. Backing: Bentley Afirma II Hardback Tile.

G. Primary Backing/Backcoating: Non-Woven Primary.

H. Secondary Backing: Reinforced Secondary Backing Stabilizer.

I. Size: 18 by 36 inches.

2.2 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.

C. Metal Edge/Transition Strips: As Listed in “Interior Finish Key” in the Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance.

B. Examine carpet tile for type, color, pattern, and potential defects.

C. Concrete Substrates:

1. Verify that finishes comply with requirements specified in Section 03 3000 "Cast-in-Place Concrete" and that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits.
2. Prepare according to flooring manufacture requirements.

    a. PH and Moisture levels to meet each Manufacturer’s requirements.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Comply with the Carpet and Rug Institute's CRI 104 and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider, and protrusions more than 1/32 inch unless more stringent requirements are required by manufacturer's written instructions.

C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.

D. Metal Substrates: Clean grease, oil, soil and rust, and prime if recommended in writing by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.

E. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

A. General: Comply with the Carpet and Rug Institute's CRI 104, Section 10, "Carpet Tile," and with carpet tile manufacturer's written installation instructions.

B. Installation Method: Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive .

C. Maintain dye-lot integrity. Do not mix dye lots in same area.

D. Maintain pile-direction patterns recommended in writing by carpet tile manufacturer and as shown on Finish Floor Plans.

E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing carpet tile:

1. Remove excess adhesive and other surface blemishes using cleaner recommended by carpet tile manufacturer.
2. Remove yarns that protrude from carpet tile surface.
3. Vacuum carpet tile using commercial machine with face-beater element.

B. Protect installed carpet tile to comply with the Carpet and Rug Institute's CRI 104, Section 13.7.

C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 09 6813

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SECTION 09 8100 – ACOUSTIC INSULATION & SEALANT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Acoustical insulation in walls.
2. Acoustical sealant.

B. Related Requirements:

1. 07 9219 Acoustical Joint Sealants
2. 09 2216 Non-structural Metal Framing

C. SUBSTITUTIONS

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. C665 - Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
2. E84 - Test Method for Surface Burning Characteristics of Building Materials.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Glass-fiber blanket insulation
2. For each acoustical joint sealant.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Provide acoustical joint-sealant products that effectively reduce airborne sound transmission through perimeter joints and openings in building construction, as demonstrated by testing representative assemblies according to ASTM E 90.

2.2 ACOUSTICAL JOINT SEALANTS

A. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex acoustical sealant complying with ASTM C 834.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. GE Construction Sealants; Momentive Performance Materials Inc.
   b. Hilti, Inc.
   c. Pecora Corporation.
   d. Specified Technologies, Inc.
   e. Tremco Incorporated.
   f. USG Corporation.
2. Colors of Exposed Acoustical Joint Sealants: As selected by Architect from manufacturer's full range of colors .

B. Acoustical Sealant for Concealed Joints: Manufacturer's standard nonsag, nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber acoustical sealant.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Pecora Corporation.
   b. Serious Energy Inc.

2.3 BATT ACOUSTICAL INSULATION:

A. ASTM C665, Type I; unfaced glass fiber batts, blankets, or rolls; minimum fire hazard classification rating of 25/50 per ASTM E84;

1. minimum 3-inch thick, unless required otherwise to meet the STC requirements;
2. 2-3/4 inches thick for installation in 2-1/2 inch stud cavities;
3. 3-5/8 to 4 inches thick for installation in 3-5/8 inch stud cavities;
4. 6-1/2 inches thick for installation in 6 inch stud cavities;

B. For Installation in Stud Walls: Widths to friction-fit between studs.

C. For Installation at Partition Head Tracks and Acoustically Insulated Door Frames: Continuous strips, full width of partition or frame, as detailed.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to starting work, carefully inspect installed work of other trades and verify that such work is complete to the point where work of this Section may properly commence.

B. Notify the Architect in writing of conditions detrimental to the proper and timely completion of the work.

C. Do not begin work until all unsatisfactory conditions are resolved. Beginning work constitutes acceptance of site conditions and responsibility for defective installation caused by prior observable conditions.

D. Examine joints indicated to receive acoustical joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION FOR BATT INSULATION

A. Verify that adjacent materials are secure, properly spaced, dry, and ready to receive installation.

B. Verify that mechanical and electrical services within spaces to be insulated have been installed and tested.

C. Furnish acoustical insulation to hollow metal installer for installation in hollow metal frames in acoustical partitions.

3.3 PREPARATION FOR SEALANT

A. Surface Cleaning of Joints: Clean out joints immediately before installing acoustical joint sealants to comply with joint-sealant manufacturer's written instructions.

B. Joint Priming: Prime joint substrates where recommended by acoustical-joint-sealant manufacturer. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.4 INSTALLATION, GENERAL

A. Install insulation in stud cavities in accordance with manufacturer's instructions, and as indicated. Coordinate with other trades as necessary to complete acoustical barriers at wall penetrations.

B. Install insulation without gaps or voids.

C. Trim insulation neatly to fit spaces. Use insulation materials free of damage.

D. Sealant:

1. Install acoustical sealant continuously around perimeter of all acoustically insulated partitions; one continuous bead at each side of framing member interface with substrate.
2. Where double layer of gypsum board is indicated, provide sealant at butt joints between boards, including corner joints, and additional bead at perimeter of base layer prior to installation of finish layer.
3. Except for penetrations in fire rated construction to receive firestopping or fire rated construction joint assemblies, seal all penetrations through acoustical assemblies, including cutouts for lighting fixtures, cabinets, pipes and plumbing, HVAC ducts, and electrical boxes.

3.5 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of acoustical joint sealants and of products in which joints occur.

3.6 PROTECTION

A. Protect acoustical joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated acoustical joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION 09 8100

SECTION 09 8433 - SOUND-ABSORBING WALL UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes shop-fabricated, acoustical panel units tested for acoustical performance, including the following:

1. Sound-absorbing wall panels.
2. Ceiling Hardware and Floor track.

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.

1.3 RELATED SECTIONS

A. Section 05310 - Steel Decking: Acoustical steel deck.

B. Section 09111 - Non-Loadbearing Metal Framing: Ceiling suspension systems.

C. Section 09260 - Gypsum Board Assemblies.

D. Section 09511 - Suspended Acoustical Ceilings: Conventional grid-supported acoustic ceilings.

1.4 REFERENCES

A. ASTM C 423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2000.

B. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2000a.

C. ASTM C1338 Standard Test Method for Mold and Fungal Resistance of Building Materials

1.5 PERFORMANCE REQUIREMENTS

A. Acoustical Absorption: Perform testing in accordance with ASTM C 423, Type A mounting method unless otherwise specified.

B. Flame Spread Rating: Provide all components with Class A flame spread rating when tested in accordance with ASTM E 84, unless otherwise specified.

C. Mold and Fungal Resistant: Provide testing in accordance with ASTM C1338 showing material passes Mold and Fungal resistance testing.

1.6 DEFINITIONS

A. NRC: Noise Reduction Coefficient.

1.7 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site to coordinate installation with ceiling.

1.8 ACTION SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.
4. Independent testing agency test reports.

B. Verification Samples:

1. For each panel specified, provide two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.
2. Provide one sample of hardware.

C. Shop Drawings: For unit assembly and installation.

1. Include plans, elevations, sections, and mounting devices and details.
2. Include details at panel head, base, joints, and corners, and details at ceiling and floor base.
3. Include direction of fabric weave and pattern matching.

1.9 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Elevations and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Hardware location at floor and ceiling

    a. Coordination with Acoustic Ceiling Tile and Ceiling Grid (ACT-1)

B. Sample Warranty: For manufacturer's special warranty.

1.10 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of unit to be included in maintenance manuals. Include manufacturers' written cleaning and stain-removal instructions.

1.11 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Mounting Hardware: Provide one of each of the hardware types installed.

1.12 QUALITY ASSURANCE

A. Manufacturer Qualifications: Minimum 10 years of experience in producing acoustical products.

B. Installer Qualifications: Acceptable to the manufacturer of the acoustical products being installed.

C. Dimensional Tolerances of Finished Units: Plus, or minus 1/16 inch for the following:

1. Thickness.
2. Edge straightness.
3. Overall length and width.
4. Squareness from corner to corner.

1.13 DELIVERY, STORAGE, AND HANDLING

A. Protect acoustical products during shipment, storage, and handling.

B. Store products in manufacturer's unopened packaging until ready for installation.

1. Store materials flat
2. Do not stand panels on end.
3. Protect edges from damage.

C. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.14 FIELD CONDITIONS

A. Environmental Limitations: Do not install units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work at and above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Lighting: Do not install units until a permanent level of lighting is provided on surfaces to receive the units.

C. Air-Quality Limitations: Protect units from exposure to airborne odors, such as tobacco smoke, and install units under conditions free from odor contamination of ambient air.

D. Field Measurements: Verify unit locations and actual dimensions of openings and penetrations by field measurements before fabrication and indicate them on Shop Drawings.

1.15 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace units and components that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to the following:

a. Acoustical performance.
b. Warping of panel.

2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: G&S Acoustics; 3555 Scarlet Oak Blvd., St. Louis, MO 63122. ASD. Tel: (636) 225-8800 or (800) 737-0307. Fax: (636) 225-2966. Email: inquiry@gsacosutics.com. www.gsacoustics.com.

B. Requests for substitutions will be considered in accordance with provisions of Special Conditions.

C. Provide all acoustical products and hardware specified herein by a single manufacturer.

2.2 SOUND-ABSORBING WALL UNITS: (SAWU-1)

A. Sound-Absorbing Wall Panel: Polyester Fiber Panels

B. Polyester Fiber Panels: aCapella Scores Wall Panels (AS); 100% PET 12 pcf polyester core with integral color throughout.

1. Core Thickness: .5 inch (12 mm); NRC 0.95
2. Size: 4’ x 8’

3. Color: As Listed in the “Interior Finish Key” in Drawings.
4. Edges: Square
5. Corners: Square
6. Shape: (select from below)

a) Rectangle AS Runway

7. Pattern: As Listed in the “Interior Finish Key” in Drawings.

2.3 MATERIALS

A. Core Materials: 100% PET 12 pcf polyester core with integral color throughout.

B. Mounting Hardware: **(SAWUH-1)**

1. Acceptable Manufacturer: Griplock Hardware provided by G&S Acoustics. As Listed in the "Interior Finish Key" in Drawings. As shown on in Drawings, 2 Cable Systems per SAWUH panel.

    a. Ceiling Track: Griplock Ceiling Track DG-TRAC-80 with Track Clips (continuous track), Finish: Silver

    b. Coupler: Griplock RT-CC-M13: (2 per panel), Finish: Silver

    c. Cables: Griplock Stainless Steel Aircraft Cable. Medium AS-16-87 with cable terminal that inserts into Coupler. (2 per panel), Finish: Silver
    d. Top Clamp Gripper - Large: DG-25Z-TC-500-SAT (2 per panel) Finish: Silver
    e. Floor Track to hold SAWU-1 Panel: CR Laurence ½" interior clearance U-Channel (continuous track) #DSCD12BA, Finish: Brushed Stainless Steel
    f. Guideclamps: Griplock Guide Clamp – Double Sided, DG-GCKX2-SAT (2 between each adjacent panels), Finish: Silver
    g. Metal Floor Track 2"h x 1"w, Finish: Brushed Stainless Steel

2.4 FABRICATION

A. Standard Construction: Use manufacturer's standard construction unless otherwise indicated; with facing material applied to face, edges, and back border of dimensionally stable core; and with rigid edges to reinforce panel perimeter against warpage and damage.

B. Dimensional Tolerances of Finished Units: Plus or minus 1/16 inch for the following:

1. Thickness.
2. Edge straightness.
3. Overall length and width.
4. Squareness from corner to corner.
5. Chords, radii, and diameters.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fabric, fabricated units, substrates, areas, and conditions for compliance with requirements, installation tolerances, and other conditions affecting unit performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install units in locations indicated. Unless otherwise indicated, install units with vertical surfaces and edges plumb, top edges level and in alignment with other units, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.

B. Comply with manufacturer's written instructions for installation of units using type of mounting devices indicated. Mount units securely to supporting substrate.

C. Align fabric pattern and grain with adjacent units.

3.4 INSTALLATION TOLERANCES

A. Variation from Plumb and Level: Plus or minus 1/16 inch in 48 inches, noncumulative.

B. Variation of Joint Width: Not more than 1/16-inch variation from reveal line in 48 inches, noncumulative.

3.5 CLEANING

A. Clip loose threads; remove pills and extraneous materials.

B. Clean panels on completion of installation to remove dust and other foreign materials according to manufacturer's written instructions.

END OF SECTION 09 8433

SECTION 09 8436 - SOUND-ABSORBING CEILING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes shop-fabricated, acoustical panel units tested for acoustical performance, including the following:

1. Sound-absorbing ceiling panels.

1.3 REFERENCES

A. ASTM C 423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2000.

B. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2000a.

C. ASTM C1338 Standard Test Method for Mold and Fungal Resistance of Building Materials.

1.4 DEFINITIONS

A. NRC: Noise Reduction Coefficient.

1.5 PERFORMANCE REQUIREMENTS

A. Acoustical Absorption: Perform testing in accordance with ASTM C 423, Type A mounting method unless otherwise specified.

B. Flame Spread Rating: Provide all components with Class A flame spread rating when tested in accordance with ASTM E 84, unless otherwise specified.

C. Mold and Fungal Resistant: Provide testing in accordance with ASTM C1338 showing passes Mold and Fungal resistance testing.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For unit assembly and installation.

1. Include reflected ceiling plans, elevations, sections, and mounting devices and details.
2. Include details at joints and corners; and details at ceiling intersections and intersections with walls. Indicate panel edge profile and core materials.

C. Samples for Verification: For the following products:

1. For each product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

1.7 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For manufacturer's special warranty.

1.8 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of unit to be included in maintenance manuals. Include manufacturers' written cleaning and stain-removal instructions.

1.9 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Mounting Hardware: Provide one of each of the hardware types installed including anchors, fasteners and Snap On Rotofasts.

1.10 QUALITY ASSURANCE

A. Installer Qualifications: Acceptable to the manufacturer of the acoustical products being installed.

B. Dimensional Tolerances of Finished Units: Plus or minus 1/16 inch for the following:

1. Thickness.
2. Edge straightness.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Protect acoustical products during requirements for shipment, storage, and handling.

B. Deliver materials and units in unopened bundles and store in a temperature-controlled dry place with adequate air circulation.

C. Store products in manufacturer's unopened packaging until ready for installation.

1.12 FIELD CONDITIONS

A. Environmental Limitations: Do not install units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work at and above ceilings is complete, and ambient

temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Air-Quality Limitations: Protect units from exposure to airborne odors, such as tobacco smoke, and install units under conditions free from odor contamination of ambient air.

C. Field Measurements: Verify unit locations and actual dimensions of openings and penetrations by field measurements before fabrication, and indicate them on Shop Drawings.

1.13 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace units and components that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Acoustical performance.
b. Warping of panel.

2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain ceiling units specified in this Section from single source from single manufacturer.

B. Substitutions: Not permitted

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: Units shall comply with "Surface-Burning Characteristics" or "Fire Growth Contribution" Subparagraph below, or both, as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. Surface-Burning Characteristics: Comply with ASTM E 84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

a. Flame-Spread Index: 25 or less.
b. Smoke-Developed Index: 450 or less.

2. Fire Growth Contribution: Comply with acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 286.

2.3 MANUFACTURERS

A. Acceptable Manufacturer: G&S Acoustics; 3555 Scarlet Oak Blvd., St. Louis, MO 63122. ASD. Tel: (636) 225-8800 or (800) 737-0307. Fax: (636) 225-2966. Email: inquiry@gsacosutics.com. www.gsacoustics.com.

B. Requests for substitutions will be considered in accordance with provisions of Special Conditions.

C. Provide all acoustical products and hardware specified herein by a single manufacturer.

2.4 SOUND-ABSORBING CEILING UNITS: (SACU-1 and SACU-2)

A. Sound-Absorbing Ceiling Panel: Manufacturer's standard panel construction consisting of facing material

1. Polyester Fiber Classic Plus Ceiling Panels (CP); 100% PET 6-7 pcf high density fiberglass and factory cut out design.
2. Panel Shape: Flat 1" thick, Up to 4' x 8'. Refer to Reflected Ceiling Plans for panel sizes and locations.
3. Edge Profile: Square.
4. Corner Detail in Elevation: Square
5. Reveals between Panels: Flush reveals.
6. Facing Material: 1/8 inch.
7. Color: White.
8. Acoustical Performance: Sound absorption NRC of .85 according to ASTM C 423 for Type A mounting according to ASTM E 795.
9. Nominal Core Thickness: 1 inch.
10. Panel Width: 48 inches.
11. Panel Length: 96 inches.

2.5 MOUNTING SYSTEMS FOR SOUND-ABSORBING CEILING UNITS:

A. Direct Ceiling Mounting System: G&S Acoustics Snap-On Rotofast: (SACU-1)

1. Materials:
   a. Anchors and Fasteners as required.
   b. Snap on Rotofast
   c. Ratchet
   d. Marking Plug
   e. Rotofast Driver Tool
2. Install per manufacturers Instruction:
   a. Locate mounting locations on the back of panel. Rotofast fasteners should be mounted 6” from the edge. See drawings for typical spacing on panels.
   b. Screw Rotofast Snap-On Anchors to the back of panels using the Rotofast Driver Tool.
   c. Insert Marking Plugs into the Snap-On Anchors.
   d. Push the panels against the ceiling to mark anchor locations.
   e. Screw Ratchets to ceilings at marked locations
   f. Firmly push panels onto Ratchets to complete installation.

B. Offset Ceiling Mounting System: G&S Acoustics Continuous Hanger Bar: (SACU-2)

1. Materials:
   a. Anchors and Fasteners as required.

b. Continuous Hanger Bar (CHB)
c. SGNI Plate
d. 2 Safety clips per panel
e. 2 Corner clips per panel
f. Adhesive as required.

2. Install per manufacturers Instruction, Reference G&S Acoustics Ceiling Mounting Installation Sheet for how to locate and install:
   a. Continuous Hanger Bar
   b. SGNI Plates
   c. Adhesive required.
   d. Corner and Safety Clip locations

2.6 MATERIALS

A. Core Materials:

1. Glass-Fiber Board: ASTM C 612; of type standard with manufacturer; nominal density of 6 to 7 lb/cu. ft. , unfaced, and dimensionally stable, molded rigid board; and with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

2. Flammability: All components have a Class “A” rating per ASTM E84.

2.7 FABRICATION

A. Standard Construction: Use manufacturer's standard construction unless otherwise indicated, with facing material applied to face, edges, and back border of dimensionally stable core and with rigid edges to reinforce panel perimeter against warpage and damage.

B. Measure each area and establish layout of panels and joints of uniform size with balanced borders at opposite edges within a given area.

C. Dimensional Tolerances of Finished Units: Plus or minus 1/16 inch for the following:

1. Thickness.
2. Edge straightness.
3. Overall length and width.
4. Squareness from corner to corner.
5. Chords, radii, and diameters.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fabric, fabricated units, substrates, areas, and conditions for compliance with requirements, installation tolerances, and other conditions affecting unit performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install units in locations indicated. Unless otherwise indicated, install units with edges in alignment with walls and other units, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.

B. Comply with manufacturer's written instructions for installation of units using type of mounting devices indicated. Mount units securely to supporting substrate.

3.3 INSTALLATION TOLERANCES

A. Variation from Alignment with Surfaces: Plus or minus 1/16 inch in 48 inches, noncumulative.

B. Variation from Level or Slope: Plus or minus 1/16 inch 1/8 inch.

C. Variation of Joint Width: Not more than 1/32 inch wide from hairline in 48 inches, noncumulative.

3.4 CLEANING

A. Clip loose threads; remove pills and extraneous materials.

B. Clean panels on completion of installation to remove dust and other foreign materials according to manufacturer's written instructions.

END OF SECTION 09 8436

SECTION 09 8453 - SOUND BARRIER MULLION TRIM CAP

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 sound barrier mullion trim caps providing sound transmission control at curtain wall.

B. Related Requirements:

1. Section 07 9200 "Joint Sealants" for joint sealing.
2. Section 09 2216 "Non-Structural Metal Framing" for interior wall construction.
3. Section 09 2900 "Gypsum Board" for interior wall construction

1.3 ACTION SUBMITTALS

A. Product Data:

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for sound barrier wall end cap system.

B. Shop Drawings:

1. Include typical dimensioned cross-section(s) at the location where drywall partition terminates at the perimeter curtain wall, indicating:

a. Dimensions
b. Finish

C. Samples: For each color and texture specified.

1. Size: 2” x3-1/2” (51 mm x 89 mm) custom color paint sample.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each sound barrier mullion trim cap assembly, for ASTM E 90 tests performed by a qualified third party testing agency.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer of aluminum extrusions and anodizing shall be ISO-9001 certified.

B. Installer Qualifications: An entity that employs installers and supervisors who are approved by manufacturer.

C. Testing Agency Qualifications: ASTM E 90 testing to be performed by laboratory accredited by IAS as complying with ISO/IEC Standard 17025.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver sound barrier mullion trim caps until spaces to receive them are clean, dry, and ready for their installation.

B. Store sound barrier mullion trim caps in original undamaged packaging inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace sound barrier mullion trim caps that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Ten years limited warranty from date of Substantial Completion.
2. Limited warranty does not cover adjacent products or improper installation.

PART 2 - PRODUCTS

2.1 SOUND BARRIER MULLION TRIM CAP

A. Basis-of-Design Product: Subject to compliance with requirements, provide Gordon Incorporated; Mullion Mate Partition Gap Closure, Series 40 or comparable product by one of the following:

1. MULL-it-OVER Products**;** Mull-it-Over 55, Wide Sound Barrier (No Mullion) trim cap system.

2.2 SYSTEM DESCRIPTION

A. General: Provide sound barrier mullion trim caps of design, basic profile, materials, and operation indicated. Provide units with capability to accommodate variations in adjacent surfaces.

1. Furnish units in lengths of sufficient additional length to allow for field trimming to required length to match variations in construction tolerances of adjacent systems.

2.3 PERFORMANCE REQUIREMENTS

A. Sound Transmission:

1. Double-Sided Installations: STC 55 or higher.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Mullion trim cap to be sized to accommodate thermal movement.

2.4 COMPONENTS

A. Aluminum Extrusions:
1. Profile: As selected and approved by Architect to allow solid attachment and fastening to the partition wall framing.

B. Sound Absorbing Foam:

1. Resistant to smoke, flame, and microbial growth.
2. Fire Rating: ASTM E 84 Class 1.
3. Fungi Resistance: Zero rating per ASTM G 21.

C. Compressible Foam: Between edge of extrusion and interior face of curtain wall glass.

1. Thickness: as required to accommodate mullion deflection.
2. Color: Charcoal.

D. Fasteners:

1. Self Tapping or appropriate threaded fastener.
2. Compatible with all materials fasteners will contact with and not causing galvanic corrosion.

E. Snap Cover: Snap-on fastener cover.

F. Acoustical Sound Sealant: Acrylic latex based.

2.5 ACCESSORIES

A. Provide necessary and related parts and tools to complete installation.

2.6 FABRICATION

A. Extrusions and generic profiles to be shipped in custom lengths as required to meet project requirements or shipped in standard incremental foot lengths and cut to exact length on jobsite.

2.7 FINISHES

A. Exposed surfaces of exposed aluminum extrusion:
1. Factory applied Baked Enamel or Powder Coat to match Standard Colors or Custom Color and gloss as required.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine walls and adjacent curtain wall for suitable conditions where sound barrier wall end cap will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Measure and cut sound barrier wall end cap to proper lengths.

B. Notch around horizontal mullions, sills, or other obstructions leaving appropriate gap for differential movement between the sound barrier wall end cap and the obstruction.

C. Apply continuous bead of acoustical sealant to the unexposed side of extruded aluminum surface that will be in contact with the drywall edge.

D. Place sound barrier wall end cap on the vertical surface of the drywall partition wall and loosely install fasteners in the top and bottom slotted holes of the wall end cap.

E. Plumb the wall end cap leaving recommended gap spacing between the interior glass surface and the wall end cap. Foam gasket to be in contact with glass.

F. Tighten top and bottom fasteners to secure end cap.

G. Install additional fasteners at 12 inches on center, minimum.

H. Install snap cover to conceal fasteners.

I. Apply color matched sealant at joints of dissimilar materials as desired.

3.3 CLEANING

A. After work is complete in adjacent areas, clean exposed surfaces with suitable cleaner that will not harm or attack the finish.

3.4 PROTECTION

A. Protect sound barrier wall end caps from damage during installation, general construction activities, and until turnover of structure.

END OF SECTION 09 8453

SECTION 09 9123 - INTERIOR PAINTING

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 surface preparation and the application of paint systems on the following interior substrates:

1. Concrete masonry units (CMUs).
2. Steel and iron.
3. Gypsum board.

B. Related Requirements:

1. Section 05 1200 "Structural Steel Framing” for shop priming structural steel.

1.3 DEFINITIONS

A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.

B. MPI Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

C. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

D. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

E. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

F. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

G. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

B. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.

1. Submit Samples on rigid backing, 8 inches’ square.
2. Step coats on Samples to show each coat required for system.

C. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

B. Furnish quantity of one gallon for each type, and color of paint.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Products: Subject to compliance with requirements, provide products indicated in Interior Painting Schedule or comparable product by one of the following:

1. Benjamin Moore and Co.
2. Sherwin-Williams Company
3. PPG Architectural Finishes Inc.

B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include but are not limited to products listed in the Interior Painting Schedule for the paint category indicated.

2.2 PAINT, GENERAL

A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."

B. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

C. Colors: As listed in “Interior Finish Key” in Drawings.

2.3 PRIMER/SEALER

A. Primer Sealer, Latex, Interior: MPI #50.

2.4 METAL PRIMERS

A. Primer, Alkyd, Anti-Corrosive, for Metal: MPI #79.

B. Primer, Alkyd, Quick Dry, for Metal: MPI #76.

2.5 WATER-BASED PAINTS

A. Latex, Interior, High Performance Architectural, (Gloss Level 2): MPI #138.

B. Latex, Interior, High Performance Architectural, Semi-Gloss (Gloss Level 5): MPI #141.

2.6 SOLVENT-BASED PAINTS

A. Alkyd, Interior, Semi-Gloss (Gloss Level 5): MPI #47.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Masonry (Clay and CMUs): 12 percent.
2. Gypsum Board: 12 percent.

C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

E. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.

E. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer.

F. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. 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.

E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed in equipment rooms:

   a. Equipment, including panelboards.

2. Paint the following work where exposed in occupied spaces:

   a. Equipment, including panelboards.
   b. Uninsulated metal piping.
   c. Pipe hangers and supports.
   d. Metal conduit.
   e. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
   f. Other items as directed by Architect.

3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. 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.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE:

A. Steel Substrates: (IPS-5A)

1. Semi-gloss Enamel on Metal (IPS-5A):

   a. Prime Coat: S-W Pro Industrial Pro-Cryl Universal Primer, B66-310 Series
   b. Intermediate Coat: matching topcoat.

c. Topcoat: S-W Pro Industrial Pre-Catalyzed Water Based Epoxy, K46-1151 Series

B. Gypsum Board Substrates: (IPS-1A, IPS-1B, IPS-1C, IPS-2A)

1. Eggshell Latex (IPS-1A, IPS-1B, IPS-1C):

a. Prime Coat: S-W ProMar 200 Zero VOC Latex Flat, B30-12600 Series
b. Intermediate and topcoats: S-W ProMar 200 HP Zero VOC Latex Eg-Shel, B20-1900 Series

2. Flat Latex (IPS-2A):

a. Prime Coat: S-W ProMar 200 Zero VOC Latex Flat, B30-12600 Series
b. Intermediate and topcoats: S-W ProMar 200 Zero VOC Latex Flat, B30-12600 Series

C. Concrete Substrates: (IPS-3A, IPS-3B)

1. Eggshell Latex (IPS-3A, IPS-3B)

a. Prime Coat: S-W Pro Industrial Block Filler
b. Intermediate and topcoats: Intermediate and topcoats: S-W ProMar 200 HP Zero VOC Latex Eg-Shel, B20-1900 Series.

END OF SECTION 09 9123

SECTION 10 1100 – GLASS MARKER BOARDS (MB-1, MB-2)

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Resinous markerboards.

1.2 SCOPE

1. Furnish markerboards with manufacturer's installation kits and accessories as needed.

1.3 ACTION SUBMITTALS

A. Product Data Submittals: For each product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, finishes, and accessories for visual display units.
2. Include electrical characteristics for motorized units.

B. Shop Drawings: For visual display units.

1. Include plans, elevations, sections, details, and attachment to other work.
2. Show locations of panel joints.

C. Samples for Verification: For each type of visual display unit indicated.

1. Visual Display Panel: Not less than 8-1/2 by 11 inches, with facing, core, and backing indicated for final Work. Include one panel for each type, color, and texture required.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranties: Submit manufacturer's standard warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For glass markerboards to be included in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by the manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver factory-fabricated visual display units completely assembled in one piece. If dimensions exceed maximum manufactured unit size, or if unit size is impracticable to ship in one piece, provide two or more pieces with joints in locations indicated on approved Shop Drawings.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install visual display units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings 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.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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.

1. Coordinate with outlets on walls

2.2 GLASS MARKERBOARDS: (MB-1, MB-2)

A. Basis of Design: 3Form, As listed in the “Interior Finish Key” in the drawings.

1. Other manufacturers:
   a. Clarus

2. Substitutions are acceptable provided they meet the requirements herein.

B. Magnetic Glass Markerboards:

1. Markerboard Features:
   a. Magnetic
   b. Non-staining
   c. Factory finished edges.
   d. Optically Clear.

   e. Non-staining shall mean impervious to staining from dry erase, wet erase and permanent markers.
   f. Markerboard colorant: Permanent opaque color on back

2. Edge and Corner Detail: Polished Edge

3. Color: Chalk

4. Finish: Gloss

5. Mounting: Floating with Z-Strip mounting hardware.

6. Size: 3.5’x5’ and 4’x6’, Refer to drawings for locations.

C. Accessories:

1. Magnetic Marker Tray
2. Magnetic Accessory Kit

PART 3 - EXECUTION

3.1 EXAMINATION

A. Per manufacturer’s installation guidelines examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.

B. Examine roughing-in for electrical power systems to verify actual locations of connections before installation of motorized, sliding visual display units.

C. Examine walls and partitions for proper preparation and backing for visual display units.

D. Examine walls and partitions for suitable framing depth where sliding visual display units will be installed.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Comply with manufacturer's written instructions for surface preparation.

B. Clean substrates of substances, such as dirt, mold, and mildew, that could impair the performance of and affect the smooth, finished surfaces of visual display boards.

C. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between visual display units and wall surfaces.

D. Prime wall surfaces indicated to receive visual display units and as recommended in writing by primer/sealer manufacturer and visual display unit manufacturer.

E. Prepare recesses for sliding visual display units as required by type and size of unit.

3.3 INSTALLATION

A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

B. Install Products in accordance with manufacturer’s instructions at locations indicated in construction documents.

C. Install markerboard products level, plumb, and at the height indicated in construction documents.

D. Leave manufacturer’s protective peel-sheet on resinous markerboard during the installation process. Do not remove until ready to use.

E. Prior to initial use, remove peel-sheet from resinous markerboard surface and clean surface thoroughly in accordance with manufacturer’s written guidelines.

3.4 CLEANING

A. Follow manufacturer’s written instructions. Do not use solvents, harsh chemicals, or abrasive cleaners on the surface of resinous markerboard products.

3.5 PROTECTION

A. Protect installed products from damage during construction.

3.6 CLEANING AND PROTECTION

A. Clean visual display units in accordance with manufacturer's written instructions. Attach one removable cleaning instructions label to visual display unit in each room.

B. Touch up factory-applied finishes to restore damaged or soiled areas.

C. Cover and protect visual display units after installation and cleaning.

END OF SECTION 10 1100

SECTION 10 2600 - WALL AND DOOR PROTECTION (CG-1, CG-2)

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. Corner guards.
2. Abuse-resistant wall coverings.

B. Related Requirements:

1. Section 08 7100 "Door Hardware" for metal protective trim units, according to BHMA A156.6, used for armor, kick, mop, and push plates.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes.

B. Samples for Verification: For each type of exposed finish on the following products, prepared on Samples of size indicated below:

1. Corner Guards: 12 inches long. Include example top caps.
2. Advanced Wall Protection: 6 by 6 inches square.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of wall and door protection product to include in maintenance manuals.

1. Include recommended methods and frequency of maintenance for maintaining best condition of plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to finishes and performance.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Corner-Guard Covers: Full-size plastic covers of maximum length equal to 5 percent of each type, color, and texture of cover installed.
2. Advanced Wall Protection: 5 percent of each type, color.
3. Mounting and Accessory Components: Amounts proportional to the quantities of extra materials. Package mounting and accessory components with each extra material.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store wall and door protection in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1. Maintain room temperature within storage area at not less than 70 deg F during the period plastic materials are stored.
2. Keep plastic materials out of direct sunlight.
3. Store plastic wall- and door-protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 70 deg F.

    a. Store corner-guard covers in a vertical position.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of wall- and door-protection units that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Structural failures including detachment of components from each other or from the substrates, delamination, and permanent deformation beyond normal use.
    b. Deterioration of metals, metal finishes, plastics, and other materials beyond normal use.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain wall- and door-protection products of each type from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Surface Burning Characteristics: Comply with ASTM E 84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

2.3 CORNER GUARDS: (CG-1, CG-2)

A. Surface-Mounted, Plastic-Cover Corner Guards: Manufacturer's standard assembly consisting of snap-on, resilient plastic cover installed over retainer; including mounting hardware; fabricated with 90- or 135-degree turn to match wall condition.

B. Basis-of-Design Product to compliance with requirements, As indicated in the Interior Finish Key in drawings or comparable product by one of the following:

a. InPro Corporation (CG-1, CG-2)

b. CS Acrovyn

1. Cover: Extruded rigid plastic, minimum 0.100-inch wall thickness; in dimensions and profiles indicated on Drawings.

a. Profile: Nominal 2-inch- long leg and 1/4-inch corner radius.
b. Height: 4’-0”.
c. Color and Texture: As indicated in the Interior Finish Key on Drawings.

2. Continuous Retainer: Minimum 0.060-inch- thick, one-piece, extruded aluminum.
3. Top and Bottom Caps: Prefabricated, injection-molded plastic; color matching cover; field adjustable for close alignment with snap-on cover.

2.4 MATERIALS

A. Plastic Materials: Chemical- and stain-resistant, high-impact-resistant plastic with integral color throughout; extruded and sheet material as required, thickness as indicated.

B. Polycarbonate Plastic Sheet: ASTM D 6098, S-PC01, Class 1 or Class 2, abrasion resistant; with a minimum impact-resistance rating of 15 ft.-lbf/in. of notch when tested according to ASTM D 256, Test Method A.

C. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.

D. Adhesive: As recommended by protection product manufacturer.

2.5 FABRICATION

A. Fabricate wall and door protection according to requirements indicated for design, performance, dimensions, and member sizes, including thicknesses of components.

B. Factory Assembly: Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.

C. Quality: Fabricate components with uniformly tight seams and joints and with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

2.6 FINISHES

A. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine walls to which wall and door protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.

1. For wall and door protection attached with adhesive, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Complete finishing operations, including painting, before installing wall and door protection.

B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

A. Installation Quality: Install wall and door protection according to manufacturer's written instructions, level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.

B. Mounting Heights: Install wall and door protection in locations and at mounting heights indicated on Drawings.

C. Accessories: Provide splices, mounting hardware, anchors, trim, joint moldings, and other accessories required for a complete installation.

1. Provide anchoring devices and suitable locations to withstand imposed loads.
2. Where splices occur in horizontal runs of more than 20 feet, splice aluminum retainers and plastic covers at different locations along the run, but no closer than 12 inches apart.

3. Adjust end and top caps as required to ensure tight seams.

D. Abuse-Resistant Wall Covering: Install top and edge moldings, corners, and divider bars as required for a complete installation.

E. Door-Frame Protectors: Install on both door jams.

F. Fire Doors: Install protection according to the listing of each item.

3.4 CLEANING

A. Immediately after completion of installation, clean plastic covers and accessories using a standard ammonia-based household cleaning agent.

B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION 10 2600

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SECTION 10 2613 - FRP PANELS

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. FRP Panels and trim.

1.3 SUBMITTALS

A. Product Data: Include construction details, material descriptions, impact strength, fire-test-response characteristics, dimensions of individual components and profiles, and finishes for each impact-resistant wall protection unit.

B. Samples for Initial Selection: For each type of impact-resistant wall protection unit indicated.

1. Include similar Samples of accent strips and accessories involving color selection.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Source Limitations: Obtain impact-resistant wall protection units from single source from single manufacturer.

C. Product Options: Drawings indicate size, profiles, and dimensional requirements of impact-resistant wall protection units and are based on the specific system indicated.

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

D. Surface-Burning Characteristics: Provide impact-resistant, plastic wall protection units with surface-burning characteristics as determined by testing identical products per ASTM E 84, NFPA 255, or UL 723 by UL or another qualified testing agency.

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

PART 2 - PRODUCTS

2.1 MATERIALS

A. PVC Plastic: ASTM D 1784, Class 1, textured, chemical- and stain-resistant, high-impact-resistant PVC or acrylic-modified vinyl plastic with integral color throughout; sheet material, thickness as indicated.

1. Chemical and Stain Resistance: Tested according to ASTM D 543
2. Self-extinguishing when tested according to ASTM D 635.
3. Flame-Spread Index: 25 or less.
4. Smoke-Developed Index: 450 or less.

B. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.

2.2 FRP PANELS

A. RFP Panels: Fabricated from plastic sheet material.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Panolam, .090” thick, Textured Wall Panels or comparable product by another manufacturer.
2. Sheet Thickness: 0.090 inch minimum.
3. Color and Texture: Refer to “Interior Finish Key” on Drawings.
4. Height: Full wall.
5. Trim and Joint Moldings: Extruded rigid plastic that matches sheet wall covering color.
6. Mounting: Adhesive.

2.3 FABRICATION

A. Fabricate FRP wall protection units to comply with requirements indicated for design, dimensions, and member sizes, including thicknesses of components.

B. Fabricate components with tight seams and joints with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances, fire rating**,** and other conditions affecting performance of work.

B. Examine walls to which impact-resistant wall protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.

1. For impact-resistant wall protection units attached with adhesive or foam tape, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Complete finishing operations, including painting, before installing impact-resistant wall protection system components.

B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

A. General: Install impact-resistant wall protection units level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.

1. Provide splices, mounting hardware, anchors, and other accessories required for a complete installation.

    a. Provide anchoring devices to withstand imposed loads.
    b. Where splices occur in horizontal runs of more than 20 feet, splice aluminum retainers and plastic covers at different locations along the run, but no closer than 12 inches.
    c. Adjust end and top caps as required to ensure tight seams.

B. Impact-Resistant Wall Covering: Install top and edge moldings, corners, and divider bars as required for a complete installation.

3.4 CLEANING

A. Immediately after completion of installation, clean plastic covers and accessories using a standard, ammonia-based, household cleaning agent.

B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION 10 2613

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SECTION 10 2800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Public-use washroom accessories.
2. Childcare accessories.
3. Underlavatory Guards.

B. Related Requirements:

1. Section 09 3013 "Ceramic Tiling" for ceramic toilet and bath accessories.

1.2 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.3 ACTION SUBMITTALS

A. Product Data Submittals: For each product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
3. Include electrical characteristics.

B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

1. Identify locations using room designations indicated.
2. Identify accessories using designations indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For manufacturer's special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For accessories to include in maintenance manuals.

1.6 WARRANTY

A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, visible silver spoilage defects.
2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 OWNER-FURNISHED MATERIALS

A. Owner-Furnished Materials: .

1. Toilet Paper Dispenser (TPD) – surface mounted
2. Soap Dispenser (SD) – surface mounted
3. Paper Towel Dispenser (PTD) – surface mounted

2.2 PERFORMANCE REQUIREMENTS

2.3 PUBLIC-USE WASHROOM ACCESSORIES

A. Source Limitations: Obtain public-use washroom accessories from single source from single manufacturer.

B. Grab Bar (GB) :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ASI-American Specialties, Inc.
   b. Bobrick Washroom Equipment, Inc.
   c. Bradley Corporation.
2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 0.05 inch thick.
   a. Finish: Smooth, ASTM A480/A480M No. 4 finish (satin) on ends and slip-resistant texture in grip area.
4. OD: 1-1/2 inches.
5. Configuration and Length: As indicated on Drawings .

C. Mirror Unit (MIRROR):

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. Basis of Design Product: Bobrick; B-290 series.
   b. Frame: Stainless-steel angle, 0.05 inch thick.
   c. Corners: Welded-frame, ground smooth and polished.
2. Size: As indicated on Drawings.
3. Hangers: Manufacturer's standard rigid, tamper, and theft resistant.

a. One-piece, galvanized-steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
b. Wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove

D. Hook (RH):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ASI-American Specialties, Inc.
b. Bobrick Washroom Equipment, Inc.
c. Bradley Corporation.

2. Description: Double-prong unit .
3. Mounting: Concealed .
4. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin) .

2.4 UNDERLAVATORY GUARDS

A. Underlavatory Guard :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Buckaroos, Inc.
b. Truebro; IPS Corporation.

2. Description: Insulating pipe covering for supply and drain piping assemblies that prevents direct contact with and burns from piping; allow service access without removing coverings.
3. Material and Finish: Antimicrobial, molded plastic, white.

2.5 MATERIALS

A. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.031-inch- minimum nominal thickness unless otherwise indicated.

B. Brass: ASTM B19, flat products; ASTM B16/B16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B30, castings.

C. Steel Sheet: ASTM A1008/A1008M, Designation CS (cold rolled, commercial steel), 0.036-inch-minimum nominal thickness.

D. Galvanized-Steel Sheet: ASTM A653/A653M, with G60 hot-dip zinc coating.

E. Galvanized-Steel Mounting Devices: ASTM A153/A153M, hot-dip galvanized after fabrication.

F. Fasteners: Screws, bolts, and other devices of same material as accessory unit, unless otherwise recommended by manufacturer or specified in this Section, and tamper and theft resistant where exposed, and of stainless or galvanized steel where concealed.

G. Chrome Plating: ASTM B456, Service Condition Number SC 2 (moderate service).

H. Mirrors: ASTM C1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

2.6 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six (6) keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories in accordance with manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

1. Remove temporary labels and protective coatings.

B. Grab Bars: Install to comply with specified structural-performance requirements.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Clean and polish exposed surfaces in accordance with manufacturer's written instructions.

END OF SECTION 10 2800

SECTION 10 4413 - FIRE PROTECTION CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire-protection cabinets for the following:

a. Portable fire extinguisher.

B. Related Requirements:

1. Section 10 4416 "Fire Extinguishers" for portable, hand-carried fire extinguishers accommodated by fire-protection cabinets.

1.2 PREINSTALLATION CONFERENCE

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed-, semirecessed-, or surface-mounting method and relationships of box and trim to surrounding construction.

B. Product Schedule: For fire-protection cabinets. Indicate whether recessed, semirecessed, or surface mounted. Coordinate final fire-protection cabinet schedule with fire-extinguisher schedule to ensure proper fit and function. Use same designations indicated on Drawings.

1.4 COORDINATION

A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain fire-protection cabinets, accessories, and fire extinguishers from single source from single manufacturer.

2.2 FIRE-PROTECTION CABINET (FEC)

A. Cabinet Type: Suitable for fire extinguisher .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Babcock-Davis.
    b. Guardian Fire Equipment, Inc.
    c. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
    d. Larsen's Manufacturing Company.
    e. Potter Roemer LLC; a Division of Morris Group International.

B. Cabinet Construction: Nonrated .

C. Cabinet Material: Cold-rolled steel sheet .

    1. Shelf: Same metal and finish as cabinet.

D. Semirecessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).

    1. Rolled-Edge Trim: 2-1/2-inch backbend depth.

E. Cabinet Trim Material: Stainless steel sheet Same material and finish as door.

F. Door Material: Stainless steel sheet .

G. Door Style: Vertical duo panel with frame .

H. Door Glazing: Tempered float glass (clear) .

I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

    1. Provide projecting door pull and friction latch .
    2. Provide continuous hinge, of same material and finish as trim, , permitting door to open 180 degrees.

J. Accessories:

    1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
    2. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as directed by Architect .

        a. Identify fire extinguisher in fire-protection cabinet with the words " FIRE EXTINGUISHER ."

            1) Location: Applied to cabinet glazing .
            2) Application Process: Pressure-sensitive vinyl letters.
            3) Lettering Color: Red .
            4) Orientation: Vertical .

K. Materials:

    1. Cold-Rolled Steel: ASTM A1008/A1008M, Commercial Steel (CS), Type B.

        a. Finish: Baked enamel, TGIC polyester powder coat, HAA polyester powder coat, epoxy powder coat, or polyester/epoxy hybrid powder coat, complying with AAMA 2603.

b. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
c. Color: As selected by Architect from manufacturer's full range .

2. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304.

a. Finish: ASTM A480/A480M No. 4 directional satin finish, .

3. Tempered Float Glass: ASTM C1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear) .

2.3 FABRICATION

A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

1. Weld joints and grind smooth.
2. Miter corners and grind smooth.
3. Provide factory-drilled mounting holes.
4. Prepare doors and frames to receive locks.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.

1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
2. Fabricate door frames of one-piece construction with edges flanged.
3. Miter and weld perimeter door frames and grind smooth.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.4 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.

C. Finish fire-protection cabinets after assembly.

D. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for hose valves and cabinets to verify actual locations of piping connections before cabinet installation.

B. Examine walls and partitions for suitable framing depth and blocking where semirecessed cabinets will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare recesses for semirecessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

A. General: Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at height indicated below:

1. Fire-Protection Cabinet Mounting Height: 42 inches above finished floor to top of fire extinguisher.

B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.

1. Unless otherwise indicated, provide recessed fire-protection cabinets. If wall thickness is inadequate for recessed cabinets, provide semirecessed fire-protection cabinets.
2. Provide inside latch and lock for break-glass panels.
3. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.

C. Identification:

1. Apply vinyl lettering at locations indicated.

3.4 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and mounting bracket manufacturers.

E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 10 4413

SECTION 11 5213 - PROJECTION SCREENS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Electrically operated, front-projection screens.

1.2 DEFINITIONS

A. ALR: Ambient-light rejection; for specular reflective viewing surfaces, measured as the percentage of ambient light striking the viewing surface that has equal angles of incidence and reflection.

B. Gain: Ratio of light reflected from viewing-surface material to that reflected perpendicularly from a magnesium carbonate surface as determined in accordance with SMPTE RP 94.

C. Half-Gain Angle: The angle, measured from the axis of the viewing surface to the most central position on a perpendicular plane through the horizontal centerline of the viewing surface, where the gain is half of the peak gain.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show layouts and types of front-projection screens. Include the following:

1. Drop heights.
2. For end-mounted motors, location of screen centerline relative to ends of screen case.
3. Anchorage details, including connection to supporting structure for suspended units.
4. Details of juncture of screen case or trim with adjacent finishes.
5. For electrically operated units, wiring diagrams and location of wiring connections.
6. Accessories.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For front-projection screens to include in maintenance manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Environmental Limitations: Do not deliver front-projection screens until spaces are enclosed and weathertight, wet-work in installation spaces is complete and dry, and temporary or permanent HVAC system is operating and maintaining ambient temperature and humidity conditions planned for building occupants during the remainder of the construction period.

B. Store front-projection screens in manufacturer's protective packaging and according to manufacturer's written instructions.

1.6 COORDINATION

A. Coordinate layout and installation of front-projection screens with adjacent construction, including ceiling suspension systems, light fixtures, HVAC system components, and partitions.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Viewing-Surface and Masking Materials:

1. Mildew-Resistance Rating: Zero or 1 when tested in accordance with ASTM G21.
2. Flame Resistance: Passes NFPA 701.
3. Flame-Spread Index: Not greater than 75 when tested in accordance with ASTM E84.

2.2 ELECTRICALLY OPERATED, FRONT-PROJECTION SCREENS

A. General Requirements: Manufacturer's standard units, consisting of case, screen, motor, controls, mounting accessories, and other components necessary for a complete installation. Provide units that are listed and labeled as an assembly by Underwriters Laboratories Inc. (UL) or another testing and inspecting agency acceptable to authorities having jurisdiction.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Screen Mounting: Top edge securely anchored to rigid metal roller and bottom edge formed into a pocket holding a metal rod, with ends of rod protected by plastic caps.

B. Suspended, Electrically Operated Screen : Unit designed and fabricated for suspended mounting.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Draper, Inc.; Ultimate Access/Series V or comparable product by one of the following:

    a. Legrand AV Inc.; Legrand North America, LLC.

2. Motor in Roller: Instant-reversing motor of size and capacity recommended in writing by screen manufacturer; with permanently lubricated ball bearings, automatic thermal-overload protection, preset limit switches to automatically stop screen in up and down positions, and positive-stop action to prevent coasting. Mount motor inside roller with vibration isolators to reduce noise transmission.
3. End-Mounted Motor: Instant-reversing, gear-drive motor of size and capacity recommended in writing by screen manufacturer; with permanently lubricated ball bearings, automatic thermal-overload protection, preset limit switches to automatically stop screen in up and down positions, and positive-stop action to prevent coasting. Locate motor in its own compartment . Support roller with self-aligning bearings in brackets.
4. Wiring Compartment: Metal or metal lined.
5. Controls: Remote, three-position control switch installed in recessed device box with flush cover plate matching other electrical device cover plates in room where switch is installed.

    a. Provide with one control switch .
    b. Provide power supply for low-voltage systems if required.

c. Provide radio-frequency remote control, consisting of battery-powered transmitter and receiver.
d. Provide video interface control for connecting to projector. Projector provides signal to raise or lower screen.

6. Screen Case: Metal .

a. Ceiling Aperture: With closure, hinged to automatically open when screen is lowered and automatically close when screen is fully raised.

1) Provide screen case with trim flange to receive ceiling finish .

b. Finish on Exposed Surfaces: Manufacturer's standard .

7. Tab-Tensioned, Gain-White Viewing Surface: Minimum peak gain of 1.3 and 75-degree minimum half-gain angle. Provide viewing surface with black backing and without seams.

a. Tab Tensioning: Durable low-stretch cord, such as braided polyester, on each side of screen that is connected to edge of entire height of screen by tabs, to pull viewing surface flat horizontally.

8. Size of Viewing Surface: 79 by 140 inches .

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install front-projection screens at locations indicated on Drawings to comply with screen manufacturer's written instructions.

B. Install front-projection screens with screen cases in position and in relation to adjoining construction indicated. Securely anchor them to supporting substrate in a manner that produces a smoothly operating screen that, when lowered, has flat viewing surface and plumb vertical edges.

1. Install low-voltage controls in accordance with NFPA 70 and complying with manufacturer's written instructions.

a. Wiring Method: Install wiring in raceway, except in accessible ceiling spaces and in gypsum board partitions, where unenclosed wiring method may be used. Use UL-listed plenum cable in environmental air spaces, including plenum ceilings. Conceal raceway and cables, except in unfinished spaces.

2. Test electrically operated units to verify that screen controls, limit switches, closures, and other operating components are in optimum functioning condition.
3. Test manually operated units to verify that screen-operating components are in optimum functioning condition.

END OF SECTION 11 5213

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SECTION 12 2413 - ROLLER WINDOW SHADES

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. Manual-operated shades with single rollers.

B. Related Requirements:

1. Section 06 1053 "Miscellaneous Rough Carpentry" for wood blocking and grounds for mounting roller shades and accessories.
2. Section 07 9200 "Joint Sealants" for sealing the perimeters of installation accessories for light-blocking shades with a sealant.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.

B. Samples for Verification: For each type of roller shade.

1. Shadeband Material: Not less than 3 inches square. Mark inside face of material if applicable.
2. Roller Shade: Full-size operating unit, not less than 16 inches wide by 36 inches long for each type of roller shade indicated.
3. Installation Accessories: Full-size unit, not less than 10 inches long.

C. Shop Drawings:

1. Drawings to show:

a. Shade and shade cloth type with same callout as shown on the drawings.
b. Size of shade
c. Chain side location

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roller shades to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. HunterDouglas

2. Draper
3. MechoSystems

B. Source Limitations: Obtain roller shades from single source from single manufacturer.

2.2 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS: (RS-1, RS-2)

A. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.

1. Bead Chains: Manufacturer's standard

a. Loop Length: Full length of roller shade.
b. Limit Stops: Provide upper and lower ball stops.
c. Chain-Retainer Type: Chain tensioner, jamb mounted.
d. Chain operator to be included for all windows.

B. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.

1. Roller Drive-End Location: Right side of inside face of shade.
2. Direction of Shadeband Roll: Regular, from back of roller.
3. Shadeband-to-Roller Attachment: Manufacturer's standard method.

C. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.

D. Shadebands:

1. Shadeband Material: Light-filtering fabric. As Listed in the Interior Finish Key on the Drawings: Color and openness percentage to be selected from manufacturers full range.
2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.

E. Installation Accessories:

1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.

a. Single Fascia: Room Side Only (RS-1)
b. Double Fascia: Room and Window Sides (RS-2)
c. Shapes and heights of fasciae vary among manufacturers.
d. Shape: L-shaped.
e. Height: Manufacturer's standard height required to conceal roller and shadeband when shade is fully open, but not less than 4 inches.
f. Fascia end cap trim pieces to be provided where required.

2. Installation Accessories Color and Finish: To be selected from manufacturers full range.

2.3 SHADEBAND MATERIALS

A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

B. Light-Filtering Fabric: Woven fabric, stain and fade resistant.

1. Source: Roller-shade manufacturer.
2. Type: PVC-coated polyester.
3. Weave: Basketweave.
4. Roll Width: 48 inches.
5. Orientation on Shadeband: Up the bolt.
6. Openness Factor: To be selected by architect from manufacturer's full range. percent.
7. Color: As listed in “Interior Finish Key” on Drawings.

2.4 ROLLER-SHADE FABRICATION

A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.

B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at:

1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch per side or 1/2-inch total, plus or minus 1/8 inch. Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch, plus or minus 1/8 inch.

a. If jamb to jamb dimension exceeds maximum width available, roller shade seam location is to align with mullions and to be coordinated with architect with shop drawings indicating each shade length.

2. Outside of Jamb Installation: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.

C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible except as follows:

1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.
2. Skylight Shades: Provide battens and seams at uniform spacings along shadeband as required to ensure shadeband tracking and alignment through its full range of movement without distortion or sag of material.
3. Railroaded Materials: Railroad material where material roll width is less than the required width of shadeband and where indicated. Provide battens and seams as required by railroaded material to produce shadebands with full roll-width panel(s) plus, if required, one partial roll-width panel located at top of shadeband.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, accurate locations of connections to building electrical system, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ROLLER-SHADE INSTALLATION

A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.

1. Opaque Shadebands: Located so shadeband is not closer than 2 inches to interior face of glass. Allow clearances for window operation hardware.

3.3 ADJUSTING

A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

A. Clean roller-shade surfaces after installation, according to manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.

C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain motor-operated roller shades.

END OF SECTION 12 2413

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SECTION 12 3623.13 - PLASTIC-LAMINATE-CLAD COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plastic-laminate-clad countertops.
2. Accessories.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Plastic-laminate-clad countertops.
2. Accessories.

B. Product Data Submittals: For each product.

1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

C. Shop Drawings: For plastic-laminate-clad countertops.

1. Include plans, sections, details, and attachments to other work. Detail fabrication and installation, including field joints.
2. Show locations and sizes of cutouts and holes for items installed in plastic-laminate-clad countertops.

D. Samples for Verification: As follows:

1. Plastic Laminates: For each type, color, pattern, and surface finish required, 8 by 10 inches in size.
2. Wood-Grain Plastic Laminates: For each type, color, pattern, and surface finish required, 12 by 24 inches in size.
3. Fabrication Sample: For each type and profile of countertop required, provide one sample applied to core material with specified edge material applied to one edge.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer fabricator.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver countertops only after casework and supports on which they will be installed have been completed in installation areas.

B. Store countertops in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

C. Keep surfaces of countertops covered with protective covering during handling and installation.

1.6 FIELD CONDITIONS

A. Environmental Limitations with Humidity Control: Do not deliver or install countertops until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during the remainder of the construction period.

B. Field Measurements: Where countertops are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Established Dimensions: Where countertops are indicated to fit to other construction, establish dimensions for areas where countertops are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-CLAD COUNTERTOPS: (PL-1)

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of plastic-laminate-clad countertops indicated for construction, finishes, installation, and other requirements.

B. Grade: Premium.

C. High-Pressure Decorative Laminate: ISO 4586-3, Grade HGS.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following as Listed in “Interior Finish Legend” in Drawings:

    a. Formica
    b. Wilsonart
    c. Nevamar

D. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. Match Architect's sample.

E. Edge Treatment: 3.0-mm PVC edging.

F. Core Material: Particleboard or medium-density fiberboard.

G. Core Thickness: 3/4 inch to 1-1/4 inch.

1. Build up countertop thickness to 1-1/4 inches at front, back, and ends with additional layers of core material laminated to top.

H. Backer Sheet: Provide plastic-laminate backer sheet, ISO 4586-3, grade to match exposed surface, on underside of countertop substrate.

2.2 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard unless otherwise indicated.

1. Wood Moisture Content: 5 to 10 percent.

B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of countertop and quality grade specified unless otherwise indicated.

a. Particleboard: ANSI A208.1, Grade M-2, made with binder containing no urea formaldehyde.

2.3 ACCESSORIES

A. Metal Support Brackets: (B-1)

1. Rakks

a. B-1: EH-1818(18”x18”) for counters up to 24” deep
b. Finish: As indicated in the Interior Finish Key in drawings.
c. Spacing: maximum 48” center to center (with continuous blocking)

2.4 MISCELLANEOUS MATERIALS

A. Adhesives: Do not use adhesives that contain urea formaldehyde.

2.5 FABRICATION

A. Fabricate countertops to dimensions, profiles, and details indicated. Provide front and end overhang of 1 inch over base cabinets. Ease edges to radius indicated for the following:

1. Solid-Wood (Lumber) Members: 1/16 inch unless otherwise indicated.

B. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Notify Architect seven days in advance of the dates and times countertop fabrication will be complete.
2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended, and check measurements of assemblies against field measurements before disassembling for shipment.

C. Shop cut openings to maximum extent possible to receive appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

1. Seal edges of cutouts by saturating with varnish.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition countertops to average prevailing humidity conditions in installation areas.

B. Before installing countertops, examine shop-fabricated work for completion and complete work as required, including removal of packing.

3.2 INSTALLATION

A. Grade: Install countertops to comply with same grade as item to be installed.

B. Assemble countertops and complete fabrication at Project site to the extent that it was not completed in the shop.

1. Provide cutouts for appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
2. Seal edges of cutouts by saturating with varnish.

C. Field Jointing: Where possible, make in the same manner as shop jointing, using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.

1. Secure field joints in countertops with concealed clamping devices located within 6 inches of front and back edges and at intervals not exceeding 24 inches. Tighten in accordance with manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.

D. Scribe and cut countertops to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Countertop Installation: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.

1. Install countertops level and true in line. Use concealed shims as required to maintain not more than a 1/8-inch-in-96-inches variation from a straight, level plane.
2. Secure backsplashes to walls with adhesive.
3. Seal joints between countertop and backsplash, if any, and joints where countertop and backsplash abut walls with mildew-resistant silicone sealant or another permanently elastic sealing compound recommended by countertop material manufacturer.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective countertops, where possible, to eliminate functional and visual defects. Where not possible to repair, replace countertops. Adjust joinery for uniform appearance.

B. Clean countertops on exposed and semiexposed surfaces.

C. Protection: Provide Kraft paper or other suitable covering over countertop surfaces, taped to underside of countertop at a minimum of 48 inches o.c. Remove protection at Substantial Completion.

END OF SECTION 12 3623.13

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SECTION 12 3661.16 - SOLID SURFACING COUNTERTOPS, WINDOWSILLS AND WALL PANEL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid surface material countertops.
2. Solid surface material backsplashes.
3. Solid surface material end splashes.

B. Related Requirements:

1. Section 22 4100 "Residential Plumbing Fixtures" for non-integral sinks and plumbing fittings.

1.2 ACTION SUBMITTALS

A. Product Data: For countertop materials.

B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.

1. Show locations and details of joints.
2. Show direction of directional pattern, if any.

C. Samples for Verification: For the following products:

1. Countertop material, 6 inches square.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For solid surface material countertops to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.

B. Installer Qualifications: Fabricator of countertops.

1.6 FIELD CONDITIONS

A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.7 COORDINATION

A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.1 SOLID SURFACE COUNTERTOP MATERIALS: (SS-1, SS-2, SS-3)

A. Solid Surface Material: Homogeneous-filled plastic resin complying with ISFA 2-01.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following as Listed in “Interior Finish Legend” in Drawings:

    a. Formica
    b. Corian
    c. Wilsonart

2. Type: Provide Standard type or Veneer type made from material complying with requirements for Standard type, as indicated unless Special Purpose type is indicated.
3. Colors and Patterns: As Listed in “Interior Finish Legend” in Drawings.

B. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.

C. Composite Wood Products: Verify products are made without added urea formaldehyde.

2.2 FABRICATION

A. Fabricate countertops according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WI's "Architectural Woodwork Standards."

1. Grade: Premium.

B. Countertops:

1. 1/2-inch- thick or 3/4-inch- thick, solid surface material with front edge built up with same material (SS-1)

C. Backsplashes: 3/4-inch- thick, solid surface material (SS-1)

D. Windowsills: 3/4-inch- thick, solid surface material (SS-3)

E. Wall panels: 1/4-inch- thick, solid surface material (SS-2)

F. Fabricate tops with shop-applied edges unless otherwise indicated. Comply with solid surface material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

G. Joints:

1. Fabricate countertops in sections for joining in field.

    a. Joint Locations: Not within 18 inches of a sink or cooktop and not where a countertop section less than 36 inches long would result, unless unavoidable.
    b. Splined Joints: Accurately cut kerfs in edges at joints for insertion of metal splines to maintain alignment of surfaces at joints where indicated. Make width of cuts slightly more than thickness of splines to provide snug fit. Provide at least three splines in each joint.

H. Cutouts and Holes:

1. Undercounter Plumbing Fixtures: Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.

    a. Provide vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces of countertop and projecting 3/16 inch into fixture opening.

2. Counter-Mounted Plumbing Fixtures: Prepare countertops in shop for field cutting openings for counter-mounted fixtures. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.
3. Wire-management Cutouts: 2” Diameter circular opening with eases edges, rounded to 3/8- inch.

2.3 INSTALLATION MATERIALS

A. Metal Support Brackets: (B-1, B-2)

1. Rakks (B-1):

    a. EH-1818(18”x18”) for counters up to 24” deep
    b. Finish: As indicated in the Interior Finish Key in drawings.
    c. Spacing: maximum 48” center to center (with continuous blocking). As recommended by manufacturer.

2. Rakks (B-2):

    a. ADA – Compliant Vanity Support Bracket
    b. Finish: As indicated in the Interior Finish Key in drawings.
    c. Installed: As recommended by manufacturer.
3.

B. Adhesive: Product recommended by solid surface material manufacturer.

C. Sealant for Countertops: Comply with applicable requirements in Section 07 9200 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to receive solid surface material countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install countertops level to a tolerance of 1/8 inch in 8 feet, 1/4 inch maximum. Do not exceed 1/64-inch difference between planes of adjacent units.

B. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.

C. Secure countertops to subtops with adhesive according to solid surface material manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

D. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.

1. Install metal splines in kerfs in countertop edges at joints where indicated. Fill kerfs with adhesive before inserting splines and remove excess immediately after adjoining units are drawn into position.
2. Clamp units to temporary bracing, supports, or each other to ensure that countertops are properly aligned and joints are of specified width.

E. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.

F. Install aprons to backing and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears. Fasten by screwing through backing. Predrill holes for screws as recommended by manufacturer.

G. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.

1. Seal edges of cutouts in particleboard subtops by saturating with varnish.

H. Apply sealant to gaps at walls; comply with Section 07 9200 "Joint Sealants."

END OF SECTION 12 3661.16

SECTION 13 9000 - COVER SYSTEM FOR CONCEALMENT OF FIRE SPRINKLER SYSTEMS, PIPING, CONDUIT, WIRING AND CABLE

PART 1 - GENERAL

1.1 DESCRIPTION

A. The soffit/cover system shall incorporate a concealed snap-lock connection, which, once assembled, renders the cover essentially irremovable with the use of ordinary tools.

1.2 SUBMITTALS

A. Submit copies of manufacturer's shop drawings, installation instructions, and product data.

1.3 JOB CONDITIONS

A. Coordinate installation soffit/cover system with all other trades.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitation: Obtain soffit/cover system from a single source from a a single manufacturer.

B. Basis of Design Manufacturers:

1. JG Innovations, Inc.; 121 Burbank Avenue, P.O. Box 8128, Janesville, WI 53547-8128, Phone: (888) 933-2248, Fax: (608) 766-8202
2. In-Ex Systems, Inc.: 4473 Cavallon Way, Acworth, GA 30101 Phone: (800)-483-8201, Fax (678)-766-8202

2.2 MATERIALS

A. Cover System

1. A factory-fabricated steel cover support system with concealed surface-mounted attachment clamps, in dimensions as shown on the drawings for concealment of Fire Sprinkler Systems, Piping, HVAC, Conduit, Wiring or Cable
2. Support/Attachment Devices

    a. Spring steel shield clips of the size recommended by manufacturer, for securement of the cover. Clips shall be produced from 21 Gauge minimum zinc-plated spring steel and shall have a reverse curvature design such that the clips soundly secure the soffit from easy removal. Each clip must be demonstrated as being able to resist a force of 100 lbs. uplift at the free end. Test results shall be available upon request.

3. Soffit/Cover

a. The soffit/cover shall be smooth in appearance and shall be made of 20 Gauge A60/G90 galvannealed steel, with a paint grip finish and factory painted of a color to be specified by the owner's representative. The cover shall have a snap-lock interfacing with the clips such that once assembled, it is rendered virtually irremovable with the use of ordinary tools.
b. The soffit and related fittings shall be factory painted with Sherwin Williams epoxy polyester hybrid powder coating of a color to be specified by the architect. Matching touch-up paint shall be supplied to the owner by the manufacturer.
c. Cover manufacturer shall be staffed with a licensed engineer having a minimum of five years experience with such systems.
d. The soffit/cover shall be sized in accordance with requirements to accommodate the specific application size as specified by the project documents, specifications, and drawings, provided to the cover manufacturer prior to bid date.
e. L-Shield soffit profile for sidewall installations and/or U-Shield soffit profile for sidewall and/or pendant installations respectively.
f. Cover joints shall be butt-joined with interlocking internal splice couplings and/or with male/female interlocking joints. External couplings will NOT be allowed.

B. Accessories

1. The system shall include tamper-resistant end caps, prefabricated corners, wall flanges, couplings, and other items, which may be necessary to complete the system, and shall be installed in accordance with manufacturer recommendations.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation of system shall be in strict accordance with approved shop drawings and manufacturer's printed instructions.

1. If used to conceal fire sprinkler systems, the sprinkler contractor/engineer must determine the piping and sprinkler layout, including sprinkler head locations and pipe support locations (based on pipe manufacturer's specifications). Indicate areas on drawings where cover system is to be used.
2. Select appropriate fasteners for the substrate encountered to adequately secure the pipe and cover system.
3. To insure that the cover is linear and snug-fitting when installed, it is imperative that its support devices are anchored squarely and firmly against the structural surface in a straight line.
4. All penetrations to the soffit/cover system must be field cut to prevent misalignment with intended protrusion. The exceptions to this are that access doors will be factory furnished and installed and perforations, if required, for ventilation purposes will be factory perforated.
5. Guidelines for installation of modular soffit/cover system shall be supplied by the manufacturer of said system and the installing contractor shall adhere to the manufacturer's guidelines.
6. All field cut ends and scratches shall be "touched up" (spray or brush) with a matching paint.
7. Manufacturer shall supply on-site installation instruction, upon installer's request, by a qualified installation instructor for a minimum of one day for the project start-up (1,500 lineal feet minimum.)
8. The completed installation shall be visibly searched for voids between the interfacing of the cover and construction surface. Voids shall be sealed with a color matching siliconized caulk or urethane caulk.

END OF SECTION 13 9000

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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 2021 (IFC)

B. National Fire Protection Association Standards

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 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 21 0500 - 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. Sleeves.
3. Escutcheons.
4. Fire-suppression equipment and piping demolition.
5. Painting and finishing.
6. 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 QUALITY ASSURANCE

A. 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.

1.6 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 to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 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.

2.4 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.

2.5 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.

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.

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. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
    c. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece cast-brass type with polished chrome-plated finish.
    d. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type and set screw.
    e. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    f. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed hinge and set screw
    g. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
    h. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw
    i. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

2. Existing Piping: Use the following:

a. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and spring clips.
c. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and set screw.
e. Bare Piping in Unfinished Service Spaces: Split-casting, cast-brass type with polished chrome-plated finish.
f. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed hinge and set screw or spring clips.
g. Bare Piping in Equipment Rooms: Split-casting, cast-brass type.
h. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with set screw or spring clips.
i. 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. 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.

R. Verify final equipment locations for roughing-in.

S. 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. 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.

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.

END OF SECTION 21 0500

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SECTION 210553 - IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Pipe labels.
   2. Valve tags.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Valve Schedules: Valve numbering scheme.

PART 2 - PRODUCTS

2.1 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service and showing flow direction according to ASME A13.1.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe-Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

   1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
   2. Lettering Size: Size letters according to ASME A13.1 for piping.

E. Pipe-Label Colors:

   1. Background Color: Safety Red.
   2. Letter Color: White.

2.2 VALVE TAGS

A. Description: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping-system abbreviation and 1/2-inch (13-mm) numbers.

1. Tag Material: Brass, 0.032 inch (0.8 mm) thick, with predrilled holes for attachment hardware.
2. Fasteners: Brass wire-link chain.
3. Valve-Tag Color: Safety Red.
4. Letter Color: White.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

3.2 PIPE LABEL INSTALLATION

A. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection excluding short takeoffs. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit a view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet (15 m) along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

B. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes including pipes where flow is allowed in both directions.

3.3 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in fire-suppression piping systems. List tagged valves in a valve-tag schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below:

1. Valve-Tag Size and Shape:
   a. Wet-Pipe Sprinkler System: 1-1/2 inches (38 mm), round or square.

END OF SECTION 210553

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SECTION 21 1313 - 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. Sprinklers.

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. Building Service Areas: Ordinary Hazard, Group 1.
    b. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
    c. General Storage Areas: Ordinary Hazard, Group 1.
    d. Libraries except Stack Areas: Light Hazard.
    e. Library Stack Areas: Ordinary Hazard, Group 2.
    f. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
    g. Office and Public Areas: Light Hazard.
3. Minimum Density for Automatic-Sprinkler Piping Design:

a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.
d. Extra-Hazard, Group 1 Occupancy: 0.30 gpm over 2500-sq. ft. area.
e. Extra-Hazard, Group 2 Occupancy: 0.40 gpm over 2500-sq. ft. area.
f. Special Occupancy Hazard: As determined by authorities having jurisdiction.

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. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

C. 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.

D. Qualification Data: For qualified Installer and professional engineer.

E. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
1. Sprinklers shall be referred to on drawings, submittals, and other documentation by the sprinkler identification or Model number as specifically published in the appropriate agency listing or approval. Trade names or other abbreviated designations shall not be allowed.

F. Welding certificates.

G. Fire-hydrant flow test report.

H. 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."

I. Field quality-control reports.

J. 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. All grooved couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
1. All castings used for couplings housings, fittings, or valve and specialty bodies shall be date stamped for quality assurance and traceability.

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 Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13, "Installation of Sprinkler Systems."

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, Black-Schedule 40 Steel Pipe: ASTM A 53/A 53M, Type E- electrically resistance welded, Grade B. Pipe ends may be factory or field formed to match joining method.

B. Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.

C. Uncoated, Steel Couplings: ASTM A 865, threaded.

D. Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

E. Malleable- or Ductile-Iron Unions: UL 860.

F. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.

G. Grooved-Joint, Steel-Pipe Appurtenances:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Victaulic Company
    b. Anvil International, Inc.
    c. Shurjoint Piping Products.
    d. Tyco Fire & Building Products LP.

2. Pressure Rating: 175 psig minimum.
3. Uncoated, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, Grade 65-45-12 ductile-iron casting; with dimensions matching steel pipe. In applicable sizes, fittings shall be short pattern, with flow equal to standard pattern fittings.
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 center leg gasket, with pipe stop to ensure proper groove engagement, alignment and pipe insertion depth, and ASTM A449 electroplated steel bolts and nuts.
    a. Rigid Type: Housings cast with offsetting, angle-pattern, boldt pads to provide system rigidity and support and hanging in accordance with NFPA-13, fully installed at visual pad-to-pad offset contact. (Couplings that require exact gapping at specific torque ratings are not permitted.). Installation-Ready for complete installation without field disassembly. Basis of Design: Victaulic Style 108, 109, 009N, and 107N.
    b. Flexible Type: For use in locations where vibration attenuation and stress relief are required. Basis of Design: Victaulic Installation Ready Style 75, 77, and 177N.

H. 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: AWWA C110, rubber, flat face, 1/8 inch thick.

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. 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.

D. Groove Joint Lubricants: Lubricant gasket in accordance with the manufacturer's published instructions with lubricant approved for the gasket elastomer and fluid media.

2.4 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. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Victaulic Company.
    b. Anvil International, Inc.
    c. NIBCO INC.
    d. Tyco Fire & Building Products LP.
    e. Watts Water Technologies, Inc.

2.5 SPRINKLER SPECIALTY PIPE FITTINGS

A. Branch Outlet Fittings:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Victaulic Style 920/920N or comparable product by one of the following
    a. Victaulic Company.
    b. Tyco Fire & Building Products LP
    c. Anvil International, Inc.
    d. National Fittings, Inc.
    e. Shurjoint Piping Products.

2. Standard: UL 213.
3. Pressure Rating: 175 psig minimum.

4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
5. Type: Mechanical-T and -cross fittings.
6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
8. Branch Outlets: Grooved, plain-end pipe, or threaded.

2.6 SPRINKLERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Reliable Automatic Sprinkler Co., Inc.
   2. Tyco Fire & Building Products LP.
   3. 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. Nonresidential Applications: UL 199.
   2. 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.

   1. Characteristics:

      a. Nominal 1/2-inch Orifice: With Discharge Coefficient K between 5.3 and 5.8.
      b. Nominal 17/32-inch Orifice: With Discharge Coefficient K between 7.4 and 8.2.

E. Sprinkler Finishes:

   1. Chrome plated.
   2. Bronze.
   3. Painted.

F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

   1. Ceiling Mounting: Plastic, white finish, one piece, flat.
   2. Sidewall Mounting: Plastic, white finish, one piece, flat.

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.
e. Standard: UL 199.

2. Type: Wire cage with fastening device for attaching to sprinkler.
3. Escutcheons and guards shall be listed, supplied, and approved for use with the sprinkler by the sprinkler manufacturer.
4. Wrenches shall be provided by the sprinkler manufacturer that directly engage the wrench boss cast in the sprinkler body.

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 WATER-SUPPLY CONNECTIONS

A. Connect sprinkler piping to building's interior water-distribution piping. Comply with requirements for interior piping in Division 22 Section "Domestic Water Piping."

3.3 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 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.

D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

E. Install sprinkler piping with drains for complete system drainage.

F. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.

G. Fill sprinkler system piping with water.

H. 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."

3.4 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. 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.

G. 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.

H. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606 in accordance with the manufacturer’s latest published instructions. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints. Grooved coupling manufacturer’s factory trained field representative shall provide on-site training for contractor’s field personnel in the proper use of grooving tools, application of groove, and installation of grooved piping products. The factory trained representative shall periodically visit the jobsite to ensure best practices in grooved product installation are being followed. Contractor shall remove and replace any improperly installed products.

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.

3.6 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.

B. Do not install sprinklers that have been dropped, damaged, show a visible loss of fluid, or a cracked bulb.

C. The sprinkler bulb protector shall be removable by hand, without tools or devices that may damage the bulb.

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. 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, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

B. 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 roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

C. 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 roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved 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: Concealed sprinklers.
3. Wall Mounting: Sidewall sprinklers.

B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
2. Upright and Sidewall Sprinklers: Factory painted white in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view.

END OF SECTION 211313

SECTION 22 0100 – 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.

1.3 REFERENCED STANDARDS

A. International Plumbing Code 2021 (IPC)

B. 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 Ross & Baruzzini 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 Ross & Baruzzini.
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 Ross & Baruzzini 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 Ross & Baruzzini as to the accuracy or correctness of the information provided. Ross & Baruzzini 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.

PRODUCTS (NOT APPLICABLE)

PART 2 - EXECUTION

2.1 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

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SECTION 22 0500 – 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” 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. Pipe sleeves.
5. Escutcheons.
6. Penetration firestopping of fire-resistance-rated assemblies and/or smoke barriers by plumbing piping or conduit.
7. Labeling and identifying plumbing systems and equipment.
8. Non-shrink grout for equipment installations.
9. Painting and finishing of plumbing work.
10. Coordination with Structural work.
11. Selective Demolition.
12. 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, and identification materials and devices.

B. Shop Drawings: Detail fabrication and installation for supports and anchorage for plumbing materials and equipment.

C. Coordination Drawings: For access panel and door locations.

1.5 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.

1.6 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. 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-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.

C. 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.

D. Solder Filler Metals: ASTM B32 lead-free alloys. Include water-flushable flux according to ASTM B813.

E. 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.

F. Plastic Pipe Seals: ASTM F477, elastomeric gasket.

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 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 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.

2.6 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.

2.7 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."

2.8 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.

2.9 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.

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. Sleeves are not required for core-drilled holes.

J. Permanent sleeves are not required for holes formed by PE removable sleeves.

K. 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. Support for Suspended Equipment: As specified in Division 22 Section “Hangers and Supports.”

3.4 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.

3.5 PAINTING AND FINISHING

A. For all painting and finishing work required for plumbing installations, refer to Division 09 Sections for application requirements.

B. 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.

C. In addition, paint the following:

1. Equipment, and pipe insulation having ASJ or other paintable jacket material.

D. Primers specified above may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

3.6 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 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.

3.7 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.”

3.8 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.

3.9 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.

3.10 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 22 0500

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SECTION 22 0523 – VALVES

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 the following general-duty valves common to Division 22 plumbing piping systems:

1. Ball valves.
2. Butterfly valves.
3. Check valves.

B. Related Sections include the following:

1. Division 22 piping Sections for general-duty and specialty valves for site construction piping.
2. Division 21 fire-suppression piping and fire pump Sections for fire-protection valves.
3. Division 22 Section “Plumbing Identification” for valve tags and charts.
4. Division 22 piping Sections for specialty valves applicable to those Sections only.

1.3 DEFINITIONS

A. The following are standard abbreviations for valves used in this Section:

1. CWP: Cold working pressure (formerly WOG – Water, Oil, Gas working pressure).
2. EPDM: Ethylene-propylene-diene terpolymer rubber.
3. IBBM: Iron body, bronze-mounted.
4. PTFE: Polytetrafluoroethylene plastic.
5. SWP: Steam working pressure.
6. TFE: Tetrafluoroethylene plastic.
7. Class 125: Minimum 125-psig (860-kPa) SWP and minimum 200-psig (1380-kPa) CWP ratings.
8. Class 150: Minimum 150-psig (1035-kPa) SWP and minimum 300-psig (2070-kPa) CWP ratings.

1.4 SUBMITTALS

A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions;

and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

B. Maintenance Data: For each type of valve, to include in the operation and maintenance manual specified in Division 01. Include detailed manufacturer's instructions on adjusting, servicing, disassembling, and repairing.

1.5 QUALITY ASSURANCE

A. ASME Compliance: ASME B31.9 for building services piping valves.

B. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.

C. NSF Compliance: NSF 61 for valve materials for potable-water service in compliance with Public Law #111-380.

D. MSS Compliance: Comply with the various MSS Standard Practice documents referenced herein.

E. Buy-American: All valves shall be furnished from domestic sources (USA).

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set ball valves open to minimize exposure of functional surfaces.
4. Set butterfly valves closed or slightly open.
5. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. General: Subject to compliance with requirements, provide gate valves, globe valves, and swing check valves by one of the following:

1. Crane Co.; Crane Valve Group; Crane, Jenkins, & Stockham brands.
2. Grinnell Corporation.
3. Hammond Valve.
4. Milwaukee Valve Company.
5. NIBCO Inc.

6. Watts Industries, Inc.; Water Products Div.

B. Ball Valves: Subject to compliance with requirements, provide ball valves by one of the following:

1. Any of the manufacturers listed under the “General” subheading above.
2. Conbraco Industries, Inc.; Apollo Div.
3. Jamesbury, Inc.
4. Watts
5. Nibco

C. Standard-Performance Butterfly Valves: Subject to compliance with requirements, provide butterfly valves by one of the following:

1. Any of the manufacturers listed under the “General” subheading above.
2. Central Sprinkler Co.; Central Grooved Piping Products
3. Crane Co.; Crane Valve Group; Center Line brand.
4. General Signal; DeZurik Unit
5. McWane, Inc.; Kennedy Div.
6. Victaulic Co. of America.

D. Swing, piston and Wafer Check Valves: Subject to compliance with requirements, provide butterfly-style dual-plate wafer check valves, piston-style lift-disc, and swing check valves by one of the following: Any of the manufacturers listed under the “General” subheading above.
1. Nibco
2. Watts
3. Kennedy
4. Apollo

2.2 VALVES, COMMON REQUIREMENTS

A. General: Refer to Part 3 “Valve Applications Schedule” Article for application schedule of valves, end connections, and actuator types.

B. Valve Sizes: Same as upstream pipe size, unless otherwise indicated.

C. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.

D. Valve Grooved Ends: AWWA C606.

E. Valve Threaded Ends: With threads according to ASME B1.20.1.

F. Valve Bypass and Drain Connections: MSS SP-45.

G. Material Substitution: Ductile iron is acceptable anywhere cast iron is specified, but cast iron is not acceptable where ductile iron is specified.

H. Class Substitution: If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.

I. Chainwheel Operators: Where required, provide valve actuation assembly with ductile iron sprocket rim, brackets, and hot-dip galvanized steel chain; of type, number, size and fasteners as required for the host valve.

J. For piping systems required to be insulated, valve stems shall be extended to accommodate insulation. Refer to other Division 22 Sections for piping systems required to be insulated.

K. NSF Compliance: NSF Compliance: NSF 61 and NSF 372 for valve materials for potable-water service.

L. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

M. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

2.3 BALL VALVES

A. Liquid Service, Size NPS 2-1/2 and smaller:

1. General: Valve shall conform to MSS SP-110.
2. Minimum SWP rating: 150-psig (1035-kPa).
3. Minimum CWP rating: 600-psig (4140-kPa).
4. Body: ASTM B584 bronze, two-piece construction.
5. Ball: Type 316 stainless steel, full port.
6. Stem: Blowout-proof Type 316 stainless steel.
7. Seat/Packing: PTFE or TFE.
8. Ends: Threaded/Soldered.
9. Handle: Vinyl-covered steel lever with memory stop; and zinc-plated steel nut.

2.4 STANDARD-PERFORMANCE BUTTERFLY VALVES

A. General: Valve shall conform to MSS SP-67, Type I.

B. Minimum CWP rating: 175-psig (1207-kPa).

C. Body and bonnet: ASTM A536 ductile-iron, extended neck. Cast iron valves will be rejected.

D. Packing: Field-replaceable EPDM sleeve and stem seals.

E. Stem and Stem Hardware: Type 316 or 416 stainless steel.

F. Disc: Aluminum bronze or Type 316 stainless steel.

G. End Connections: Lug and flanged bodies are acceptable; wafer bodies are not acceptable. Grooved-end valve bodies are acceptable wherever grooved-end piping is permitted; refer to other Division 22 Sections for permitted applications of grooved-end piping.

H. Dead End Service: All butterfly valves shall be suitable for bi-directional dead-end service without downstream blind flange. Bolt holes on lugged valve bodies shall be threaded per ANSI B-1.1 coarse thread, with center stop, to accept cap screws from both directions.

I. Operator: Lever handle with ten-position latching mechanism, except where noted below.

1. Chainwheel Operators: Required for butterfly valves larger than NPS 4 (DN 100), if installed 96 inches (2400 mm) or higher above finished floor elevation.
2. Gear Drive: Required for butterfly valves NPS 8 (DN 200) and larger, and for any butterfly valves larger than NPS 4 (DN 100) if installed 96 inches (2400 mm) or higher above finished floor elevation, to accommodate a chainwheel operator.

2.5 CHECK VALVES

A. Bronze Swing Check Valve, NPS 2 (DN50) and smaller: Valve shall conform to MSS SP-80.

1. Minimum pressure rating: Class 150.
2. Body: ASTM B62 bronze body, y-pattern.
3. Bonnet: ASTM B62 bronze, threaded, removable for regrinding.
4. Disc and seat: Renewable; ASTM B62 bronze with bronze-alloy hinge pin.
5. Hardware: Bronze or bronze alloy.
6. Ends: Threaded.

B. Cast-Iron Swing Check Valves, NPS 2½ (DN65) and larger: Valve shall conform to MSS SP-71, Type I.

1. Minimum pressure rating: Class 125.
2. Body: ASTM A126 Cl. B cast-iron body and bronze-mounted (IBBM).
3. Bonnet: ASTM A126 Cl. B cast-iron, bolted to body with steel bolts.
4. Disc and seat: Renewable; Ductile-iron or bronze-alloy.
5. Ends: Flanged.

C. Wafer Check Valves, NPS 2½ (DN65) and larger: Valve shall conform to API 594.

1. Minimum pressure rating: Class 125.
2. Body: ASTM A126 Cl. B cast-iron.
3. Discs: Dual-plate aluminum bronze, spring-loaded, butterfly style.
4. Spring and hinge hardware: Type 316 stainless steel.
5. Ends: Wafer style, with diameter made to fit within bolt circle of adjacent flanges.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

D. Examine threads on valve and mating pipe for form and cleanliness.

E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

F. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves as indicated, according to manufacturer's written instructions.

B. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

C. Install isolation valves at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

D. Locate valves for easy access and provide separate support where necessary.

E. Install valves in horizontal piping with stem at or above center of pipe.

F. 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.

G. Install chainwheel operators where specified. Extend chains to within 60 inches (1520 mm) above finished floor elevation.

H. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level, or vertical with upward flow.
2. Dual-Plate Wafer Check Valves: In horizontal position, or vertical with upward flow.
3. Lift Check Valves: With stem upright and plumb.

3.3 JOINT CONSTRUCTION

A. Refer to Division 22 Section “Basic Plumbing Materials and Methods” for basic piping joint construction.

B. Grooved Joints: Assemble joints with keyed coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer’s written instructions.

C. Threaded Connections: Note the internal length of threads in valve ends and proximity of valve internal seat or wall to determine how far pipe should be threaded into valve.

1. Align threads at point of assembly.
2. Apply appropriate tape or thread compound to the external pipe threads, except where dry seal threading is specified.
3. Assemble joint, wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.

D. Flanged Connections: Align flange surfaces parallel.

1. 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 with a torque wrench.
2. For dead-end service, butterfly valves require flanges both upstream and downstream for proper shutoff and retention.

3.4 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.5 VALVE APPLICATIONS SCHEDULE

A. General: Refer to piping Sections and Drawings for specific valve applications. If no specific valve type is indicated, use the valve types indicated in the following schedules.

B. Domestic Water Piping: Choices are contractor's option unless a specific type of valve is specifically called out by name on the Drawings.

1. For shutoff duty, NPS 2 (DN 50) and smaller, use ball valves.
2. For shutoff duty, NPS 2½ (DN 65) and larger, use butterfly valves.
3. For one-way flow control other than at pump discharge, use swing check valves in all sizes.

END OF SECTION 220523

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SECTION 22 0529 – 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 200800 “Seismic Protection,” 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. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Equipment supports.

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. Equipment supports.
5. Trapeze pipe hangers. Include Product Data for components.
6. Metal framing systems. Include Product Data for components.
7. Pipe stands. 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.”

1.7 BUY AMERICAN ACT

A. The Contractor shall use only domestic construction materials and components in performing under these specifications in accordance with the Buy American Act (41 USC 10a-10d) or shall submit waivers for same as permitted thereunder.

B. Each material or component must be manufactured in the United States and the cost of the domestic sub-components must exceed 50% of the cost of all the components unless one or more exceptions apply under the Buy American Act.

C. Comply by either certifying that the materials purchased for the project meet the criteria or apply for a waiver. Document compliance by one of these methods as part of each product’s shop drawing submittal.

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.

B. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.

2. Galvanized Metallic Coatings: Pre-galvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon 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 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.

2.7 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.8 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. 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 nonmetallic coatings on attachments for electrolytic protection, where hangers are in direct contact with copper tubing.

E. Use padded hangers for piping that is subject to scratching.

F. 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.

G. 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).

H. 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).

I. 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.

J. 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.

K. 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.

L. 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).

M. 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. Support vertical runs at roof, at each floor, and at 10-foot (3-m) intervals between floors.

E. Rod diameters may be reduced one size for double-rod hangers, with 3/8-inch (10 mm) minimum rods.

F. 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.

L. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.

M. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

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

SECTION 22 0700 -PLUMBING PIPE INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Section 20 0800 “Seismic Protection,” Section 22 01 00 “Basic Plumbing Requirements,” and Section 22 0500 “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 plumbing insulation for, equipment, piping, and other installations, including the following:

1. Insulation Materials:
   a. Flexible elastomeric.
   b. Mineral fiber.
2. Protective shielding guards.

B. Related Sections include the following:

1.3 DEFINITIONS

A. ASJ: All-service jacket.

B. FSK: Foil, scrim, kraft paper.

C. SSL: Self-sealing lap.

D. Thermal Resistivity: “R-values” represent the reciprocal of thermal conductivity (k-value). Thermal conductivity is the rate of heat flow through a homogenous material exactly 1-inch thick. Thermal resistivities are expressed by the temperature difference in degrees F between two exposed faces required to cause one BTU to flow through one square foot of material, in one hour, at a given mean temperature.

E. Refer to Division 22 Section “Basic Plumbing Materials and Methods” for definitions of finished, interior, exterior, exposed, and concealed locations.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated, identify thermal conductivity, thickness, and jackets (both factory and field applied, if any).

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Fire-Test-Response Characteristics: Insulation and related materials shall have flame-spread index of 25 or less, and smoke-developed index of 50 or less, as determined by testing identical

products per ASTM E84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section “Hangers and Supports.”

B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:

1. Flexible Elastomeric Insulation:

    a. Aeroflex USA Inc.; Aerocel.
    b. Armacell LLC; AP Armaflex.
    c. K-Flex USA; Insul-Lock® Seam-Seal.
    d. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.

2. Mineral-Fiber, Preformed Pipe Insulation:

    a. Johns Manville.
    b. Knauf Insulation.
    c. Manson Insulation Inc.
    d. Owens Corning.

2.2 INSULATION MATERIALS

A. Refer to Schedule in Part 3 for requirements about where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Adhesives shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

G. 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: 0.27 average maximum at 100ºF mean temperature.
2. Adhesive: Comply with MIL-A-24179A, Type II, Class I.
3. Low-emitting (VOC) adhesive.

H. Mineral-Fiber, Preformed Pipe Insulation: Type I, 850ºF (454 C); mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C547, Type I, Grade A, with factory-applied jacket.

1. Thermal Conductivity: 0.26 average maximum at 75°F mean temperature.
2. Jacket: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I; with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.
3. Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
4. Low emitting (VOC) adhesive.

2.3 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers.
1. Description: Manufactured plastic wraps for covering plumbing fixture trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.
2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain plumbing. Comply with ADA requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 COMMON INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, fittings, and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4-inches (100 mm) o.c.
3. Overlap jacket longitudinal seams at least 1½-inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2-inches (50 mm) o.c.
4. For below ambient services, apply vapor-barrier mastic over staples.
5. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
6. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4-inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

O. At the following locations, omit jacket and provide a separate cutaway removable segment of insulation clearly labeled “Access.” For below-ambient services, provide a design that allows access but maintains vapor barrier.

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

B. Insulation Installation at Fire-Rated Wall and Partition Penetrations:

1. Install pipe insulation continuously through pipe penetrations of fire-rated walls and partitions.
2. Firestopping and fire-resistive joint sealers are specified in Division 07 Section “Penetration Firestopping.”

C. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies according to Division 07 Section “Penetration Firestopping.”

3.5 PIPE INSULATION INSTALLATION

A. Requirements in this Article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with tape or bands and tighten without deforming insulation materials. If furnished in half sections, orient longitudinal joints at 3 and 9 o'clock positions on the pipe.
2. All insulation shall be tightly butted and free of voids and gaps at all joints.
3. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
4. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6-inches (150 mm) o.c.
5. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant. Vapor barrier must be continuous.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
3. Cut sectional pipe insulation to fit. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.

D. Insulation Installation on Valves, Strainers, Unions, and Specials:

1. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation over valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
4. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
5. Insulate unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
6. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
7. For services not specified to receive a field-applied jacket except for flexible elastomeric, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
8. Stencil or label the outside insulation jacket of each union with the word “UNION.” Match size and color of pipe labels.

E. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.

3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2-inches (50 mm) over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

F. Special Requirements for Flexible Elastomeric Insulation Installation: Seal all transverse seams, longitudinal seams, end joints, and section joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.6 FINISHES

A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.7 PIPING INSULATION SCHEDULE, GENERAL

A. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Fire-suppression piping.
2. Drainage (sanitary/waste) piping located in crawl spaces.
3. Below-grade piping.
4. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

B. Hot Surfaces: For piping services denoted all piping surfaces including but not limited to pipe, flanges, fittings, valves of every kind, strainers, unions, and other appurtenances shall be insulated to avoid potential for personnel injury via contact with hot surface.

C. Cold Surfaces: For piping surfaces operating below surrounding ambient temperature, all piping surfaces including but not limited to pipe, flanges, fittings, valves of every kind, strainers, unions, and other appurtenances shall be insulated and shall include uninterrupted vapor barrier to avoid potential condensation.

3.8 PIPE INSULATION SCHEDULE, INDOORS

A. Domestic Cold Water:

1. Insulation shall be any of the following:
   a. Flexible Elastomeric: 1-inch (25 mm) thick.

B. Domestic Hot-Water Supply and Return, 140ºF and below:

1. NPS 1¼ and Smaller: Insulation shall be Flexible Elastomeric: 1-inch thick.

2. NPS 1½ and Larger: Insulation shall be Flexible Elastomeric: 1-1/2 inches thick.

C. Domestic Water Branch Piping to Fixtures within Walls/Chases (Hot and Cold; Non-Recirculated):

1. NPS 2 (DN 50) and smaller: Insulation shall be flexible elastomeric, 1/2 inch thick.

END OF SECTION 22 0700

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Section 200800 “Seismic Protection,” 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. Copper tube and fittings.
   2. Piping joining materials.
   3. Transition fittings.
   4. Dielectric fittings.

1.3 ACTION SUBMITTALS

A. Product Data: For transition fittings and dielectric fittings.

1.4 INFORMATIONAL SUBMITTALS

A. System purging and disinfecting activities report.

B. Field quality-control reports.

1.5 FIELD CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
   1. Notify Construction Manager and Owner no fewer than fourteen days in advance of proposed interruption of water service.
   2. Do not interrupt water service without Owner’s written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

B. Potable-water piping and components shall comply with NSF 14 and NSF 61 Annex G. Plastic piping components shall be marked with "NSF-pw."

C. Comply with NSF Standard 372 for low lead.

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.

B. Soft Copper Tube: ASTM B 88, Type K and water tube, annealed temper.

C. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

D. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

E. Copper Unions:
   1. MSS SP-123.
   2. Cast-copper-alloy, hexagonal-stock body.
   3. Ball-and-socket, metal-to-metal seating surfaces.
   4. Solder-joint or threaded ends.

F. Copper-Tube, Extruded-Tee Connections:
   1. Description: Tee formed in copper tube according to ASTM F 2014.

2.3 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:
   1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
   2. Full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys.

D. Flux: ASTM B 813, water flushable.

2.4 TRANSITION FITTINGS

A. General Requirements:
   1. Same size as pipes to be joined.
   2. Pressure rating at least equal to pipes to be joined.
   3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Sleeve-Type Transition Coupling: AWWA C219.

2.5 DIELECTRIC FITTINGS

A. See Section 220500 “Basic Plumbing Materials and Methods”.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install shutoff valve immediately upstream of each dielectric fitting.

C. Install domestic water piping level without pitch and plumb.

D. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

E. 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.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

G. Install piping to permit valve servicing.

H. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

I. Install piping free of sags and bends.

J. Install fittings for changes in direction and branch connections.

K. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

L. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220500 “Basic Plumbing Materials and Methods."

M. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220500 “Basic Plumbing Materials and Methods." Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220500 “Basic Plumbing Materials and Methods."

3.3 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

D. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

E. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.4 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

3.5 DIELECTRIC FITTING INSTALLATION

A. See section 220500 “Basic Plumbing Material and Methods”.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

3.7 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."

B. Label pressure piping with system operating pressure.

3.8 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Piping Inspections:

    a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
    b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

        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 authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.

    c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
    d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:

    a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
    b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
    c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
    d. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.

e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.9 ADJUSTING

A. Perform the following adjustments before operation:
1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
a. Adjust calibrated balancing valves to flows indicated.
4. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
5. Remove and clean strainer screens. Close drain valves and replace drain plugs.
6. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
7. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.10 CLEANING

A. Clean and disinfect potable domestic water piping as follows:
1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:

a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
b. Fill and isolate system according to either of the following:

1) Fill system or part thereof with water/chlorine solution with at least 50 ppm (50 mg/L) of chlorine. Isolate with valves and allow to stand for 24 hours.
2) Fill system or part thereof with water/chlorine solution with at least 200 ppm (200 mg/L) of chlorine. Isolate and allow to stand for three hours.

c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
d. Repeat procedures if biological examination shows contamination.
e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Clean non-potable domestic water piping as follows:
1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:

a. Flush piping system with clean, potable water until dirty water does not appear at outlets.

b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.11 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Aboveground domestic water piping, NPS 3 and smaller, shall be one of the following:
   1. Hard copper tube, ASTM B 88, Type L; wrought- copper, solder-joint fittings; and soldered joints.

3.12 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
   1. Shutoff Duty: Use ball valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
   2. Hot-Water Circulation Piping, Balancing Duty: Calibrated balancing valves.
   3. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION 221116

SECTION 22 1119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Section 20 0800 “Seismic Protection,” Section 22 0100 “Basic Plumbing Requirements,” and Section 22 0500 “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. Backflow preventers.
   2. Balancing valves.
   3. Water-hammer arresters.
   4. Specialty valves.
   5. Flexible connectors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For domestic water piping specialties.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Potable-water piping and components shall comply with NSF 61 Annex G.

2.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig (860 kPa) unless otherwise indicated.

2.3 BACKFLOW PREVENTERS

A. Dual-Check-Valve Backflow Preventers:
   1. Acceptable manufacturers: WATTS, Apollo and Zurn.
   2. Standard: ASSE 1024.
   3. Operation: Continuous-pressure applications.
   4. Body: Bronze with union inlet.

2.4 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:
   1. Acceptable manufacturers: Bell & Gossett, WATTS and Nibco.
   2. Type: Ball or Y-pattern globe valve with two readout ports and memory-setting indicator.
   3. Body: Brass or bronze.
   4. Size: Same as connected piping, but not larger than NPS 2 (DN 50).
   5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

2.5 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Individual-Fixture, Water Tempering Valves:
   1. Acceptable manufacturers: Leonard, Bradley, Zurn and Wilkins.
   2. Standard: ASSE 1070 , thermostatically controlled, water tempering valve.
   3. Pressure Rating: 125 psig (860 kPa) minimum unless otherwise indicated.
   4. Body: Bronze body with corrosion-resistant interior components.
   5. Temperature Control: Adjustable.
   6. Inlets and Outlet: Threaded.
   7. Finish: Rough or chrome-plated bronze.
   8. Tempered-Water Setting: [**105 °F]**

2.6 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:
   1. Acceptable manufacturers: PPP Inc., WATTS, Sioux Chief.
   2. Standard: ASSE 1010 or PDI-WH 201.
   3. Type: Copper tube with piston.
   4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.7 FLEXIBLE CONNECTORS

A. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
   1. Working-Pressure Rating: Minimum 200 psig (1380 kPa).
   2. End Connections NPS 2 (DN 50) and Smaller: Threaded steel-pipe nipple.
   3. End Connections NPS 2-1/2 (DN 65) and Larger: Flanged steel nipple.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
   1. Locate backflow preventers in same room as connected equipment or system.
   2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
   3. Do not install bypass piping around backflow preventers.

B. Install balancing valves in locations where they can easily be adjusted.

C. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
   1. Install cabinet-type units recessed in or surface mounted on wall as specified.

D. Install water-hammer arresters in water piping according to PDI-WH 201.

E. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

F. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.

3.2 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
   1. Coordinate list below with products retained in Part 2.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Test each reduced-pressure-principle backflow preventer and double-check, backflow-prevention assembly according to authorities having jurisdiction and the device's reference standard.

B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.4 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

END OF SECTION 221119

SECTION 22 1316 - 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.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. 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.

2.2 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.3 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 , water tube, drawn temper.

D. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.4 PVC PIPE AND FITTINGS

A. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-DWV" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

B. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

C. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

D. Adhesive Primer: ASTM F 656.
   1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Adhesive primer shall comply with the testing and product requirements of the California Department of Health Services, “Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers.”

E. Solvent Cement: ASTM D 2564.
   1. Adhesive primer shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Adhesive primer shall comply with the testing and product requirements of the California Department of Health Services, “Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers.”

2.5 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

   1. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
   2. Unshielded, Non-pressure Transition Couplings:

      a. Acceptable manufacturers; Fernco, Anaco-Huskey, and Joints Coupling.

      b. Standard: ASTM C 1173.
      c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
      d. End Connections: Same size as and compatible with pipes to be joined.
      e. Sleeve Materials:

1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

3. Shielded, Non-pressure Transition Couplings:

a. Acceptable manufacturers; Mission, MIFAB, or CREMCO.

b. Standard: ASTM C 1460.
c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
d. End Connections: Same size as and compatible with pipes to be joined.

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. 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.

K. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:

1. Building Sanitary Waste: 1 percent downward in direction of flow for piping NPS 2 and smaller; 1 percent downward in direction of flow for piping NPS 3 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.

L. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."

M. Install aboveground PVC piping according to ASTM D 2665.

N. Install underground PVC piping according to ASTM D 2321.

O. Plumbing Specialties:

1. Install drains in sanitary waste gravity-flow piping.

a. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."

P. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

Q. 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."

R. 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."

2. 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."

2. JOINT CONSTRUCTION

S. 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.

T. 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.

U. Plastic, Non-pressure-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. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 appendixes.

3.3 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in ODs.
2. In Waste Drainage Piping: Shielded, non-pressure transition couplings.

B. Dielectric Fittings:

1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.
3. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flange kits.

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

3.5 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. Comply with requirements for cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."
6. 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. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

E. 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.

3.6 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping.

B. Comply with requirements for identification specified in Section 220500 "Basic Plumbing Materials and Methods"

3.7 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of 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.

3.8 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. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

E. Repair damage to adjacent materials caused by waste and vent piping installation.

3.9 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground, soil and waste piping NPS 4 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, CISPI hubless-piping couplings; and coupled joints.
3. Copper Type DWV tube, copper drainage fittings, and soldered joints.
4. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

C. Aboveground, vent piping NPS 4 and smaller shall be any of the following:
1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

D. Underground, soil, waste, and vent piping NPS 6 and smaller shall be any of the following:
1. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

END OF SECTION 221316

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SECTION 22 1319 - 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. Cleanouts.
   2. Through-penetration firestop assemblies.
   3. Miscellaneous sanitary drainage piping specialties.
   4. Floor drains.

B. Related Requirements:

1.3 DEFINITIONS

A. PVC: Polyvinyl chloride.

B. FRP: Fiberglass-reinforced plastic.

C. HDPE: High-density polyethylene.

D. PE: Polyethylene.

E. PP: Polypropylene.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 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 CLEANOUTS

A. Cast-Iron Exposed Cleanouts:

1. Approved manufacturers are J. R. Smith, Josam, and Zurn.
2. Standard: ASME A112.36.2M.
3. Size: Same as connected drainage piping
4. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch as required to match connected piping.
5. Closure: Countersunk or raised-head, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Cast-Iron Exposed Floor Cleanouts:

1. Approved manufacturers are J. R. Smith, Josam, and Zurn.
2. Standard: ASME A112.36.2M for adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Adjustable housing
5. Body or Ferrule: Cast iron.
6. Clamping Device: Required.
7. Outlet Connection: Inside calk.
8. Closure: Brass plug with tapered threads.
9. Adjustable Housing Material: Cast iron with threads.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Medium Duty.
13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts:

1. Approved manufacturers are J. R. Smith, Josam, and Zurn.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hub-and-spigot, cast-iron soil pipe T-branch as required to match connected piping.
5. Closure Plug:
    a. Brass.
    b. Countersunk or raised head.
    c. Drilled and threaded for cover attachment screw.
    d. Size: Same as or not more than one size smaller than cleanout size.
6. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
7. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

2.3 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.

2.4 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.

2.5 FLOOR DRAINS

A. Cast-Iron Floor Drains:

1. Approved manufacturers are Josam, J. R. Smith and Zurn.

2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Gray iron.
5. Seepage Flange: Required.
6. Anchor Flange: Required.
7. Clamping Device: Required.
8. Outlet: Bottom.
9. Top or Strainer Material: Nickel bronze.
10. Top of Body and Strainer Finish: Nickel bronze
11. Top Shape: Round.
12. Top Loading Classification: Medium Duty.

PART 3 - EXECUTION

3.1 INSTALLATION

A. 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.

B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

D. 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."

E. 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."

F. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.

1. Comply with requirements in Section 078413 "Penetration Firestopping."

G. Install deep-seal traps on floor drains and other waste outlets, if indicated.

H. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

I. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.

J. Install fire-rated wood-blocking reinforcement for wall-mounting-type specialties.

K. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

L. Install 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.

6. Set grates of drains flush with finished surface, unless otherwise indicated.

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."

3.3 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."

3.4 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

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SECTION 22 4300 - PLUMBING FIXTURES

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 the following fixtures and specialties:

1. Water closets.
2. Flushometer valves.
3. Toilet seats.
4. Sinks.
5. Supports.
6. Lavatories.
7. Urinals.
8. Service sinks.
9. Electric water coolers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fixtures.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Sustainable Design Submittals.

C. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For plumbing fixtures and faucets to include in operation and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Servicing and adjustments of flushometer valves.

PART 2 - PRODUCTS

2.1 WATER CLOSETS

A. Water Closets.

1. Acceptable manufacturers: Kohler and American Standard

2.2 URINALS

A. Urinals.

1. Acceptable manufacturers: Kohler, American Standard and Zurn.

2.3 FLUSH VALVES

A. Flush valves.

1. Acceptable manufacturers: Sloan, Zurn and Toto.

2.4 LAVATORIES

A. Lavatories.

1. Acceptable manufacturers: Kohler, American Standard and Sloan.

2.5 LAVATORY FAUCETS

A. Lavatory faucets.

1. Acceptable manufacturers: Sloan and Zurn.

2. For public lavatories include ASSE 1070 certified mixing device, see Section 221119 “Domestic Water Piping Specialties”.

2.6 TOILET SEATS

A. Toilet Seats.

1. Acceptable manufacturers: Bemis, Church, and Beneke.

2.7 SERVICE SINKS

A. Service sinks.

1. Acceptable manufacturers: Fiat, Stern Williams and E.L. Mustee & Sons.

2.8 ELECTRIC WATER COOLERS

A. Electric water coolers.

1. Acceptable manufacturers: Oasis, Elkay and Haws.

2.9 SINK FAUCETS

A. Sink faucets.

1. Acceptable manufacturers: Sloan, T&S, American Standard, Kohler, , Zurn and Chicago Faucet.

2.10 SUPPORTS (CARRIERS)

A. Supports (carriers).

1. Acceptable manufacturers: Zurn, Josam and Jay R. Smith.

2.11 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF 61 Annex G, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Supply Piping: Chrome-plated brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass or stainless-steel wall flange.

D. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

E. Operation: Loose key.

F. Risers: NPS 1/2 (DN 15) chrome-plated, rigid-copper pipe and brass straight or offset tailpieces.

2.12 WASTE FITTINGS

A. Waste fittings

1. Acceptable manufacturers: Keeney Mfg, Wolverine Brass and Dearborn Brass.

2.13 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.

B. Examine walls, floors, cabinets, and counters for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install plumbing fixtures level and plumb according to roughing-in drawings & manufacturer's instructions.

B. Install supports, affixed to building substrate, for wall-mounted fixtures.

1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.

C. Install counter-mounted fixtures in and attached to casework.

D. Install water-supply piping with stop on each supply to each fixture, including showers, to be connected to water-distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.

1. Exception: Use ball or gate valve if supply stops are not specified with fixture. Comply with valve requirements specified in Section 220523 "Ball Valves."

E. Install flushometer valves on water closets & urinals.

F. Install flushometer valves for accessible water closets & urinals with lever handle mounted on wide side of compartment.

G. Install toilet seats on water closets.

H. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts, if faucets are not available with required rates and patterns. Include adapters if required.

I. Install laminar-flow, faucet-spout fittings in faucet spouts where laminar-flow fittings are specified.

J. Install shower flow-control fittings with specified maximum flow rates in shower arms.

K. Install traps on fixture outlets.

1. Exception: Omit trap on fixtures with integral traps.

L. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

M. Seal joints between plumbing fixtures, counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

N. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220500 "Valves.."

O. Install accessible plumbing fixtures at handicapped/elderly mounting heights according to ICC/ANSI A117.1.

P. Install an ASSE 1070 mixing device at each point of use location for every public lavatory.

3.3 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with requirements for water piping specified in Section 221116 "Domestic Water Piping."

C. Comply with requirements for soil and waste drainage piping and vent piping specified in Section 221316 "Sanitary Waste and Vent Piping."

D. Comply with requirements for atmospheric vent piping specified in Section 221316 "Sanitary Waste and Vent Piping."

E. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.4 ADJUSTING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning plumbing fixtures, fittings, and controls.

B. Adjust water pressure at faucets and flushometer valves to produce proper flow.

C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

A. After installing plumbing fixtures, inspect and repair damaged finishes.

B. Clean plumbing fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed fixtures and fittings.

D. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224300

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SECTION 23 0100 – BASIC MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes general administrative and procedural requirements for mechanical 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.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this and the other sections of Division 23.

1.3 CONTRACTOR'S SUBMITTAL RESPONSIBILITIES

A. General: Follow the procedures specified in Division 01. In addition to the requirements specified in Division 01, comply with the following:

1. Increase by two (2) the quantity of print copies required by Division 01 for submittals, if paper submittals are used. (Paperless electronic submittals are preferred.)
2. Electronic Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number. Transmit via email. Include PDF transmittal form. Include information in email subject line as to project name, project number, submittal number, and applicable specification section number.
3. Submit line-by-line specification verification for equipment other than the "basis of design" as further described in the following article "Material and Equipment Selection".

B. 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.

C. 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.

D. 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.

E. 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.

F. Refer to Division 01 and each individual Division 23 Section for additional submittal requirements.

1.4 REFERENCED STANDARDS

A. American Society of Heating, Refrigerating and Air-Conditioning Engineers. Guideline 4-2008 (RA 2013) *Preparation of Operating and Maintenance Documentation for Building Systems*. Atlanta, GA: ASHRAE, 1993.

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 23 section, do not assume that the selection of materials is the contractor's option. Refer to "Part 3 – Execution" subsection of that same Division 23 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.

1.6 COORDINATION DRAWINGS

A. Prepare project coordination drawings 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 HVAC piping, plumbing 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.
13. 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.

1.7 ELECTRONIC MEDIA AND FILES

A. Electronic media files of the contract drawings in AutoCAD or PDF format and copies of the specifications in PDF format may be requested.

B. Complete and return a signed “Electronic File Transmittal” form provided by Introba upon request for electronic media.

C. 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.

D. 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.

E. The drawings prepared by Introba for bidding purposes may not be used directly for raceway layout drawings or coordination drawings.

F. 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.

G. 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.

1.8 RECORD DOCUMENTS

A. 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. Ductwork mains and branches, size and location, for both exterior and interior; locations of dampers and other control devices; filters, boxes, and terminal units requiring periodic maintenance or repair.
2. 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.
3. Valve location diagrams, complete with valve tag chart. Refer to Division 23 Section “Basic Mechanical Materials and Methods.”
4. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
5. Approved substitutions, Contract Modifications, and actual equipment and materials installed.
6. Contract Modifications, actual equipment and materials installed.

1.9 MAINTENANCE MANUALS

A. 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.

B. In addition to the above, comply with ASHRAE Guideline 4-2008 (RA 2013) *Preparation of Operating and Maintenance Documentation for Building Systems*.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. During construction, meet or exceed the recommended Design Approaches of SMACNA *IAQ Guideline for Occupied Buildings under Construction*.

B. 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 23 0100

SECTION 23 0500 – 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. Flexible pipe connectors.
4. Modular sleeve seals.
5. Pipe sleeves.
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. Non-shrink grout for equipment installations.
9. Painting and finishing of mechanical work.
10. Concrete base construction requirements.
11. Coordination with Structural work.
12. Field-fabricated equipment supports.
13. Selective Demolition.
14. 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. Section 23 0100 “Basic Mechanical Requirements” applies to the work of this Section as if fully repeated herein.

C. 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 transition couplings, flexible pipe connectors, modular sleeve seals, and identification materials and devices.

B. Shop Drawings: Detail fabrication and installation for supports and anchorage for mechanical materials and equipment.

C. Coordination Drawings: For access panel and door locations.

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.

I. Unless otherwise noted, install all ductwork above all other systems. Coordinate with all other disciplines. Provide required access to duct mounted access doors and dampers.

J. Dielectric fittings are not allowed. Install bronze shutoff valve where dissimilar metals are joined. Valve must be installed in an accessible area or above an access panel.

K. All work that will shut down existing utilities must be coordinated a minimum seven (7) days in advance.

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. Flexible Pipe Connectors:

    a. Anvil International.
    b. Flexicraft Industries, Inc.
    c. Hyspan Precision Products, Inc.
    d. Mason Industries, Inc.
    e. The Metraflex Company
    f. Proco Products, Inc.

3. Modular Sleeve Seals:

    a. Calpico, Inc.
    b. Flexicraft Industries, Inc. “PipeSeal”
    c. GPT div. of EnPro Industries, Inc “Link-Seal”
    d. The Metraflex Company

4. 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. Solder Filler Metals: ASTM B32 lead-free alloys. Include water-flushable flux according to ASTM B813.

F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

G. 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.

H. Plastic Pipe Seals: ASTM F477, elastomeric gasket.

I. Flanged, Ductile-Iron Pipe Gasket, Bolts, and Nuts: AWWA C110, rubber gasket, carbon-steel bolts and nuts unless noted otherwise.

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.

J. Transition Couplings: Iron-body sleeve assembly, fabricated to match OD of plain-end, pressure pipes.

1. Sleeve: ASTM A126, Class B, gray iron.
2. Followers: ASTM A47 (ASTM A47M) malleable iron or ASTM A536 ductile iron.
3. Gaskets: Rubber.
4. Bolts and Nuts: AWWA C111.
5. Finish: Enamel paint.

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. 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. Refer to Division 07 Firestop specifications.

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. Pressure-Sensitive Pipe Markers: Manufacturer's standard preprinted, permanent adhesive, color-coded, pressure-sensitive vinyl, complying with ASME A13.1.

1. Nomenclature: Heating Water Supply, Heating Water Return, Chilled Water Supply, Chilled 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.
4. Pipe Size: Indicate nominal pipe size, in inches, on each label.
5. Example: ←2" CHILLED WATER RETURN←

E. Plastic Duct Markers: Manufacturer's standard color-coded, laminated plastic. Comply with the following color code:

1. Green: Cold air.
2. Yellow: Hot air.

3. Yellow/Green or Green: Supply air.
4. Blue: Exhaust, outside, return, and mixed air.
5. For hazardous exhausts, use colors and designs recommended by ASME A13.1.
6. Nomenclature: Include direction of airflow and duct service.
7. Example: ←RETURN AIR←

F. 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.

G. 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.

H. Valve Tag Fasteners: Brass, wire-link chain or stainless steel beaded chain.

I. 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."

2.9 CONCRETE AND GROUT

A. Concrete: For all minor concrete work required for mechanical 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 23 as if fully reproduced herein.

2.10 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.

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. Install piping to allow application of insulation plus 1-inch (25-mm) clearance around insulation.

K. Locate groups of pipes parallel to each other, spaced to permit valve servicing.

L. Install fittings for changes in direction and branch connections.

M. Install couplings according to manufacturer's written instructions.

N. Piping Support: As specified in Division 23 Section "Hangers and Supports."

O. All flexible pipe connectors shall be installed in accessible locations. Shut-off valve shall be installed between pipe main and flexible connector.

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. 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.

F. 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.

G. 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.

H. 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.

I. Piping Connections: Make connections according to the following, unless otherwise indicated.

1. Install unions, in piping 2-inch NPS (DN50) and smaller, adjacent to each valve and 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. 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.

B. Install sleeves for pipes passing through concrete and masonry walls, and concrete floor and roof slabs.

C. 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.

D. 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.

E. Build sleeves into new walls and slabs as work progresses.

F. 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.

G. 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.

H. 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.

I. Sleeves are not required for core-drilled holes.

J. Permanent sleeves are not required for holes formed by PE removable sleeves.

K. 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. Where detailed on the Drawings.

F. Support for Suspended Equipment: As specified in Division 23 Section “Hangers and Supports.”

3.6 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.

3.7 PAINTING AND FINISHING

A. For all painting and finishing work required for mechanical installations, refer to Division 09 Sections for application requirements.

B. 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.

C. 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.
3. Mechanical room floors and all equipment curb edges.

D. Steel Substrates: Primer, alkyd, anti-corrosive, for metal, MPI #79; plus topcoat of latex, interior, semi-gloss, MPI #54.

E. Galvanized-Metal Substrates: Primer, galvanized, water based, MPI #134; plus topcoat of latex, interior, semi-gloss, MPI #54.

F. Aluminum (Not Anodized or Otherwise Coated) Substrates: Primer, quick dry, for aluminum, MPI #95; plus topcoat of latex, interior, semi-gloss, MPI #54.

G. ASJ Insulation-Covering Substrates: Including pipe and duct coverings. Primer sealer, latex, interior, MPI #50; plus topcoat of latex, interior, semi-gloss, MPI #54.

H. Primers specified above may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

3.8 CONCRETE BASES

A. Anchor equipment to concrete base according to equipment manufacturer’s written instructions.

B. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.

C. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.

D. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.

E. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

F. Install anchor bolts according to anchor-bolt manufacturer's written instructions. Install anchor bolts to elevations required for proper attachment to supported equipment.

G. When anchoring equipment that is installed on neoprene or rubber vibration isolator pads, the anchor bolt shall include a neoprene or rubber grommet placed between the nut and the equipment frame so as not to short-circuit the vibration isolation provided by the neoprene pad. An example of one such device is Model GW Grommet Washers by Vibro-Acoustics, a Swegon Group company.

H. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete and reinforcement as specified in Division 03.

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. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
3. 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.

J. Refer to Division 01 Sections “Execution” and/or “Cutting and Patching” for additional requirements.

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 23 0500

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SECTION 23 0513 – 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 23 0100 "Basic Mechanical Requirements," and Section 23 0500 "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. ECM: Electrically-commutated motor.

C. ODP: Open drip-proof.

D. 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.

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.

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 (no substitutions).

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.

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.

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.

END OF SECTION 23 0513

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SECTION 23 0523 – VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following general-duty valves common to Division 23 mechanical piping systems:

1. Ball valves.
2. Butterfly valves.
3. Check valves.
4. Chainwheel actuators.

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 23 0100 “Basic Mechanical Requirements,” and Section 23 0500 “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 02 piping Sections for general-duty and specialty valves for site construction piping.
2. Division 21 fire-suppression piping and fire pump Sections for fire-protection valves.
3. Division 23 Section “Basic Mechanical Materials and Methods” for valve tags and charts.
4. Division 23 Section “Control Systems” for control valves and actuators.
5. Division 23 piping Sections for specialty valves applicable to those Sections only.

D. Valves for fire protection, and other specialty services are specified in their respective piping Section.

1.3 DEFINITIONS

A. The following are standard abbreviations for valves used in this Section:

1. CWP: Cold working pressure (formerly WOG – Water, Oil, Gas working pressure).
2. EPDM: Ethylene-propylene-diene terpolymer rubber.
3. PTFE: Polytetrafluoroethylene plastic.
4. SWP: Steam working pressure.
5. TFE: Tetrafluoroethylene plastic.
6. Class 125: Minimum 125-psig (860-kPa) SWP and minimum 200-psig (1380-kPa) CWP ratings.
7. Class 150: Minimum 150-psig (1035-kPa) SWP and minimum 300-psig (2070-kPa) CWP ratings.
8. Class 300: Minimum 300-psig (2070-kPa) SWP; and minimum 635-psig (4380-kPa) CWP rating at 400°F (204°C).

1.4 SUBMITTALS

A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

B. Maintenance Data: For each type of valve, to include in the operation and maintenance manual specified in Division 01. Include detailed manufacturer's instructions on adjusting, servicing, disassembling, and repairing.

1.5 QUALITY ASSURANCE

A. ASME Compliance: ASME B31.9 for building services piping valves.

B. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.

C. MSS Compliance: Comply with the various MSS Standard Practice documents referenced herein.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set ball valves open to minimize exposure of functional surfaces.
4. Set butterfly valves closed or slightly open.
5. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. General: Subject to compliance with requirements, provide gate valves, globe valves, and swing check valves by one of the following:

1. Crane Co.; Crane Valve Group; Crane, Jenkins, & Stockham brands.
2. Grinnell Corporation.
3. Hammond Valve.
4. Milwaukee Valve Company.

5. NIBCO Inc.
6. Red-White Valve Corp.
7. Watts Industries, Inc.; Water Products Div.

B. Ball Valves: Subject to compliance with requirements, provide ball valves by one of the following:

1. Any of the manufacturers listed under the “General” subheading above.

C. Standard-Performance Butterfly Valves: Subject to compliance with requirements, provide butterfly valves by one of the following:

1. Any of the manufacturers listed under the “General” subheading above.

2. Bray International, Inc.
3. Crane Co.; Crane Valve Group; Center Line brand.
4. General Signal; DeZurik Unit
5. Grinnel
6. McWane, Inc.; Kennedy Div.
7. Metraflex Co.

D. Wafer and Lift-Disc Check Valves: Subject to compliance with requirements, provide butterfly-style dual-plate wafer check valves and piston-style lift-disc check valves by one of the following:

1. Any of the manufacturers listed under the “General” subheading above.
2. Metraflex Co.

2.2 VALVES, COMMON REQUIREMENTS

A. General: Refer to Part 3 “Valve Applications Schedule” Article for application schedule of valves, end connections, and actuator types.

B. Valve Sizes: Same as upstream pipe size, unless otherwise indicated.

C. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.

D. Valve Threaded Ends: With threads according to ASME B1.20.1.

E. Valve Bypass and Drain Connections: MSS SP-45.

F. Material Substitution: Ductile iron is acceptable anywhere cast iron is specified, but cast iron is not acceptable where ductile iron is specified.

G. Class Substitution: If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.

H. Chainwheel Operators: Where required, provide valve actuation assembly with ductile iron sprocket rim, brackets, and hot-dip galvanized steel chain; of type, number, size and fasteners as required for the host valve.

I. For piping systems required to be insulated, valve stems shall be extended to accommodate insulation. Refer to other Division 23 Sections for piping systems required to be insulated.

2.3 BALL VALVES

A. Liquid Service, Size NPS 2 (DN 50) and smaller:

1. General: Valve shall conform to MSS SP-110.
2. Minimum SWP rating: 150-psig (1035-kPa).
3. Minimum CWP rating: 600-psig (4140-kPa).
4. Body: ASTM B584 bronze, two-piece construction.
5. Ball: Type 316 stainless steel, full port.
6. Stem: Blowout-proof Type 316 stainless steel.
7. Seat/Packing: PTFE or TFE.
8. Ends: Threaded.
9. Handle: Provide insulated extension handle to prevent condensation and other extraneous moisture from entering the insulated pipe system. Handle shall incorporate memory stop feature that requires no disassembly or removal of the handle to engage and make adjustments.
    a. Housing: Fire Resistant ABS.
    b. Sleeve: Fire Resistant ABS.
    c. Cap: Polyethylene
    d. Insulation Insert: Polystyrene
    e. Sheild: Plastic Sleeve
    f. Lock Washer: Stainless Steel
    g. Stop Plate & Screws: Stainless Steel
    h. Memory Stop Assembly: Stainless Steel.

2.4 STANDARD-PERFORMANCE BUTTERFLY VALVES

A. General: Valve shall conform to MSS SP-67, Type I.

B. Minimum CWP rating:
1. 12 inch valves and below: 200-psig (1379-kPa).
2. Above 12 inch valves: 150-psig (1034-kPa).

C. Body and bonnet: ASTM A536 ductile-iron, extended neck. Cast iron valves will be rejected.

D. Packing: Field-replaceable EPDM sleeve and stem seals.

E. Stem and Stem Hardware: Type 316 stainless steel.

F. Disc: Aluminum bronze or Type 316 stainless steel.

G. End Connections: Lug and flanged bodies are acceptable; **wafer bodies are not acceptable and will be rejected.**

H. Dead End Service: All butterfly valves shall be suitable for bi-directional dead-end service without downstream blind flange. Bolt holes on lugged valve bodies shall be threaded per ANSI B-1.1 coarse thread, with center stop, to accept cap screws from both directions.

I. Operator: Lever handle with ten-position latching mechanism, except where noted below.

1. Chainwheel Operators: Required for butterfly valves larger than NPS 4 (DN 100), if installed 96 inches (2400 mm) or higher above finished floor elevation.
2. Gear Drive: Required for butterfly valves NPS 8 (DN 200) and larger, and for any butterfly valves larger than NPS 4 (DN 100) if installed 96 inches (2400 mm) or higher above finished floor elevation, to accommodate a chainwheel operator.

2.5 CHECK VALVES

A. Bronze Swing Check Valve, NPS 2 (DN50) and smaller: Valve shall conform to MSS SP-80.

1. Minimum pressure rating: Class 150.
2. Body: ASTM B62 bronze body, y-pattern.
3. Bonnet: ASTM B62 bronze, threaded, removable for regrinding.
4. Disc and seat: Renewable; ASTM B62 bronze with bronze-alloy hinge pin.
5. Hardware: Bronze or bronze alloy.
6. Ends: Threaded.

B. Wafer Check Valves, NPS 2½ (DN65) and larger: Valve shall conform to API 594.

1. Minimum pressure rating: Class 125.
2. Body: ASTM A126 Cl. B cast-iron.
3. Discs: Dual-plate aluminum bronze, spring-loaded, butterfly style.
4. Spring and hinge hardware: Type 316 stainless steel.
5. Ends: Wafer style, with diameter made to fit within bolt circle of adjacent flanges.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

D. Examine threads on valve and mating pipe for form and cleanliness.

E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

F. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves as indicated, according to manufacturer’s written instructions.

B. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

C. Install isolation valves at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

D. Locate valves for easy access and provide separate support where necessary. Install valves in horizontal piping with stem at or above center of pipe. Install valves in position to allow full stem movement.

E. 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.

F. Install chainwheel operators where specified. Extend chains to within 60 inches (1520 mm) above finished floor elevation.

G. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level, or vertical with upward flow.

3.3 JOINT CONSTRUCTION

A. Refer to Division 23 Section “Basic Mechanical Materials and Methods” for basic piping joint construction.

B. Threaded Connections: Note the internal length of threads in valve ends and proximity of valve internal seat or wall to determine how far pipe should be threaded into valve.

1. Align threads at point of assembly.
2. Apply appropriate tape or thread compound to the external pipe threads, except where dry seal threading is specified.
3. Assemble joint, wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.

C. Flanged Connections: Align flange surfaces parallel.

1. 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 with a torque wrench.
2. For dead-end service, butterfly valves require flanges both upstream and downstream for proper shutoff and retention.

3.4 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.5 VALVE APPLICATIONS SCHEDULE

A. General: Refer to piping Sections and Drawings for specific valve applications. If no specific valve type is indicated, use the valve types indicated in the following schedules.

B. HVAC Chilled Water, Hydronic Heating Water Piping, HVAC Makeup Water and Drain Piping: Use the following types of valves. Choices are contractor's option unless a specific type of valve is specifically called out by name on the Drawings.

1. For shutoff duty, NPS 2 (DN 50) and smaller, use ball valves.
2. For shutoff duty, NPS 2½ (DN 65) and larger, use butterfly valves.
3. For throttling duty, NPS 2 (DN 50) and smaller, use ball valves.
4. For throttling duty, NPS 2½ (DN 65) and larger, use butterfly valves.
5. For pump discharge protection, NPS 2 (DN 50) and smaller, use swing check valves.
6. For pump discharge protection, NPS 2½ (DN 65) and larger, use wafer check valves.
7. For one-way flow control other than at pump discharge, use swing check valves in all sizes.

END OF SECTION 23 0523

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SECTION 23 0529 – 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 23 0100 “Basic Mechanical Requirements,” and Section 23 0500 “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.
2. Division 21 Section “Standpipe and Sprinkler Systems” for fire-suppression pipe hangers.
3. Division 23 Section “Metal Ducts” for duct hangers and supports.

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.
5. Manufacturer paint color chart for Architect to pick color for all equipment installed in exposed spaces.

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.

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. 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*.

D. 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.

1. Metallic Coating: Hot-dipped galvanized.
2. Paint Coating: Polyester Power Finish.
3. Plastic Coating: PVC

2.4 THERMAL-HANGER SHIELD INSERTS

A. Insulation-Insert Material: 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. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

C. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

D. 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, stainless-steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.6 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 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. 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, 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.

G. 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).

H. 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).

I. 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.

J. 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.

K. 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.

L. 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).

M. 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.

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. Flanged, Threaded, or Welded Steel Piping for any Liquid-service piping systems:

1. NPS ¾ (DN 20): Maximum span, 7 feet (2.1 m); minimum rod size, 3/8-inch (10 mm).
2. NPS 1 (DN 25): Maximum span, 7 feet (2.1 m); minimum rod size, 3/8-inch (10 mm).
3. NPS 1¼ (DN 32): Maximum span, 7 feet (2.1 m); minimum rod size, 3/8-inch (10 mm).
4. NPS 1½ (DN 40): Maximum span, 9 feet (2.7 m); minimum rod size, 3/8-inch (10 mm).
5. NPS 2 (DN 50): Maximum span, 10 feet (3 m); minimum rod size, 3/8-inch (10 mm).
6. NPS 2½ (DN 65): Maximum span, 11 feet (3.4 m); minimum rod size, 1/2-inch (13 mm).
7. NPS 3 (DN 80): Maximum span, 12 feet (3.7 m); minimum rod size, 1/2-inch (13 mm).
8. NPS 4 (DN 100): Maximum span, 14 feet (4.3 m); minimum rod size, 5/8-inch (16 mm).
9. NPS 5 (DN 125): Maximum span, 17 feet (5.2 m); minimum rod size, 3/4-inch (19 mm).
10. NPS 6 (DN 150): Maximum span, 17 feet (5.2 m); minimum rod size, 3/4-inch (19 mm).
11. NPS 8 (DN 200): Maximum span, 19 feet (5.8 m); minimum rod size, 7/8-inch (22 mm).

C. Drawn-Temper Copper Piping for any liquid-service piping systems:

1. NPS ¾ (DN 20): Maximum span, 5 feet (1.5 m); minimum rod size, 3/8-inch (10 mm).
2. NPS 1 (DN 25): Maximum span, 6 feet (1.8 m); minimum rod size, 3/8-inch (10 mm).
3. NPS 1¼ (DN 32): Maximum span, 6 feet (1.8 m); minimum rod size, 3/8-inch (10 mm).
4. NPS 1½ (DN 40): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8-inch (10 mm).
5. NPS 2 (DN 50): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8-inch (10 mm).

D. Copper Piping for Refrigerant Suction, Refrigerant Hot Gas, Compressed Air and/or Fuel Gas piping systems:

1. NPS ¾ (DN 20): Maximum span, 7 feet (2.1 m); minimum rod size, 3/8-inch (10 mm).
2. NPS 1 (DN 25): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8-inch (10 mm).
3. NPS 1¼ (DN 32): Maximum span, 9 feet (2.7 m); minimum rod size, 3/8-inch (10 mm).
4. NPS 1½ (DN 40): Maximum span, 10 feet (3 m); minimum rod size, 3/8-inch (10 mm).

5. NPS 2 (DN 50): Maximum span, 10 feet (3 m); minimum rod size, 3/8-inch (10 mm).
6. NPS 2½ (DN 65): Maximum span, 10 feet (3 m); minimum rod size, 1/2-inch (13 mm).

E. 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.

F. Support vertical runs at roof, at each floor, and at 10-foot (3-m) intervals between floors.

G. Rod diameters may be reduced one size for double-rod hangers, with 3/8-inch (10 mm) minimum rods.

H. Hanger and support spacing for piping and tubing not listed above shall be according to MSS SP-58 and piping manufacturer's written instructions.

3.3 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. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

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 (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.

3.5 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.

3.6 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.

3.7 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).

3.8 PAINTING

A. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.

END OF SECTION 23 0529

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SECTION 23 0700 - MECHANICAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes mechanical insulation for ductwork, equipment, piping, appliance breechings and other installations, including the following:

1. Insulation Materials: Flexible elastomeric and mineral fiber.
2. Insulating cements, adhesives, mastics, and sealants.
3. Insulating cements, adhesives, mastics, and sealants.
4. Factory-applied jackets.
5. Field-applied fabric-reinforcing mesh.
6. Field-applied jackets.
7. Tapes and securements.

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 23 0100 “Basic Mechanical Requirements,” and Section 23 0500 “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 02 Section “Hydronic Distribution” for loose-fill pipe insulation in underground piping outside the building.

1.3 DEFINITIONS

A. ASJ: All-service jacket.

B. FSK: Foil, scrim, kraft paper.

C. SSL: Self-sealing lap.

D. Thermal Resistivity: “R-values” represent the reciprocal of thermal conductivity (k-value). Thermal conductivity is the rate of heat flow through a homogenous material exactly 1-inch thick. Thermal resistivities are expressed by the temperature difference in degrees F between two exposed faces required to cause one BTU to flow through one square foot of material, in one hour, at a given mean temperature.

E. 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.

F. Exposed Installations: Exposed to view. Examples include finished occupied spaces without ceilings, mechanical equipment rooms, courtyards and rooftop locations.

G. Concealed Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings or within duct shafts.

H. Conditioned Space: Spaces that are served by both a mechanical heating and mechanical cooling system are conditioned spaces. Heating-only spaces are not conditioned spaces. The space above a ceiling is considered conditioned space if the space directly below that ceiling is conditioned space. A vertical shaft is considered conditioned space if the spaces on all sides surrounding the shaft are conditioned spaces.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated, identify thermal conductivity, thickness, and jackets (both factory and field applied, if any).

B. MSDS (Material Safety Data Sheet) for each adhesive, mastic, sealant, and cement furnished.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Fire-Test-Response Characteristics: Insulation and related materials shall have flame-spread index of 25 or less, and smoke-developed index of 50 or less, as determined by testing identical products per ASTM E84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section “Hangers and Supports.”

B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:

1. Flexible Elastomeric Insulation:

    a. Aeroflex USA Inc.; Aerocel.
    b. Armacell LLC; AP/Armaflex.
    c. K-Flex USA; Insul-Lock® Seam-Seal.
    d. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.

2. Mineral Fiber Insulation:

    a. CertainTeed Corp.
    b. Johns Manville.
    c. Knauf Insulation.
    d. Manson Insulation Inc.
    e. Owens Corning.

3. Insulating Cements: Same as insulation manufacturer, or

    a. Insulco, Division of MFS, Inc.
    b. P. K. Insulation Mfg. Co., Inc.
    c. Rock Wool Manufacturing Company.

4. Sealants, Adhesives and Mastics: Same as insulation manufacturer, or

    a. H.B. Fuller Construction Products Inc. (Childers and/or Foster brands)
    b. ITW TACC, Division of Illinois Tool Works.
    c. Marathon Industries, Inc.
    d. Mon-Eco Industries, Inc.
    e. Vimasco Corporation.

5. Field-Applied Jackets: Same as insulation manufacturer, or

    a. P.I.C. Plastics, Inc.
    b. PABCO Metals Corporation.
    c. Pittsburgh Corning Corporation.
    d. Polyguard Products, Inc.
    e. Proto PVC Corporation.
    f. RPR Products, Inc.
    g. Speedline Corporation.

6. Tapes: Same as insulation manufacturer, or

    a. Avery Dennison Corporation, Specialty Tapes Division.
    b. Compac Corp.

c. Ideal Tape Co., Inc., an American Biltrite Company.
d. Polyguard Products, Inc.
e. Venture Tape.

7. Bands and Wire: Same as insulation manufacturer, or

a. ACS Industries, Inc.
b. C & F Wire.
c. Childers Products.
d. PABCO Metals Corporation.
e. RPR Products, Inc.

8. Insulation Pins and Hangers: Same as insulation manufacturer, or

a. AGM Industries, Inc.
b. GEMCO.
c. Midwest Fasteners, Inc.
d. Nelson Stud Welding.

2.2 INSULATION MATERIALS

A. Refer to Schedule in Part 4 for requirements about where insulating materials shall be applied.

B. Restrictions: Products shall not contain asbestos, lead, mercury, or mercury compounds. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

C. Adhesives shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

D. 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).

E. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C553, Type II and ASTM C1290, Type III with factory-applied jacket.

1. Thermal Conductivity: 0.26 average maximum at 75°F mean temperature.
2. Density: 1.5 lb/cf (24-kg/cu. m) minimum.
3. Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.

F. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C612, Type IA or Type IB.

1. Thermal Conductivity: 0.26 average maximum at 75°F mean temperature.
2. Density: 2.0 lb/cf (32-kg/cu. m) minimum.
3. Jacket (Ducts): Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.
4. Jacket (Equipment): White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.

G. Mineral-Fiber, Preformed Pipe Insulation: Type I, 850ºF (454ºC); mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C547, Type I, Grade A, with factory-applied jacket.

1. Thermal Conductivity: 0.26 average maximum at 75°F mean temperature.
2. Jacket: White, polypropylene-coated kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I; with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip. Example of acceptable product is Owens-Corning ASJ Max-SSL or Johns Manville Micro-Loc HP Ultra.
3. Adhesive: Water-based and complying with ASTM C916 Type II; equal to Foster 85-60 and/or Childers CP-127.

2.3 CEMENTS AND MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates. Comply with ASTM C755-19 *Standard Practice for Selection of Water Vapor Retarders for Thermal Insulation* Table 2, for the selection of vapor retarder systems.

B. Insulating Cements: Select one or more of the following at contractor's option.

1. Mineral-Fiber Insulating Cement: Comply with ASTM C195.
2. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C196.
3. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C449.

C. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below-ambient services, for applications on seams, punctures, penetrations, and terminations of vapor retarder membranes. Equal to Foster 30-80 or Childers CP-35 or Vimasco 749.

1. Water-Vapor Permeance, Piping and Equipment: ASTM E96-16, Procedure A (desiccant method), 0.15 perms.
2. Water-Vapor Permeance, HVAC Ducts: ASTM E96-16, Procedure A (desiccant method), 1.0 perms.
3. Service Temperature Range: -20 to +180ºF (-29 to +82ºC).
4. Solids Content: ASTM D1644, 59 percent by volume and 71 percent by weight.
5. Color: White.

D. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services. Equal to Foster 46-50 or Childers CP-10/11 or Vimasco WC-5.

1. Water-Vapor Permeance: ASTM F1249, 3 perms (2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.
2. Service Temperature Range: -20 to +200ºF (-29 to +93ºC).
3. Solids Content: 63 percent by volume and 73 percent by weight.

4. Color: White.

2.4 SEALANTS

A. Joint Sealants: Permanently flexible, elastomeric sealant. Materials shall be compatible with insulation materials, jackets, and substrates.

1. Service Temperature Range: -100 to +200ºF (-73 to +94ºC).
2. Color: White, tan, or gray.
3. VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. FSK and Metal Jacket Flashing Sealants: Fire- and water-resistant, flexible, elastomeric sealant. Materials shall be compatible with insulation materials, jackets, and substrates.

1. Service Temperature Range: -40 to +250ºF (-40 to +121°C).
2. Color: Aluminum.
3. VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants: Fire- and water-resistant, flexible, elastomeric sealant. Materials shall be compatible with insulation materials, jackets, and substrates.

1. Service Temperature Range: -40 to +250ºF (-40 to +121°C).
2. Color: White.
3. VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.5 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness 30 mils (0.8 mm); roll stock ready for shop or field cutting and forming.

1. Adhesive: Compatible with PVC, as recommended by jacket material manufacturer.
2. Color: White.
3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
4. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
5. Factory-fabricated tank heads and tank side panels.

C. Metal Jackets: Sheet and roll stock ready for shop or field sizing. Factory pre-cut and rolled to size is also acceptable.

1. Aluminum Jacket: Comply with ASTM B209, Alloy 3003, 3005, 3105 or 5005, Temper H-14. Finishes and thickness as follows:

a. Indoor Ducts and Plenums: Smooth, 0.016-inch (0.41 mm) thick.
b. Indoor Equipment: Stucco Embossed, 0.016-inch (0.41 mm) thick.

c. Outdoor Ducts, Equipment, and Piping: Stucco embossed, with Z-shaped locking seam, 0.024-inch (0.61 mm) thick.

2. Stainless-Steel Jacket: ASTM A167 or ASTM A240; Type 304 stucco embossed, with Z-shaped locking seam; 0.016-inch (0.41 mm) thick.
3. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper.
4. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
5. Factory-Fabricated Fitting Covers: Same material, finish, and thickness as jacket; provide as required for preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows, tee covers, flange and union covers, end caps, beveled collars, and valve covers.
6. Field-fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.6 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136 and UL listed.

1. Width: 3-inches (75 mm).
2. Thickness: 11.5 mils (0.29 mm).
3. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136 and UL listed.

1. Width: 3-inches (75 mm).
2. Thickness: 6.5 mils (0.16 mm).
3. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.

1. Width: 2-inches (50 mm).
2. Thickness: 6 mils (0.15 mm).
3. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
4. Elongation: 500 percent.
5. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive and UL listed.

1. Width: 2-inches (50 mm).
2. Thickness: 3.7 mils (0.093 mm).
3. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
4. Elongation: 5 percent.
5. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

2.7 SECUREMENTS

A. Bands:

1. Stainless Steel: ASTM A167 or ASTM A240, Type 304; 0.015-inch (0.38 mm) thick, ½-inch (13 mm) wide with wing or closed seal.
2. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020-inch (0.51 mm) thick, ½-inch (13 mm) wide with wing or closed seal.
3. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated with integral 1½-inch (38-mm) galvanized carbon-steel washer.
3. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch (0.41-mm) thick, aluminum or stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1½-inches (38 mm) in diameter. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

C. Staples: Outward-clinching insulation staples, nominal ¾-inch- (19-mm-) wide, stainless steel or Monel.

D. Wire: 0.062-inch (1.6-mm) soft-annealed, stainless steel.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application. Verify that systems and equipment 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.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 COMMON INSTALLATION REQUIREMENTS

A. 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.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs. Install multiple layers of insulation with longitudinal and end seams staggered.

E. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer. Install insulation with least number of joints practical.

H. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

I. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

J. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4-inches (100 mm) o.c.
3. Overlap jacket longitudinal seams at least 1½-inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2-inches (50 mm) o.c.
4. For below ambient services, apply vapor-barrier mastic over staples.
5. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.

6. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.

K. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

L. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

M. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4-inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

N. At the following locations, omit jacket and provide a separate cutaway removable segment of insulation clearly labeled “Access.” For below-ambient services, provide a design that allows access but maintains vapor barrier.

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2-inches (50 mm) below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2-inches (50 mm).
4. Seal jacket to wall flashing with flashing sealant.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. Insulation Installation at Fire-Rated Wall and Partition Penetrations:

1. Install pipe insulation continuously through pipe penetrations of fire-rated walls and partitions.
2. Install duct insulation continuously through duct penetrations of fire-rated walls and partitions, for cases where no fire or smoke damper is required.
3. Terminate duct insulation at fire or smoke damper sleeves for cases where fire or smoke dampers are used, but overlap duct insulation at least 2-inches (50 mm) onto sleeve.
4. Firestopping and fire-resistive joint sealers are specified in Division 07 Section “Penetration Firestopping.”

E. Insulation Installation at Floor Penetrations:

1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2-inches (50 mm).
2. Pipe: For below-ambient piping services, install insulation continuously through floor penetrations. For above-ambient piping services, either do the same as for below-ambient piping, or it is acceptable to install uninsulated piping through the slab and butt the pipe insulation tight to the slab on both the top side and the underneath side.
3. Seal penetrations through fire-rated assemblies according to Division 07 Section “Penetration Firestopping.”

3.5 DUCT INSULATION INSTALLATION

A. See Part 4 Insulation Schedules for specific requirements.

B. The following ductwork items need not be insulated, unless noted otherwise:

1. Fibrous-glass ducts.
2. Metal ducts with internal duct liner.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums, casings, fan housings, and air terminal units.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.

C. Secure all insulation on ducts and plenums with insulation pins. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

1. On duct sides with dimensions 18-inches (450 mm) and smaller, pins may be omitted.
2. On duct sides with dimensions 18-inches (450 mm) and larger, place pins along longitudinal centerline of duct. Space 3-inches (75 mm) maximum from insulation end joints, and 16-inches (400 mm) o.c.
3. On duct sides with dimensions larger than 36-inches (900 mm), place pins 16-inches (400 mm) o.c. each way, and 3-inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
4. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
5. Do not over-compress insulation during installation.
6. If using blanket insulation, impale insulation over pins and attach speed washers.

7. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

D. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2-inches (50 mm) from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with ½-inch (13-mm) outward-clinching staples, 1-inch (25 mm) o.c. Complete the vapor barrier by applying FSK tape specified in Part 2, or vapor-barrier mastic and sealant, at all joints, seams, and protrusions.

1. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
2. Install vapor stops for ductwork and plenums operating below 50ºF (10 C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3-inches (75 mm).

E. If using blanket insulation, overlap unfaced blankets a minimum of 2-inches (50 mm) on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18-inches (450 mm) o.c.

F. Unless factory-insulated, install duct insulation continuously and unbroken over duct-mounted accessories such as fans, coils, terminal units, humidifier housings, damper housings, airflow measuring station housings, etc.

G. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. If using board insulation, groove and score insulation to fit as closely as possible to outside and inside radius of elbows.

H. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

I. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-(150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6-inches (150 mm) o.c.

3.6 PIPE INSULATION INSTALLATION

A. See Part 4 Insulation Schedules for specific requirements.

B. Requirements in this Article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

C. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with tape or bands and tighten without deforming insulation materials. If furnished in half sections, orient longitudinal joints at 3 and 9 o'clock positions on the pipe.
2. All insulation shall be tightly butted and free of voids and gaps at all joints.
3. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.

4. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6-inches (150 mm) o.c.
5. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant. Vapor barrier must be continuous.

D. Insulation Installation on Pipe Flanges or Mechanical Couplings:

1. Install preformed pipe insulation to outer diameter of pipe flange or mechanical coupling (such as grooved pipe couplings, if applicable).
2. Make width of insulation section same as overall width of flange/coupling and bolts, plus twice the thickness of pipe insulation, not to exceed 1½-inch (38-mm) thickness.
3. Fill voids between inner circumference of flange/coupling insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1-inch (25 mm), and seal joints with flashing sealant.

E. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
3. Cut sectional pipe insulation to fit. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.

F. Insulation Installation on Valves, Strainers, Unions, and Specials:

1. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation over valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
4. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
5. Insulate unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
6. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for

above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.

7. For services not specified to receive a field-applied jacket except for flexible elastomeric, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
8. Stencil or label the outside insulation jacket of each union with the word “UNION.” Match size and color of pipe labels.

G. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

H. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2-inches (50 mm) over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.7 FIELD-APPLIED JACKET INSTALLATION

A. See Part 4 Insulation Schedules for specific requirements.

B. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

C. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12-inches (300 mm) o.c. and at end joints.

3.8 FINISHES

A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

B. Duct, Equipment, and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
2. Finish Coat Material: Interior, flat, latex-emulsion size.

C. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

D. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

E. Do not field paint aluminum or stainless-steel jackets.

PART 4 - SCHEDULES

4.1 INSULATION SCHEDULES

A. Furnish and install duct, equipment, and piping insulation as specified above and in accordance with the schedules below. All insulation thicknesses and pipe sizes in the following tables are given in nominal inches. Where more than one type of allowable material or more than one type of field jacket is listed, the choice is contractor’s option.

B. Hot Surfaces: For piping, ductwork, and equipment services denoted as 105ºF or greater, all piping surfaces including but not limited to pipe, duct, flanges, fittings, valves of every kind, pumps, dampers, strainers, unions, steam traps, and other appurtenances shall be insulated to avoid potential for personnel injury via contact with hot surface.

C. Cold Surfaces: For piping, ductwork, and equipment surfaces operating below surrounding ambient temperature, all surfaces including but not limited to pipe, duct, flanges, fittings, valves of every kind, pumps, dampers, strainers, unions, and other appurtenances shall be insulated and shall include uninterrupted vapor barrier to avoid potential condensation.

DUCT INSULATION Service	Duct Shape	Duct Location	Minimum R-Value	Allowable Materials	Insulation Thickness	Field Jacket	Keyed Notes
	Rectangular	ICC,ICN	R-6	FGBK	1.50	---	(5)
		IEC,IEN	R-6	FGBD	1.50	---	(5)
Return Air Service	Rectangular	ICC,IEC	---	---	---	---	
		ICN	R-6	FGBK	2.00	---	(5)
		IEN	R-6	FGBD	1.50	---	(5)
Exhaust Air Service	Rectangular	ICC, IEC	---	---	---	---	---
		ICN, IEN	---	---	---	---	---
		Outdoors	R-8/R-12	FGBD,FE	2.00	AL	(5)

KEYED NOTES:

(1) *Insulate only if the exhaust is routed to an energy-recovery device.*
(2) *Insulate only between final isolation damper and penetration of building exterior.*
(3) *The specified field jacket is required only if less than 84-inches AFF.*
(4) *For boilers, furnaces, water heaters, and engine exhaust, if not factory-insulated.*
(5) *Omit insulation if duct is expressly called out to be internally lined.*
(6) *Thickness as required to achieve 2-hour fire rating.*

LEGEND:

ICC	Indoor, Concealed, in Conditioned space	CS	Calcium Silicate
ICN	Indoor, Concealed, in Non-conditioned space	FRW	Fire-Rated Wrap
IEC	Indoor, Exposed, in Conditioned space	AL	Aluminum
IEN	Indoor, Exposed, in Non-conditioned space	SS	Stainless Steel
FGBK	Fiberglass Insulation, 1.5-lb density, Blanket		
FGBD	Fiberglass Insulation, 1.5-lb density, Board		
FE	Flexible Elastomeric		

PIPE INSULATION Services	Temperature Range °F	Size Range	Location	Allowable Materials	Thick- ness	Field Jacket	Keyed Notes
Equipment drains, blowdown,	below 60	¾ to 1¼	Indoors	FE	0.50	---	
hot vents, coil condensate,		1½ & up	Indoors	MF	1.00	PVC	(3)
makeup or fill water	above 105	All	All	MF	1.50	AL,SS	(2)
Chilled Water Piping (supply and return)	40 and up	¾ to 1¼	Indoors	FE	1.00	---	
		1½ to 6	Indoors	FE	1.50	---	
		8 & up	Indoors	MF	1.50	PVC	(3)
Heating Hot Water Piping (supply and return)	140-200	¾ to 1¼	Indoors	MF	1.50	---	
		1½ & up	All	MF	2.00	AL,SS	(2)

KEYED NOTES:

(1) *Insulate condenser water piping only if used as part of a water-side economizer, or if freeze-protected (e.g., heat-traced) outdoors.*

(2) *The specified field jacket is required only if outdoors.*

(3) *The specified field jacket is required on fittings only.*

LEGEND:

AFF	Above Finished Floor		
FE	Flexible Elastomeric		
MF	Mineral Fiber	AL	Aluminum
SCR	Steam Condensate Return	HW	Hot Water
PVC	Polyvinyl Chloride	SS	Stainless Steel
		#	psig

END OF SECTION 23 0700

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SECTION 23 0900 - CONTROL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. University of Missouri Controls Specification.

B. This section contains requirements for pneumatic, electric and digital control systems as indicated on the contract drawings.

C. Contractor is responsible for providing, installing and connecting all sensors, pneumatic actuators, control valves, control dampers, electrical components and all interconnecting pneumatic tubing and electrical wiring between these devices and up to the Direct Digital Controller (DDC).

D. DDC systems consist of Johnson Controls METASYS controllers. Contractor shall install owner provided control enclosures. Owner will provide and install controllers. After all equipment has been installed, wired and pipes, Owner will be responsible for all termination connections at the DDC controller's and for checking, testing, programming, and start-up of the control system. Contractor must be on site at start-up to make any necessary hardware adjustments as required.

E. Once each mechanical system is completely operational under the new control system, contractor shall make any final connections and adjustments. For controls renovation jobs, contractor shall remove all unused sensors, operators, panels, wiring, tubing, conduit, etc. Owner shall have the option of retaining any removed pneumatic controls.

1.2 RELATED SECTIONS

A. Drawings and general provisions of Contract, including General and Special Conditions apply to work of this section.

1.3 QUALITY ASSURANCE

A. Contractor's Qualifications:
   1. Contractor shall be regularly engaged in the installation of digital control systems and equipment, of types and sizes required. Contractor shall have a minimum of five years' experience installing digital control systems. Contractor shall supply sufficient and competent supervision and personnel throughout the project in accordance with General Conditions section 3.4.1 and 3.4.4.

B. Codes and Standards:
   1. Electrical Standards: Provide electrical components of control systems which have been UL-listed and labeled, and comply with NEMA standards.
   2. NEMA Compliance: Comply with NEMA standards pertaining to components and devices for control systems.
   3. NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" where applicable to controls and control sequences.
   4. NFPA Compliance: Comply with NFPA 70 "National Electric Code".

1.4 SUBMITTALS

A. Shop Drawings: Submit shop drawings for each control system, containing the following information:

B. Product data for each damper, valve, and control device.

C. Schematic flow diagrams of system showing fans, pumps, coils, dampers, valves, and control devices.

D. Label each control device with setting or adjustable range of control.

E. Indicate all required electrical wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

F. Provide details of faces on control panels, including controls, instruments, and labeling.

G. Include written description of sequence of operation.

H. Provide wiring diagrams of contractor provided interface and I/O panels.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Air Piping:
   1. Copper Tubing: Seamless copper tubing, Type M or L, ASTM B 88; wrought-copper solder-joint fittings, ANSI B16.22; except brass compression-type fittings at connections to equipment.
   2. Flex Tubing: Virgin Polyethylene non-metallic tubing, ASTM D 2737, with flame-retardant harness for multiple tubing. Use compression or push-on polyethylene fittings. Tubing used above suspended ceilings to be plenum rated per NFPA 90A. See section 3.1.b for locations where flex tubing can be used.
   3. Copper to polyethylene connections shall be compression barbed fittings or solder barbed fittings.

B. Conduit and Raceway:
   1. Electrical Metallic Tubing: EMT and fittings shall conform to ANSI C80.3.
   2. Surface Metal Raceway and Fittings: Wiremold 500, Ivory, or approved equal.
   3. Flexible Metal Conduit: Indoors, per National Electric Code for connection to moving or vibrating equipment.
   4. Liquidtight Flexible Conduit: Outdoors, per National Electric Code for connection to moving or vibrating equipment.

C. Control Valves: Provide factory fabricated electric control valves of type, body material, and pressure class as indicated on the drawings. Butterfly style control valves are not acceptable except for two position applications. Equip control valves with heavy-duty electric actuators, with proper shutoff rating for each individual application. Refer to contract document schedule sheet and details for system and valve type.
   1. Steam
      a. Manufacturer: KMC valves and actuators not approved.
      b. Steam Service Valves: Equal percentage characteristics.
      c. Single Seated Valves: Cage type trim, providing seating and guiding surfaces for plug on "top and bottom" guided plugs.

d. Valve Trim and Stems: Polished stainless steel.
e. Packing: Spring-loaded Teflon, self-adjusting.
f. Control valves should have a minimum 100 psi close-off rating for chilled water applications.

2. Chilled Water and Heating Hot Water (Pressure Independent Control Valves)
a. Chilled and Heating Hot water control valves shall be pressure independent where noted on drawings. The flow through the valve shall not vary more than +/- 5% due to system pressure fluctuations across the valve in the selected operating range. The control valve shall accurately control the flow from 1 to 100% full rated flow.
b. The valve bodies shall be of cast iron, steel or bronze and rated for 150 PSI working pressure. All internal parts shall be stainless steel, steel, Teflon, brass, or bonze.
c. Valves shall be DeltaP Valves manufactured by Flow Control Industries or approved equal by Griswold Controls, Danfoss or Belimo only.
d. The valves shall have pressure taps across the valve for measuring the pressure drop across the valve. The pressure taps shall have ½-inch extensions for accessibility.
e. Control valves shall be installed with unions or flanges as necessary for easy remoal and replacement.
f. Valve Tag shall include the model number, AHU being served, design flow, and maximum flow for that valve.
g. The control valves shall be delivered preset to the scheduled design flow and should be capable of reaching 110% of the design flow to allow for field adjustment for capacity changes.

D. Control Dampers: Ruskin CD-50 or approved equal.
1. Provide dampers with parallel blades for 2- position control.
2. Provide opposed blades for modulating control.
3. Dampers shall be low leakage design with blade and edge seals.
4. Provide multiple sections and operators as required by opening size and sequence of operations, as indicated on the contract drawings.

E. Electric Actuators: Johnson Controls, Bray, Belimo, TAC or approved equal. KMC actuators are not approved. Size electric actuators to operate their appropriate dampers or valves with sufficient reserve power to provide smooth modulating action or 2-position action as specified. If mixed air AHU has return air, exhaust air and outside air dampers that are not mechanically linked then static safety switch must be installed and wired to safety circuit. Spring return actuators should be provided on heat exchanger control valves or dampers or as specified on the drawings. Control signal shall be 0 to 10 VDC unless otherwise specified on drawings. Actuators with integral damper end switch are acceptable. For VAV reheat valves, actuators shall have a manual override capability to aid in system flushing, startup, and balancing.

F. Air and Hot Water Electronic Temperature Sensors:
1. All electronic temperature sensors shall be compatible with Johnson METASYS systems.
2. Sensors shall be 1,000 ohm platinum, resistance temperature detectors (RTDs) with two wire connections. Duct mounted sensors shall be averaging type. Contractor may install probe type when field conditions prohibit averaging type, but must receive permission from Owner's Representative.
3. Coordinate thermowell manufacturer with RTD manufacturer. Thermowells that are installed by the contractor, but are to have the RTD installed by owner, must be Johnson Controls Inc. series WZ-1000.

G. Electronic Temperature Sensors and Transmitters:
1. Chilled Water and Heating Hot Water Temperature Sensors:
a. General: The RTD/Temperature Transmitter/Thermowell assembly shall come as a complete assembly from a single manufacturer. The Assembly shall be suitable for

use in the accurate measurement of Chilled/Hot Water and Steam temperatures in a mechanical room environment.

b. Calibration: Each RTD must be match calibrated to the Transmitter via NIST traceable calibration standards. Results are to be programmed into the transmitter. Results are to be presented on report as after condition at the specified calibration points. Assembly shall not be approved for installation until Owner has received all factory calibration reports.

c. RTD:
   1) RTD type: 2-wire or 3-wire 100 ohm platinum class A.
   2) Outside Diameter: 0.25 inch
   3) Tolerance: +/- 0.06% Type A.
   4) Stability: +/- 0.1 % over one year.
   5) TCR: 0.00385 (ohm/ohm/^{o}C).
   6) RTD shall be tip sensitive.
   7) Resistance vs. Temperature table for the RTD must be provided to the Owner.

d. Transmitter:
   1) Transmitter shall be match calibrated to the RTD and assembled as a matched pair.
   2) Type: 2 wire (loop powered).
   3) Input: 2 or 3 wire 100 ohm platinum class A or class B RTD.
   4) Output: Output shall be a 4-20 mA signal linear to temperature.
   5) Calibrated Span:
      a) Chilled Water: 30 ^{o}F to 130 ^{o}F.
      b) Hot Water: 100 ^{o}F to 250 ^{o}F.
      c) Steam: 150 ^{o}F to 450 ^{o}F.
   6) Calibration Uncertainty: including total of all errors, of the Transmitter & RTD matched pair over the entire span shall be within +/- 0.2% of the calibrated span or +/- 0.18 ^{o}F, whichever is greater.
   7) Supply Voltage: 24 VDC.
   8) Ambient Operating Temp: 32 ^{o}F to 122 ^{o}F.
   9) Epoxy potted for moisture resistance.
   10) Mounting: Transmitter shall be mounted in the RTD connection head.

e. Thermowell
   1) Thermowell shall be suitable for immersion in chilled/hot water and steam.
   2) Thermowell shall be reduced tip.
   3) Thermowell shall be one-piece stainless steel machined from solid bar stock.
   4) Thermowell shall have 1/2” NPT process connection to pipe thred-o-let.
   5) Thermowell Insertion depth shall be ½ inside pipe diameter, but not to exceed 10”.

f. Assembly:
   1) Assembly configuration: Spring loaded RTD with thermowell-double ended hex-connection head.
   2) Connection head shall be cast aluminum with chain connecting cap to body, have 1/2” NPT process and 3/4” NPT conduit connections, and a sealing gasket between cap and body.

g. RTD/Temperature Transmitter/Thermowell assembly shall be the following or approved equal:
   1) Manufacturer: Pyromation, Inc.
   2) Chilled Water: RAF185L-S4C[length code]08-SL-8HN31,TT440-385U-S(30-130)F with calibration SMC(40,60)F
   3) Hot Water: RAF185L-S4C[length code]08T2-SL-8HN31,TT440-385U-S(100-250)F with calibration SMC(140,180)F

H. Occupant Override: Provide wall mounted occupant override button in locations shown on drawings.

I. Low Limit Controllers: Provide unit-mounted low limit controllers, of rod-and-tube type, with an adjustable set point and a manual reset. Capillary shall be of adequate length to horizontally traverse face of cooling coil every 12". Multiple low limit controllers may be required for large coils. Controller shall have an extra set of contactors for connection to control panel for alarm status. Locate the thermostat case and bellows where the ambient temperature is always warmer than the set point.
   1. Freeze Stats: Johnson Controls model A70HA-1 or approved equal.

J. Humidistats: Humidistats must be contamination resistant, capable of ±2% RH accuracy, have field adjustable calibration and provide a linear proportional signal.
   1. HD20K-T91 or equivalent.

K. Humidity High Limit
   1. Multi-function device that can function as a high limit or proportional override humidity controller, as stand-alone proportional controller, or a stand-alone two-position controller.
      a. Johnson Controls TRUERH HL-67N5-8N00P or approved equal.

L. Carbon Dioxide Sensor:
   1. Wall Mount: ACI Model ESENSE-R.
   2. Duct Mount: ACI Model ESENSE-D.

M. Fan/Pump Status: Status points for fan or pump motors with a VFD must be connected to the terminal strip of the VFD for status indication. Current switches: Current switches are required for fan and pump statuses that are not connected to a VFD. The switches must have an adjustable trip setpoint with LED indication and be capable of detecting broken belts or couplings. Units shall be powered by monitored line, UL listed and CE certified, and have a five year warranty.
   1. Kele, Hawkeye or approved equal.

N. Relays Used for Fan and Pump Start/Stop: Must have LED indication and be mounted externally of starter enclosure or VFD.
   1. Kele, RIBU1C or approved equal.

O. Power Supply Used to Provide Power to Contractor-Provided Control Devices: Shall have adjustable DC output, screw terminals, overload protection and 24 VAC and 24 VDC output.
   1. Kele, DCPA-1.2 or approved equal.

P. Pressure Differential Switch:
   1. Fans: NECC model DP222 or approved equal.

Q. Differential Pressure Transmitter: Provide units with linear analog 4-20mA output proportional to differential pressure, compatible with the Johnson METASYS Systems.
   1. Water: Units shall be wet/wet differential pressure capable of a bi-directional pressure range of +/- 50 psid. Accuracy shall be +/- 0.25% full scale with a compensated temperature range of 30 to 150 deg F and a maximum working pressure of 250 psig.
   2. Install transmitter in a pre-manufactured assembly with shut off valves, vent valves and a bypass valve.
      a. Setra model 230 with Kele model 3-VLV, three valve manifold or approved equal.
   3. Air: Units shall be capable of measuring a differential pressure of 0 to 5 in. WC. Accuracy shall be +/- 1.0% full scale with a compensated temperature range of 40 to 149 deg F and a maximum working pressure of 250 psig.
      a. Setra model 267, or approved equal.
      b. Shall be installed in control panel and piped 2/3 down the duct unless shown otherwise or approved by owners representative.

R. Building Static Pressure: Transducer shall utilize a ceramic capacitive sensing element to provide a stable linear output over the specified range of building static pressure. Transducer shall be housed in a wall-mounted enclosure with LCD display. Transducer shall have the following capabilities:
   1. Input Power: 24 VAC
   2. Output: 0-10 VDC
   3. Pressure Range: -0.25 to +0.25 inches w.g.
   4. Display: 3-1/2 digit LCD, displaying pressure in inches w.g.
   5. Accuracy: +/- 1.0% combined linearity and hysteresis
   6. Temperature effect: 0.05% / deg C
   7. Zero drift (1 year): 2.0% max
   8. Zero adjust: Push-button auto-zero and digital input
   9. Operating Environment: 0 to 140 deg F, 90% RH (non-condensing)
   10. Fittings: Brass barbs, 1/8" O.D.
   11. Enclosure: High-impact ABS plastic
   12. Outside Air Sensor Pickup Port: UV stabilized thermoplastic or aluminum "can" enclosure to shield outdoor pressure sensing tube from wind effects. BAPI ZPS-ACC10-rooftop mount, wall mount, or equivalent.
   13. Transducer shall be Veris Industries Model PXPLX01S, equivalent from Setra, or approved equal.

S. High Static Pressure Limit Switch: Provide pressure high limit switch to open contact in fan circuit to shut down the supply fan when the inlet static pressure rises above the set point. Provide with an adjustable set point, a manual reset button, 2 SPST (normally closed) contacts, and ¼" compression fittings.
   1. Kele model AFS-460-DDS, or approved equal.

T. AIRFLOW/TEMPERATURE MEASUREMENT DEVICES
   1. Provide airflow/temperature measurement devices where indicated on the plans. Fan inlet measurement devices shall not be substituted for duct or plenum measurement devices indicated on the plans.

   2. The measurement device shall consist of one or more sensor probe assemblies and a single, remotely mounted, microprocessor-based transmitter. Each sensor probe assembly shall contain one or more independently wired sensor housings. The airflow and temperature readings calculated for each sensor housing shall be equally weighted and averaged by the transmitter prior to output. Pitot tubes and arrays are not acceptable. Vortex shedding flow meters are not acceptable.

   3. All Sensor Probe Assemblies
      a. Each sensor housing shall be manufactured of a U.L. listed engineered thermoplastic.
      b. Each sensor housing shall utilize two hermetically sealed, bead-in-glass thermistor probes to determine airflow rate and ambient temperature. Devices that use "chip" or diode case type thermistors are unacceptable. Devices that do not have 2 thermistors in each sensor housing are not acceptable.
      c. Each sensor housing shall be calibrated at a minimum of 16 airflow rates and have an accuracy of +/-2% of reading over the entire operating airflow range. Each sensor housing shall be calibrated to standards that are traceable to the National Institute of Standards and Technology (NIST).
         1) Devices whose accuracy is the combined accuracy of the transmitter and sensor probes must demonstrate that the total accuracy meets the performance requirements of this specification throughout the measurement range.

d. The operating temperature range for the sensor probe assembly shall be -20° F to 160 F. The operating humidity range for the sensor probe assembly shall be 0-99% RH (non-condensing).
e. Each temperature sensor shall be calibrated at a minimum of 3 temperatures and have an accuracy of +/-0.15° F over the entire operating temperature range. Each temperature sensor shall be calibrated to standards that are traceable to the National Institute of Standards and Technology (NIST).
f. Each sensor probe assembly shall have an integral, U.L. listed, plenum rated cable and terminal plug for connection to the remotely mounted transmitter. All terminal plug interconnecting pins shall be gold plated.
g. Each sensor assembly shall not require matching to the transmitter in the field.
h. A single manufacturer shall provide both the airflow/temperature measuring probe(s) and transmitter at a given measurement location.

4. Duct and Plenum Sensor Probe Assemblies
   a. Sensor housings shall be mounted in an extruded, gold anodized, 6063 aluminum tube probe assembly. Thermistor probes shall be mounted in sensor housings using a waterproof marine grade epoxy resin. All wires within the aluminum tube shall be Kynar coated.
   b. The number of sensor housings provided for each location shall be as follows:

1) Area (sq.ft.)	Sensors
<2	4
2 to <4	6
4 to <8	8
8 to <16	12
>=16	16

   c. Probe assembly mounting brackets shall be constructed of 304 stainless steel. Probe assemblies shall be mounted using one of the following options:
      1) Insertion mounted through the side or top of the duct.
      2) Internally mounted inside the duct or plenum.
      3) Standoff mounted inside the plenum.
   d. The operating airflow range shall be 0 to 5,000 FPM unless otherwise indicated on the plans.
5. Fan Inlet Sensor Probe Assemblies
   a. Sensor housings shall be mounted on 304 stainless steel blocks.
   b. Mounting rods shall be field adjustable to fit the fan inlet and constructed of nickel plated steel.
   c. Mounting feet shall be constructed of 304 stainless steel.
   d. The operating airflow range shall be 0 to 10,000 FPM unless otherwise indicated on the plans.
6. Transmitters
   a. The transmitter shall have a 16 character alpha-numeric display capable of displaying airflow, temperature, system status, configuration settings and diagnostics. Configuration settings and diagnostics shall be accessed through a pushbutton interface on the main circuit board. Airflow shall be field configurable to be displayed as a velocity or a volumetric rate.
   b. The transmitter shall be capable of independently monitoring and averaging up to 16 individual airflow and temperature readings. The transmitter shall be capable of displaying the airflow and temperature readings of individual sensors on the LCD display.
   c. The transmitter shall have a power switch and operate on 24 VAC (isolation not required). The transmitter shall use a switching power supply fused and protected from transients and power surges.
   d. All interconnecting pins, headers and connections on the main circuit board, option cards and cable receptacles shall be gold plated.

e. The operating temperature range for the transmitter shall be -20° F to 120° F. The transmitter shall be protected from weather and water.
f. The transmitter shall be capable of communicating with the host controls using one of the following interface options:
1) Linear analog output signal: Field selectable, fuse protected and isolated, 0-10VDC and 4-20mA (4-wire).
2) RS-485: Field selectable BACnet-MS/TP, ModBus-RTU and Johnson Controls N2 Bus.
3) 10 Base-T Ethernet: Field selectable BACnet Ethernet, BACnet-IP, ModBus-TCP and TCP/IP.
4) LonWorks Free Topology.
g. The transmitter shall have an infra-red interface capable of downloading individual sensor airflow and temperature data or uploading transmitter configuration data to a handheld PDA (Palm or Microsoft Pocket PC operating systems).

7. The measuring device shall be UL listed as an entire assembly.
8. The manufacturer's authorized representative shall review and approve placement and operating airflow rates for each measurement location indicated on the plans. A written report shall be submitted to the consulting mechanical engineer if any measurement locations do not meet the manufacturer's placement requirements.
9. Manufacturer
a. Primary flow elements, sensors, meters and transducers shall be EBTRON, Inc. Model GTx116-P and GTx116-F or approved equal.
b. The naming of any manufacturer does not automatically constitute acceptance of this standard product nor waive their responsibility to comply totally with all requirements of the proceeding specification.

U. Electrical Requirements: Provide electric-pneumatic switches, electrical devices, and relays that are UL-listed and of type which meet current and voltage characteristics of the project. All devices shall be of industrial/ commercial grade or better. Residential types will be rejected.
1. EP Switches: Landis & Gyr Powers, Inc. Series 265 - Junction Box Type or approved equal.
2. Relays: Relays shall have an LED status indicator, voltage transient suppression, Closed-Open-Auto switch, plastic enclosure, and color coded wires. Kele model RIBU1C or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION OF CONTROL SYSTEMS

A. General: Install systems and materials in accordance with manufacturer's instructions, roughing-in drawings and details shown on drawings.

B. Control Air Piping:
1. All control air piping shall be copper. Exception: Flexible Tubing may be used for a maximum of two (2) feet at connections to equipment [except for steam control valves] and inside control cabinets.
2. Provide copper tubing with a maximum unsupported length of 3'-0".
3. Pressure Test control air piping at 30 psi for 24 hours. Test fails if more than 5 PSI loss occurs.
4. Fasten flexible connections bridging cabinets and doors, neatly along hinge side, and protect against abrasion. Tie and support tubing neatly.
5. Number-code or color-code tubing, except local individual room control tubing, for future identification and servicing of control system.
6. All control tubing at control panel shall be tagged and labeled during installation to assist owner in making termination connections at control panel.

7. Provide pressure gages on each output device.
8. Paint all exposed control tubing to match existing.

C. Raceway: Raceway is to be installed in accordance with the National Electric Code. Use of flexible metal conduit or liquidtight flexible conduit is limited to 36" to connect from EMT to devices subject to movement. Flexible raceway is not to be used to compensate for misalignment of raceway during installation.

D. Control Wiring: Install control wiring in raceway, without splices between terminal points, color-coded. Install in a neat workmanlike manner, securely fastened. Install in accordance with National Electrical Code.
1. Install circuits over 25-volt with color-coded No. 12 stranded wire.
2. Install electronic circuits and circuits under 25-volts with color-coded No. 18 stranded twisted shielded pair type conductor.
3. N2 communications bus wire shall be 18 AWG, plenum rated, stranded twisted shielded, 3 conductor, with blue outer casing, descripted as 18-03 OAS STR PLNM NEON BLU JK distributed by Windy City Wire, constructed by Cable-Tek, or approved equivalent.
    a. Metastat wiring shall be minimum 20 AWG, plenum rated, stranded, 8 conductor stranded wire.
4. FC communications bus wire shall be 22 AWG, plenum rated, stranded twisted shielded, 3 conductor, with blue outer casing, descripted as 22-03 OAS STR PLNM NEON BLU JK distributed by Windy City Wire, constructed by Cable-Tek, or approved equivalent.
    a. Network sensor wiring (SA Bus) shall be 22 gauge plenum rated stranded twisted wire, 4 conductor.
5. All control wiring at control panel shall be tagged and labeled during installation to assist owner in making termination connections at control panel. Label all control wires per bid documents.

E. All low voltage electrical wiring shall be run as follows:
1. Route electrical wiring in concealed spaces and mechanical rooms whenever possible.
2. Provide EMT conduit and fittings in mechanical rooms and where indicated on drawings.
3. Low voltage electrical wiring routed above acoustical ceiling is not required to be in conduit, but wire must be plenum rated and properly supported to building structure.
4. Provide surface raceway, fittings and boxes in finished areas where wiring cannot be run in concealed spaces. Route on ceiling or along walls as close to ceiling as possible. Run raceway parallel to walls. Diagonal runs are not permitted. Paint raceway and fittings to match existing conditions. Patch/repair/paint any exposed wall penetrations to match existing conditions.

F. All devices shall be mounted appropriately for the intended service and location.
1. Adjustable thermostats shall be provided with base and covers in occupied areas and mounted 48" above finished floor to the top of the device. Tubing and/or wiring shall be concealed within the wall up to the ceiling where ever possible. Surface raceway may only be used with approval of Owners Representative. Wall mounted sensors such as CO2, RH, and non-adjustable temperature sensors shall be mounted 54” above finished floor. Duct mounted sensors shall be provided with mounting brackets to accommodate insulation. Mounting clips for capillary tubes for averaging sensors are required.
2. All control devices shall be tagged and labeled for future identification and servicing of control system.
3. Preheat and mixed air discharge sensors must be of adequate length and installed with capillary tube horizontally traversing face of coil, covering entire coil every 24 inches bottom to top.
4. All field devices must be accessible or access panels must be installed.

G. Install magnehelic pressure gage across each air handling unit filter bank. If the air handling unit has a prefilter and a final filter, two magnehelic pressure gages are required.

3.2 ADJUSTING AND START-UP

A. Start-Up: Temporary control of Air Handling Units shall be allowed only if approved by the owner's representative to protect finishes, etc., AHUs may be run using caution with temporary controls installed by contractor early in the startup process. All safeties including a smoke detector for shut down must be operational. Some means of discharge air control shall be utilized and provided by the contractor such as a temporary temperature sensor and controller located and installed by the Contractor.

B. The start-up, testing, and adjusting of pneumatic and digital control systems will be conducted by owner. Once all items are completed by the Contractor for each system, Contractor shall allow time in the construction schedule for owner to complete commissioning of controls before project substantial completion. This task should be included in the original schedule and updated to include the allotted time necessary to complete it. As a minimum, the following items are required to be completed by the Contractor for Owner to begin controls commissioning.
   1. Process Control Network
      a. The control boards and enclosures need to be installed in the mechanical rooms.
      b. The fiber optic conduit and box for the process control network needs to be installed. Once in place, Owner needs to be contacted so the length of the owner provided fiber cable can be determined and ordered, if required. Coordinate with Owner to schedule the pull in and termination of the fiber cable. Power should be in place at that time. (Fiber for the process control network is required to allow metering of utilities prior to turn on.)
   2. Heating System
      a. Pumps, heat exchangers, steam pressure reducing station, piping, control valves, steam and/or hot water meter, feeder conduit and wire, VFDs, control panels and control wiring installed in the mechanical room. The house keeping pads must be poured before pump operation. All must be in place in working order (pumps aligned, VFDs set up by vendor, motors checked for rotation, steam regulators set to required pressure, condensate pumps operational, heating system ready to circulate (all piping pressure tested, flushed, and insulated) with differential pressure sensors in place.
   3. Cooling System
      a. Pumps, heat exchangers, piping, control valves, chilled water meter, feeder conduit and wire, VFDs, control panels and control wiring installed in the mechanical room. The house keeping pads must be poured before pump operation. All must be in place in working order (pumps aligned, VFDs set up by vendor, motors checked for rotation, cooling system ready to circulate (all piping pressure tested, flushed, and insulated) with differential pressure sensors in place.
   4. VAVs-First Pass
      a. Power, (FC or N2 bus), and control wire installed before owner can make first commissioning pass. First pass includes installation of VAV controller, termination of power, control and network communication wiring.
   5. Air Handlers
      a. Prior to owner commissioning, at a minimum, the following items shall be complete: Power wiring, motor rotation check, fire/smoke dampers open, control wiring including all safeties, IO cabinet, air handler cleaned, and filters installed as required. To protect the systems from dirt, outside air with no return will be used until the building is clean enough for return air operation.
   6. VAVs-Second Pass
      a. After the air handlers are running and under static pressure control and the heating water system is operating, a second pass can be made on the VAVs to download

the control program and commission controllers to verify the VAV dampers, thermostat, and reheat control valves are working properly.

7. Exhaust and Energy Recovery Systems
   a. Exhaust fans need to be operational and under control before labs can be commissioned.
8. Some balance work can be done alongside the control work as long as areas are mostly complete and all diffusers are in place.

3.3 CLOSEOUT PROCEDURES

A. Contractor shall provide complete diagrams of the control system including flow diagrams with each control device labeled, a diagram showing the termination connections, and an explanation of the control sequence. The diagram and sequence shall be framed and protected by glass and mounted next to controller.

B. Contractor shall provide as built diagram of network bus routing listing all devices on bus, once wiring is complete prior to scope completion.

END OF SECTION

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SECTION 230990 - TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Section 230100 “Basic Mechanical Requirements” and Section 230500 “Basic Mechanical Materials and Methods” apply to the work of this Section as if fully repeated herein.

1.2 DESCRIPTION OF WORK

A. This scope of services specifies the requirements and procedures for mechanical systems testing, adjusting and balancing. Requirements include measurement and establishment of the fluid quantities of the mechanical systems as required to meet design specifications, and recording and reporting the results. The test and balance work will be performed by the Owner’s personnel. It is the Contractor’s responsibility to assist as outlined below.

B. Test, adjust and balance the following mechanical systems which are shown in the construction documents.
1. Supply air systems, all pressure ranges, including variable volume and constant volume systems.
2. Return air systems.
3. Outdoor air systems.
4. Exhaust air systems.
5. Hydronic systems.
6. Domestic hot water recirculating system.
7. Steam distribution systems.
8. Verify temperature control system operation.
9. Laboratory systems.

C. The Contractor’s responsibilities are as follows:
1. Notify the Owner’s Representative fourteen (14) days prior to the schedule date for balancing the system.
2. Schedule a four (4) week allowance for the testing and balancing to complete the testing and balancing work when scheduling completion of all work required of the Contractor by the contract documents.
3. Cooperate with the testing and balancing firm and shall make all necessary preparations for the TAB efforts.
4. Complete the following work prior to requesting the TAB effort.
   a. Clean and flush all piping systems.
   b. Leak test and make tight all piping systems.
   c. Fill all piping systems with clean water.
   d. Clean and seal all ductwork systems.
   e. Service and tag all equipment.
   f. Set and align all motors and drives.
   g. Start up and prove all equipment and systems.
   h. Make preliminary settings on all control devices and have all systems operational.
   i. Operate all systems successfully for twenty-four (24) hours minimum.
5. Lubricate all motors and bearings.

6. Check fan belt tension.
7. Check fan rotation.
8. Patch insulation, ductwork and housing, using materials identical to those removed.
9. Seal ducts and piping, and test for and repair leaks.
10. Seal insulation to re-establish integrity of the vapor barrier.
11. Attend a coordination meeting prior to the balancing of the system and a coordination meeting following the balancing of the system.
12. Provide a complete set of as-built drawings prior to the TAB effort.
13. Provide craftsmen of the proper trade to work with the TAB firm to make adjustments and installation changes as required.
14. Change out fan sheaves when and if required by the TAB firm.
15. Dedicate the resources to accommodate all changes identified by the test and balance firm in a timely manner.
16. If a significant rebalance (Owner's determination) of the HVAC system is required due to the Contractor's failure to properly install and check out the HVAC system, the cost of rebalancing the system shall be borne by the Contractor.

1.3 PRE-BALANCING CONFERENCE

A. Prior to beginning of the testing, adjusting and balancing procedures, a conference with the Owner's representative, Engineer and the Test and Balance Agency's representative will be held. The objective of the conference is final coordination and verification of system operation and readiness for testing, adjusting and balancing.

1.4 SEQUENCING AND SCHEDULING OF SERVICES

A. Test, adjust and balance the air conditioning systems during summer season and heating systems during winter season. This includes at least a period of operation at outside conditions within 5 deg. F wet bulb temperature of maximum summer design condition, and within 10 deg. F dry bulb temperature of minimum winter design conditions. Take final temperature readings during seasonal operation.

PART 2 - PRODUCTS (Not applicable)

PART 3 - EXECUTION (Not applicable)

END OF SECTION 23 0990

SECTION 23 2113 – HYDRONIC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:

1. Hot-water heating piping.
2. Chilled-water piping.
3. Makeup-water piping.
4. Condensate-drain piping.
5. Air-vent piping.
6. Safety-valve-inlet and -outlet piping.

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 23 0100 “Basic Mechanical Requirements,” and Section 23 0500 “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 07 Section “Penetration Firestopping” for materials and methods for sealing pipe penetrations through fire and smoke barriers.
2. Division 07 Section “Joint Sealants” for materials and methods for sealing pipe penetrations through exterior walls.
3. Division 23 Section “Basic Mechanical Materials and Methods” for general piping materials and installation requirements, and for labeling and identifying hydronic piping.
4. Division 23 Section “Hangers and Supports” for pipe supports, product descriptions, and installation requirements. Hanger and support spacing is specified in this Section.
5. Division 23 Section “Valves” for general-duty ball, butterfly, and check valves.
6. Division 23 Section “Meters and Gages” for thermometers, flow meters, and pressure gages.
7. Division 23 Section “Hydronic Pumps” for pumps, motors, and accessories for hydronic piping.
8. Division 23 Section “Control Systems” for temperature-control valves and sensors.

1.3 DEFINITIONS

A. The following definitions apply to the work of this Section. Refer to Division 23 Section “Basic Mechanical Materials and Methods” for additional definitions.

1. CWP: Cold working pressure (formerly WOG – Water, Oil, Gas working pressure).
2. DZR Brass: Brass alloy containing not more than 15% zinc by weight.
3. EPDM: Ethylene-propylene-diene terpolymer rubber.
4. PTFE: Polytetrafluoroethylene.
5. PVC: Polyvinyl chloride.

6. SWP: Steam working pressure.
7. Pipe sizes used in this Specification are Nominal Pipe Size (NPS).
8. Class 125: Minimum 125-psig (860-kPa) SWP and minimum 200-psig (1380-kPa) CWP ratings.
9. Class 150: Minimum 150-psig (1035-kPa) SWP and minimum 300-psig (2070-kPa) CWP ratings.

1.4 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:

1. Hot-Water Heating Piping: 150 psig (1030 kPa) at 200ºF (93ºC).
2. Chilled-Water Piping: 150 psig (1030 kPa) at 200ºF (93ºC).
3. Makeup-Water Piping: 80 psig (552 kPa) at 150ºF (66ºC).
4. Condensate-Drain Piping: 150ºF (66ºC).
5. Air-Vent Piping: 200ºF (93 C).
6. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

1.5 SUBMITTALS

A. Product Data: For each type of the following:
1. Pressure-seal fittings.
2. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and active flow-limiting valves.
3. Air control devices.
4. Hydronic specialties.

B. Qualification Data: For Installer.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

E. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installers of Pressure-Sealed Joints: Installers shall be certified by the pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.

B. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

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.

D. ASME Compliance: Comply with ASME B31.9, “Building Services Piping,” for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air/dirt separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

E. Comply with NFPA 70 – National Electrical Code. Do not route piping directly above electric panelboards and switchboards, or other prohibited locations.

F. All castings used for couplings housings, fittings, or valve and specialty bodies shall be date stamped for quality assurance and traceability.

1.7 COORDINATION

A. Coordinate layout and installation of hydronic piping and suspension system components with other construction, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

B. Coordinate pipe sleeve installations for foundation wall penetrations.

C. Coordinate piping installation with roof curbs, equipment supports, and roof penetrations. Roof specialties are specified in Division 07 Sections.

D. Coordinate pipe fitting pressure classes with products specified in related Sections.

E. Coordinate installation of pipe sleeves for penetrations through exterior walls and floor assemblies. Coordinate with requirements for firestopping specified in Division 07 Section “Penetration Firestopping” for fire and smoke wall and floor assemblies.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Active Flow-Limiting Valves:

   a. Bell & Gossett; a Xylem Brand
   b. Griswold Controls.
   c. Hydronic Components, Inc.
   d. Nexus Valve.
   e. Nibco Inc.
   f. Pro-Hydronic Specialties, LLC.

2. Manual & Automatic Air Vents:

a. Amtrol, Inc.
b. Armstrong Pumps, Inc.
c. Bell & Gossett; a Xylem Brand.
d. Taco.

3. Pressure-Reducing Valves and Safety Valves:
   a. Amtrol, Inc.
   b. Armstrong Pumps, Inc.
   c. Bell & Gossett; a Xylem Brand.
   d. Conbraco Industries, Inc.
   e. Spence Engineering Company, Inc.
   f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

4. Strainers:

   a. Armstrong Machine Works.
   b. Eaton Filtration.
   c. Hoffman Specialty ITT; Fluid Handling Div.
   d. Metraflex Co.
   e. Nibco Inc.
   f. Spirax Sarco.
   g. Watts Regulator Co.

2.2 PIPING MATERIALS

A. General: Refer to Part 3 “Piping Applications” Article for applications of pipe and fitting materials, including a schedule of which types of piping to use in which application.

2.3 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B88, Type L (ASTM B88M, Type B).

B. DWV Copper Tubing: ASTM B306, Type DWV.

C. Wrought-Copper Fittings and Unions: ASME B16.22.

D. Solder Filler Metals: ASTM B32, 95-5 tin antimony.

E. Field or shop fabricated fittings are not allowed. Pulled-tees or pipe fittings using “T-Drill” are not allowed.

2.4 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A53/A53M, black steel with plain ends; Type E (Electric-resistance welded), Grade B, Schedule 40; unless otherwise indicated in Part 3 “Piping Applications” Article.

B. Steel Pipe Nipples: ASTM A733, made of ASTM A53/A53M black steel, Grade B, Schedule 40; unless otherwise indicated in Part 3 “Piping Applications” Article.

C. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150 or 300 as indicated in Part 3 “Piping Applications” Article.

D. Malleable-Iron Unions: ASME B16.39; Class 150, 250, or 300 as indicated in Part 3 “Piping Applications” Article.

E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Class 125 or 250 as indicated in Part 3 “Piping Applications” Article; raised ground face, and bolt holes spot faced.

F. Wrought-Steel Fittings: ASTM A234/A234M, wall thickness to match adjoining pipe. All elbows shall be long-radius type.

G. Wrought Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

H. Material Group: 1.1.

I. End Connections: Butt welding.

J. Facings: Raised face.

K. Grooved Mechanical Joint Fittings and Couplings are not allowed.

2.5 SPECIALTIES

A. Refer to Division 23 Section “Basic Mechanical Materials and Methods” for joining materials, transition fittings, and dielectric fittings. Those requirements apply to the work of this Section as if fully reproduced herein.

2.6 GENERAL-PURPOSE VALVES

A. Refer to Division 23 Section “Valves” for Ball, and Butterfly Valves, whose requirements apply to the work of this Section as if fully reproduced herein.

B. Refer to Division 23 Section “Control Ssystems” for Automatic Temperature-Control Valves, Actuators, and Sensors, whose requirements apply to the work of this Section as if fully reproduced herein.

C. Refer to Part 3 “Valve Applications” Article elsewhere within this Section for applications of each type of valve and service.

2.7 SPECIALTY VALVES

A. Automatic Flow-Control Valves:
   1. Body: DZR-brass or ferrous metal.
   2. Piston and Spring Assembly: Bronze or Stainless steel; tamper proof, self cleaning, and removable.
   3. Combination Assemblies: Include bronze or brass-alloy ball valve.
   4. Identification Tag: Marked with zone identification, valve number, and flow rate.
   5. Size: Same as pipe in which installed.
   6. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations.
   7. Minimum CWP Rating: 175 psig (1207 kPa).
   8. Maximum Operating Temperature: 250 deg F (121 deg C).

B. Calibrated-Orifice Balancing Valves:
1. Body (Size 2-inch NPS and smaller): Bronze or DZR-brass body; ball- or plug-type with calibrated orifice or venturi.
2. Body (Size 2½-inch NPS and larger): Cast-iron or steel body; ball, plug, or globe pattern with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.
4. Plug: Resin.
5. Seat: PTFE.
6. Stem Seals: EPDM O-rings.
7. Disc: Glass and carbon-filled PTFE.
8. End Connections (Size 2-inch NPS and smaller): Threaded or socket.
9. End Connections (Size 2½-inch NPS and larger): Flanged or grooved.
10. Pressure Gage Connections: Integral seals for portable differential pressure meter.
11. Handle Style: Lever, with memory stop to retain set position.
12. Accessories: Integral pointer and calibrated scale to register degree of valve opening.
13. CWP Rating: Minimum 125 psig (860 kPa).
14. Maximum Operating Temperature: 250ºF (121 C).
15. Refer to Detail sheets for location use.

C. Diaphragm-Operated Pressure-Reducing Valves:
1. Body: Bronze or DZR-brass.
2. Disc: Glass and carbon-filled PTFE.
3. Seat: Brass.
4. Stem Seals: EPDM O-rings.
5. Diaphragm: EPT.
6. Low inlet-pressure check valve.
7. Inlet Strainer: Bronze or stainless steel; removable without system shutdown.
8. Valve Seat and Stem: Noncorrosive.
9. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

2.8 AIR CONTROL DEVICES

A. Manual Air Vents:
1. Body: Bronze.
2. Internal Parts: Nonferrous.
3. Operator: Manual via screwdriver or thumbscrew.
4. Inlet Connection: NPS ½ (DN 15).
5. Discharge Connection: NPS 1/8 (DN 6).
6. CWP Rating: 150 psig (1035 kPa).
7. Maximum Operating Temperature: 225ºF (107 C).

B. Automatic Air Vents:
1. Body: Bronze or cast iron.
2. Internal Parts: Nonferrous.
3. Operator: Noncorrosive metal float.
4. Inlet Connection: NPS ½ (DN 15).
5. Discharge Connection: NPS ¼ (DN 8).
6. CWP Rating: 150 psig (1035 kPa).
7. Maximum Operating Temperature: 240ºF (116 C).

2.9 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers, 2-inch and Smaller:
1. Body (for use in Copper piping): ASTM B584 C84400 or ASTM B-62 C83600 bronze body, with threaded bronze cover and brass drain plug.

2. Body (for use in Steel piping): ASTM A126, Class B, cast iron with threaded cap and bottom drain connection.
3. End Connections: Threaded ends.
4. Strainer Screen: 20-mesh, Type 304 stainless steel.
5. CWP Rating: 200 psig (1380 kPa) at 150ºF (65 C).
6. SWP Rating: 150 psig (1030 kPa) at 350ºF (176 C).

B. Y-Pattern Strainers, 2½-inch and Larger:
1. Body: ASTM A126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Flanged ends.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 175 psig (1200 kPa) at 150ºF (65 C).
5. SWP Rating: 125 psig (860 kPa) at 350ºF (176 C).

C. Refer to Division 23 Section “Basic Mechanical Materials and Methods” for flexible pipe connectors, whose requirements apply to the work of this Section as if fully reproduced herein.

PART 3 - EXECUTION

3.1 PIPING SCHEDULE OF APPLICATIONS

A. Hot-water heating piping and Chilled-water, aboveground, NPS 2 (DN 50) and smaller, shall be Type L (C), drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
1. Contractor’s Option: Schedule 40 steel pipe; Class 150, malleable-iron fittings; cast-iron flanges and flange fittings; and threaded joints will be acceptable.

B. Cooling Coil Condensate-Drain Piping: Type L (C), drawn-temper copper tubing, wrought-copper fittings, and soldered joints;

C. Hot-water heating piping and Chilled-water piping, aboveground, NPS 2½ (DN 65) and larger, shall be Standard Weight steel pipe; wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints. All elbows shall be long-radius type.

D. Makeup-water piping installed aboveground shall be Type L (B), drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

E. Air-Vent Piping: Same materials and joining methods as for piping specified for the service in which air vent is installed.

F. Safety-Valve-Inlet and -Outlet Piping for HVAC Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed.

3.2 VALVE APPLICATIONS

A. Install valves where indicated on Drawings and where indicated in Division 23 Section “Valves.”

B. Install specialty valves where indicated on Drawings.

C. Install ¾ inch drain valves at all low points, and ¾ inch drain valve with manual air vents at all high points, in mains, risers, branch lines and elsewhere as required for system drainage.

D. 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.

E. Route automatic air vent discharge in ¼ inch (6.4 mm) poly tubing to floor drain.

F. Install autoflow valve at end of run heating hot water systems to maintain flow at end of run.

3.3 PIPING INSTALLATIONS

A. General: General piping installation is specified in Division 23 Section “Basic Mechanical Materials and Methods,” whose requirements apply to the work of this Section as if fully repeated herein.

B. Install drains, consisting of a tee fitting, NPS ¾ (DN 20) ball valve, and short NPS ¾ (DN 20) threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
C. In closed systems, install horizontal piping at a uniform grade of 0.2 percent upward in direction of flow.
D. For cooling coil condensate-drain piping, install horizontal piping at a uniform grade of 1.0 percent downward in the direction of flow.
E. Bull-head tees prohibited: Do not use tee fittings in such a way that the flow through the branch leg equals the sum of the flows through two main legs.
F. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
G. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the top of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
H. Changes of direction, branches, tees, etc. shall be accomplished with the appropriate factory or foundry fitting meeting the requirements of these specifications. Mechanically-formed extruded tee outlets or field-fabricated tee branches and/or elbows are not acceptable.
I. All elbows shall be long-radius type.
J. Install valves according to Division 23 Section “Valves.”
K. Install unions in piping NPS 2 (DN 50) and smaller, at final connections of equipment and elsewhere as indicated.
L. Install flanges in piping NPS 2½ (DN 65) and larger, at final connections of equipment and elsewhere as indicated.
M. Install strainers on inlet side of each control valve, pressure-reducing valve, in-line pump, and elsewhere as indicated. Install NPS ¾ (DN 20) ball valve in blowdown connection of strainers NPS 2 (DN 50) and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2 (DN 50). Install removable cap to end of valve.
N. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.
O. Connect risers and branch connections to terminal units with at least four pipe fittings, including tee in riser.
P. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.
Q. Identify piping as specified in Division 23 Section “Basic Mechanical Materials and Methods.”
R. Hang, support, and anchor all piping as specified in Division 23 Section “Hangers and Supports.”
S. Connect copper branch lines to steel or iron mains as follows: Install steel branch pipe off main with black iron nipple connected to bronze ball valve. Connect bronze ball valve to copper piping with threaded copper male adaptor, which is then soldered to the copper branch line.
T. Provide shutoff valves at each floor and/or branch on hot water reheat systems.
U. Branch connections shall be made with straight tees, reducing tees, threadolets, or weldoles.
V. Tap side of weldolet or threadolet to be no more than 1/3 of the sizes of tapped pipe.
W. Flanges shall be flat face when mating with 125 lb class cast iron valves.

3.4 PIPE JOINT CONSTRUCTION

A. Refer to Division 23 Section “Basic Mechanical Materials and Methods” for joint construction requirements for soldered joints in copper tubing; threaded, welded, and flanged joints in steel piping; and solvent-welded joints for PVC piping.
B. 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.

3.5 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.
B. Install automatic air vents where indicated on Drawings.
C. Install ¾ inch ball valve with hose bib connection at all locations were a manual air vent is installed as indicated on Drawings.
D. Locate piping unions on the equipment or branch side of any shutoff valves.

3.6 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.
B. Install control valves in accessible locations close to connected equipment, but outside the service area. For example, control valve shall be as close to hydronic coil as practical, but not within the coil pull space and/or access door swing space.
C. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Division 23 Section “Meters and Gages.”

3.7 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:
   1. Notify Owners Representative 72 hours before required testing. All tests shall be conducted in the presence of the Owner Representative.
   2. Leave joints, including welds, uninsulated and exposed for examination during test.
   3. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
   4. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
   5. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
   6. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
   7. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used. Do not pressure test with air.
   8. Pressure gauge shall be a minimum 4 inch dial face, 0-160 psig, and shall be calibrated within one year to test date.
   9. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
   10. Isolate expansion tanks and determine that hydronic system is full of water.
   11. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system’s working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times “SE” value in Appendix A in ASME B31.9, “Building Services Piping.”
   12. Minimum duration of test shall be four (4) hours. During the final hour of the hydrostatic test, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
   13. Prepare written report of testing.
   14. Minimum test pressure shall be 100 PSIG.
   15. System shall be operated for a minimum of 24 hours to demonstrate to the Owner’s Representative that system is complete and operational.

B. Perform the following before operating the system:
   1. Open manual valves fully.
   2. Inspect pumps for proper rotation.

3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment to specified values.
7. Verify lubrication of motors and bearings.

C. System shall be operational for a minimum of 24 hours to demonstrate to the Owner's Representative that system is complete and operational.

3.8 CLEANING AND ADJUSTING

A. Flush hydronic piping systems with clean water. Remove and clean or replace strainer screens. After cleaning and flushing hydronic piping systems, but before balancing, remove disposable fine-mesh strainers in pump suction diffusers.

END OF SECTION 23 2113

SECTION 23 2123 – HYDRONIC PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Inline centrifugal pumps.

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 23 0100 “Basic Mechanical Requirements,” and Section 23 0500 “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 “Meters and Gages” for thermometers and pressure gages, connector plugs, and devices.
2. Division 23 Section “Motors” for pump motors.
3. Division 23 Section “Control Systems” for interlock wiring between pumps, and between pumps and field-installed control devices.
4. Division 26 Sections for power-supply wiring, field-installed disconnects, required electrical devices, and motor controllers.

1.3 DEFINITIONS

A. Buna-N: Nitrile rubber.

B. EPT: Ethylene propylene terpolymer.

C. HI: Hydraulic Institute.

1.4 SUBMITTALS

A. Product Data: Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump’s operating point on curves.

B. Shop Drawings: Show pump layout and connections. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.

C. Wiring Diagrams: Detail wiring for power, signal, and control systems, differentiating between manufacturer-installed wiring and field-installed wiring.

D. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals specified in Division 01.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain hydronic pumps through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of hydronic pumps and are based on the specific “basis of design” system indicated. Refer to Division 23 Section “Basic Mechanical Requirements” for use of products other than the “basis of design.”

C. Published pump performance (flow and head delivered) shall be determined by factory-testing per ANSI/HI 14.6 *Rotodynamic Pumps for Hydraulic Performance Acceptance Tests*.

D. Regulatory Requirements: Comply with provisions of the following:

1. ASME B31.9 “Building Services Piping” for piping materials and installation.
2. Hydraulic Institute’s “Standards for Centrifugal, Rotary & Reciprocating Pumps” for pump design, manufacture, testing, and installation.
3. UL 778 “Standard for Motor Operated Water Pumps” for construction requirements. Include UL listing and labeling.
4. NEMA MG 1 “Standard for Motors and Generators” for electric motors. Include NEMA listing and labeling.
5. NFPA 70 “National Electrical Code” for electrical components and installation.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Manufacturer’s Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.

B. Store pumps in dry location.

C. Extended Storage Longer than 5 Days: Dry internal parts with hot air or vacuum-producing device. Coat internal parts with light oil, kerosene, or antifreeze after drying. Dismantle bearings and couplings; dry; coat with acid-free, heavy oil; tag; and store in dry location.

D. Retain protective covers for flanges and protective coatings during storage. Protect bearings and couplings against damage from sand, grit, and other foreign matter.

E. Comply with pump manufacturer’s written rigging instructions.

PART 2 - PRODUCTS

2.1 PUMPS, GENERAL

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Armstrong Pumps Inc.
2. Bell & Gossett; a Xylem Brand.
3. Taco, Inc.

B. Motors: NEMA MG 1, general purpose, continuous duty, Design B, except Design C where required for high starting torque. Furnish single-speed motors, with type of enclosures and electrical characteristics indicated. Include grease-lubricated ball bearings. Select each motor to be non-overloading over full range of pump performance curve. Motors shall be high efficiency, premium quality, secured to mounting frame, with adjustable alignment. Comply with requirements in Division 23 Section “Motors,” whose requirements apply to the work of this Section as if fully reproduced herein.

1. Provide inverter-ready or inverter-duty motors with shaft grounding rings as specified in Division 23 Section “Motors” everywhere variable speed drives are indicated.

C. Factory Finish: Manufacturer's standard paint applied to factory-assembled and -tested units before shipping.

D. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.

E. Operating Speed: Do not exceed 1800 rpm unless expressly scheduled on the Drawings.

2.2 INLINE CENTRIFUGAL PUMPS

A. Inline Pump: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled or separately-coupled, inline pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally or vertically. Rate pump for 175-psig minimum working pressure and a continuous water temperature of 225ºF.

B. Close-coupled versus separately-coupled; and shaft-horizontal versus shaft-vertical; may be indicated via Schedule, via model number, or via graphic depiction on the Drawings. If so, comply with same. If not, choice is contractor's option.

C. Casing: Radially split, cast iron, with replaceable bronze wear rings, threaded gage tappings at inlet and outlet, and threaded companion-flange connections.

D. Impeller: ASTM B584 cast bronze, or Type 304 stainless steel; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw.

E. Pump Shaft: Steel, with bronze or copper-alloy shaft sleeve. A stainless steel shaft is also acceptable.

F. Shaft Coupling (If pump is separately-coupled, shaft-horizontal): Interlocking frame with interconnecting springs capable of absorbing vibration.

G. Shaft Coupling (If pump is separately-coupled, shaft-vertical): Axially-split spacer coupling.

H. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N or EPT bellows and gasket. Include water slinger on shaft between motor and seal.

I. Pump Bearings: Permanently lubricated ball bearings; or oil-lubricated bronze-journal or thrust type.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation. Examine foundations and/or inertia bases for suitable conditions where pumps are to be installed. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PUMP INSTALLATION

A. Install pumps according to manufacturer's written installation and alignment instructions. Comply with HI 1.4.

B. Install pumps in locations indicated and arranged to provide access for periodic maintenance, including removal of motors, impellers, couplings, and accessories.

C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.

D. Suspend in-line centrifugal pumps independent of piping. Install pumps with motor and pump shafts vertical. Use continuous-thread hanger rods and spring hangers of sufficient size to support pump weight. Hanger and support materials are specified in Division 23 Section “Hangers and Supports.”

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect piping to pumps. Install piping adjacent to machine to allow service and maintenance. Install valves that are same size as piping connected to pumps. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles. Install valves, flexible pipe connectors, gages, and specialty fittings on suction and discharge side of pumps as indicated by details on the Drawings.

C. Install electrical connections for power, controls, and devices. Connect wiring and ground equipment according to Division 26 Sections.

3.4 STARTUP SERVICE

A. Final Checks Before Startup: Engage a factory-authorized service representative to perform startup service and the following preventive maintenance operations and checks before startup:

1. Complete installation and startup checks according to manufacturer’s written instructions.
2. Check piping connections for tightness.
3. Clean strainers on suction piping.
4. Lubricate bearings.
5. Remove grease-lubricated bearing covers, flush bearings with kerosene, and clean thoroughly. Fill with new lubricant according to manufacturer’s recommendations.
6. Disconnect coupling and check motor for proper rotation that matches direction marked on pump casing.
7. Check that pumps are free to rotate by hand. Pumps for handling hot liquids shall be free to rotate with pump hot and cold. Do not operate pump if it is bound or even drags slightly until cause of trouble is determined and corrected.
8. Check that pump controls are correct for required application.
9. Starting procedure for pumps with shutoff power not exceeding safe motor power.
10. Prime pumps, opening suction valve, closing drains, and preparing pumps for operation.
11. Start motors.
12. Open discharge valves slowly.
13. Check general mechanical operation of pumps and motors.
14. When pumps are to be started against closed check valves with discharge shutoff valves open, steps are the same, except that discharge valves are opened sometime before motors are started.

B. Refer to Division 23 Section “Testing, Adjusting, and Balancing” for detailed requirements for testing, adjusting, and balancing hydronic systems.

3.5 TRIM IMPELLER

A. Testing, Adjusting and Balancing is the work of Division 23 Section “Testing, Adjusting, and Balancing.” After initial testing and balancing, the work of this Section shall include impeller trim. Remove, trim, and reinstall the impeller of all pumps, to match specified performance. Impeller trim shall be performed in a qualified shop acceptable to the pump supplier. Trim impeller to exact

diameter as determined under Division 23 Section “Testing, Adjusting, and Balancing” matching the desired performance in consultation with the pump curve.

1. Exception: Impeller trim is not required for pumps whose speed is controlled by a variable frequency drive.
2. Exception: Impeller trim is not required for pumps whose motor is 10 HP or smaller.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner’s maintenance personnel to adjust, operate, and maintain hydronic pumps. Refer to Division 01.

END OF SECTION 23 2123

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SECTION 23 3113 – METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes metal ducts and plenums for supply, return, outside, and exhaust air-distribution systems in pressure classes from minus 2- to plus 10-inch wg (minus 500 to plus 2500 Pa). Metal ducts include the following:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round ducts and fittings.
3. Sheet metal materials.
4. Sealants and gaskets.
5. Hangers and 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 23 0100 “Basic Mechanical Requirements,” and Section 23 0500 “Basic Mechanical Materials and Methods” 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 07 Sections “Penetration Firestopping” for fire-resistant sealants for use around duct penetrations and fire-damper installations in fire-rated floors, partitions, and walls.
2. Division 08 Section “Access Doors and Frames” for wall- and ceiling-mounted access doors and for access to concealed ducts.
3. Division 08 Section “Louvers and Vents” for intake and relief louvers and vents connected to ducts and installed in exterior walls.
4. Division 23 Section “Mechanical Insulation.”
5. Division 23 Section “Duct Accessories” for dampers, duct-mounting access doors and panels, turning vanes, and flexible ducts.
6. Division 23 Section “Air Terminals” for temperature control terminal units.
7. Division 23 Section “Diffusers, Registers and Grilles.”
8. Division 23 Section “Control Systems” for automatic control dampers and actuators.
9. Division 23 Section “Testing, Adjusting and Balancing” for air balancing and final adjusting of manual volume dampers.

1.3 DEFINITIONS

A. Thermal Conductivity and Apparent Thermal Conductivity (k-Value): As defined in ASTM C168.

1.4 PERFORMANCE REQUIREMENTS

A. Duct system design, as indicated, has been used to select size and type of air-moving and distribution equipment and other air system components. Changes to layout or configuration of duct system must be specifically approved in writing by the design professional. Accompany

requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

B. Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA *HVAC Duct Construction Standards – Metal and Flexible* and performance requirements and design criteria indicated in Part 3 of this Section.

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2016.

1.5 SUBMITTALS

A. Product Data: For each type of the following products:

1. Adhesives.
2. Sealants and gaskets.
3. Manufactured ductwork and duct fittings (if applicable).
4. MSDS (Material Safety Data Sheet) for each adhesive and sealant furnished.
5. Sheet metal thicknesses.
6. Joint and seam construction and sealing.
7. Reinforcement details and spacing.
8. Materials, fabrication, assembly, and spacing of hangers and supports.

B. Coordination Drawings: Comply with Division 23 Section “Basic Mechanical Requirements” for Coordination Drawings. Include reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components and ceiling suspension assembly members.
3. Other systems installed in same space as ducts.
4. Structural members to which duct will be attached.
5. Size and location of initial access modules for acoustical tile.
6. Ceiling- and wall-mounting access doors and panels required to provide access to dampers and other operating devices.
7. Penetrations of smoke barriers and fire-rated construction.
8. Ceiling-mounting items and/or items penetrating finished ceiling, including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

C. Field quality-control test reports: Indicate and interpret test results for compliance with performance requirements.

D. Record Drawings: Indicate actual routing, fitting details, reinforcement, support, and installed accessories and devices.

1.6 QUALITY ASSURANCE

A. NFPA Compliance: Comply with NFPA 90A-2018 *Standard for the Installation of Air Conditioning and Ventilating Systems*.

B. AMCA Compliance: All spiral ducts shall bear the AMCA Certified Ratings Program seal for Air Leakage.

C. ASHRAE Compliance: Applicable requirements in ASHRAE Standard 62.1-2016, Section 5 - "Systems and Equipment" and Section 7 – "Construction and System Start-Up."

D. ASHRAE Compliance: Applicable requirements in ASHRAE Standard 90.1-2016, Section 6.4.4 – "HVAC System Construction and Insulation."

1.7 REFERENCES

A. ANSI/SMACNA Standard 006-2006 *HVAC Duct Construction Standards – Metal and Flexible*, as published by the Sheet Metal and Air Conditioning Contractors' National Association. 3rd ed. Chantilly, VA: SMACNA, 2005. All references to this document throughout this Section refer to this specific edition.

B. ANSI/SMACNA Standard 016-2012 *HVAC Air Duct Leakage Test Manual*, as published by the Sheet Metal and Air Conditioning Contractors' National Association. 2nd ed. Chantilly, VA: SMACNA, 2012. All references to this document throughout this Section refer to this specific edition.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver sealant and firestopping materials to site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.

B. Store and handle sealant and firestopping materials according to manufacturer's written recommendations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Field-Applied Duct Sealant Materials:

    a. Ductmate, Inc.
    b. H.B. Fuller Construction Products Inc. (Childers and/or Foster brands)
    c. Hardcast, Inc.
    d. McGill Air Seal Corporation.

2. Optional Manufactured Duct Slide-on Flange System:

    a. Ductmate, Inc.
    b. Nexus Inc.
    c. Ward Industries, Inc.

3. Optional Round Duct Coupling System:

    a. Lindab, Inc. "Spirosafe"
    b. Sheet Metal Connectors, Inc.
    c. Spiramir Corp.
    d. Stamped Fittings Inc. "The Edge"

2.2 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA *HVAC Duct Construction Standards – Metal and Flexible* for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Sheet Gage: SMACNA standards notwithstanding, no material thinner than 26-gage is permitted for spiral-seam round duct, and no material thinner than 24-gage is permitted for all other ducts.

C. Galvanized Sheet Steel: Comply with ASTM A653 / A653M.

1. Galvanized Coating Designation: G90 (Z275).
2. Finishes for Surfaces Exposed to View: Mill-phosphatized.

3. Galvanized Coating Designation: G60 (Z180) or G90 (Z275).
4. Minimum Thickness for Factory-Applied PVC Coating: 4 mils (0.10 mm) thick[on sheet metal surface of ducts and fittings exposed to corrosive conditions, and minimum 2 mil (0.05 mm) thick on opposite surface.
5. Coating Materials: Acceptable to authorities having jurisdiction for use on ducts listed and labeled by an NRTL for compliance with UL 181, Class 1.

D. Reinforcement Shapes and Plates: ASTM A36 / A36M, steel plates, shapes, and bars; black and galvanized. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

E. Tie Rods: Comply with Articles 2.5 through 2.9, including all accompanying Tables and Figures, of the SMANCA HVAC Duct Construction Standards.

2.3 SEALANT MATERIALS

A. Two-Part Sealing System: Woven-fiber tape impregnated with gypsum mineral compound and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal; Hardcast® Two-Part Sealing System, Uni-Cast® by McGill AirSeal Corporation, or equal.

B. One-Part Sealing System: Flexible, adhesive sealant, fiber-reinforced, resistant to UV light when cured, UL 723 listed, and complying with NFPA requirements for Class 1 ducts. Examples of acceptable products include Uni-Mastic 181 by McGill, Foster 32-19, and Childers CP-146.

C. Water-Based Seam Sealant: Flexible, adhesive sealant, resistant to UV light when cured, UL 723 listed, and complying with NFPA requirements for Class 1 ducts.

D. Formed-on Duct Connectors: Flange shop roll-formed onto edge of ductwork, with corner closures, cleats and gaskets for seal; TDC or TDF constructed per SMACNA T-25a or T-25b.

1. Flanged Joint Mastic: One-part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C920, Type S, Grade NS, Class 25, Use O.
2. Flange Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.
3. Contractor's Option: Proprietary manufactured slide-on duct connectors by Ductmate, Ward, or Nexus meeting the above requirements will be accepted wherever formed-on duct connectors are required by these specifications.

2.4 RECTANGULAR DUCT FABRICATION

A. General: Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA *HVAC Duct Construction Standards – Metal and Flexible*. Comply with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, deflection limits, and joint types and intervals, except where more stringent requirements are specified herein.

B. All sheet metal shall be a minimum of 24-gage thickness in any case. Use 24-gage sheet metal where SMACNA allows thinner material.

C. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification.

D. Materials: Free from visual imperfections such as pitting, seam marks, roller marks, stains, and discolorations.

E. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches (480 mm) and larger and 0.0359-inch (0.9 mm) thick or less, with more than 10 sq. ft. (0.93 sq. m) of unbraced panel area, unless ducts are lined.

F. Pressure Classification: See Schedule in Part 3 of this Section.

G. Seal Classification: See Schedule in Part 3 of this Section.

H. Longitudinal Seams: Contractor's choice of Pittsburgh lock (SMACNA Figure 2-2 Type L-1) or Button Punch Snap Lock (SMACNA Figure 2-2 Type L-2) shall be used on all longitudinal seams. See "Seam and Joint Sealing" in Part 3 of this Section for further requirements.

I. Duct sizes shown on plans are free area sizes and do not include the thickness of internal duct liner, if any. For internally lined ductwork, increase the indicated duct dimensions to account for the liner thickness.

J. Contractor is free to alter the indicated sizes of rectangular duct to suit field conditions, provided that revised size is selected for friction loss no greater than that of indicated size. No prior approval by the Engineer is required for equal-friction duct size changes unless proposed size has an aspect ratio greater than 4 to 1.

K. All changes of direction shall be fabricated as elbows in accordance with SMACNA Figure 4-2 except that RE-4, RE-9 and RE-10 are prohibited. RE-6 is limited to a change-of-direction angle of 45 degrees or less.

L. Divided flow branches shall be Type 1 or Type 2 per SMACNA Figure 4-5. Type 3 divided flow branches are permitted only where expressly shown. Seek Engineer's approval of Type 3 where space and/or layout clearances prohibit Type 1 or Type 2.

M. Branch connections shall be per SMACNA Figure 4-6, except that straight taps are not permitted on any ducts 2-inch pressure class or above. Straight-tap "spin-in" fittings are permitted on ½-inch and 1-inch pressure class ductwork only.

N. Offsets and transitions shall be per SMACNA Figure 4-7, except that offset Type 2 (mitered) is limited to an angle of 45° or less.

O. Fittings at obstructions shall be per SMACNA Figure 4-8, except that Figure D is not permitted. Use Figure 4-8.B in lieu of Figure 4-8.D. Seek Engineer's approval of Figure 4-8.D where space and/or layout clearances prohibit use of Figure 4-8.B.

2.5 ROUND AND FLAT-OVAL DUCT AND FITTING FABRICATION

A. Diameter as applied to flat-oval ducts in this Section is the diameter of a round duct with a circumference equal to the perimeter of a given size of flat-oval duct.

B. Contractor's Option: The contractor is permitted to furnish spiral lock-seam round or flat-oval ductwork anywhere rectangular duct is indicated, provided the Contractor's coordination

drawings demonstrate that adequate ceiling clearances and space required by other trades will permit round ductwork. If this option is chosen, round duct sizes shall be selected by the Contractor according to “equal friction” with respect to the rectangular sizes shown.

C. Round, Spiral Lock-Seam Ducts: Fabricate supply ducts of galvanized steel according to SMACNA *HVAC Duct Construction Standards – Metal and Flexible* except that 26-gage is the thinnest material acceptable.

D. Longitudinal-seam round ducts (“stovepipe”) of a minimum 24-gage thickness, will be permitted on ½-inch and 1-inch pressure classifications only; and only if the Seal Class specified in Part 3 of this Section can be achieved.

E. Flat-Oval, Spiral Lock-Seam Ducts: Fabricate supply ducts according to SMACNA *HVAC Duct Construction Standards – Metal and Flexible* except that 24-gage is the thinnest material available. With approval of Engineer, contractor may substitute flat oval duct where round duct is indicated, provided that revised size is selected for friction loss no greater than that of indicated size.

F. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA *HVAC Duct Construction Standards – Metal and Flexible*, with metal thicknesses specified for longitudinal-seam straight ducts.

G. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.

H. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Bend radius of die-formed, gored, and pleated elbows shall be 1½ times duct diameter. Adjustable-angle elbow fittings are not permitted. Unless elbow construction type is indicated, fabricate elbows as follows:

1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA *HVAC Duct Construction Standards – Metal and Flexible* unless otherwise indicated.
2. Flat-Oval Mitered Elbows: Welded construction with same metal thickness as longitudinal-seam flat-oval duct.
3. 90-Degree, 2-Piece, Mitered Elbows: Use only if approved by the Engineer where space restrictions do not permit using radius elbows. Fabricate with turning vanes.
4. Round Elbows 8 Inches (200 mm) and Less in Diameter: Fabricate die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
5. Round Elbows 9 through 14 Inches (225 through 355 mm) in Diameter: Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
6. Round Elbows Larger Than 14 Inches (355 mm) in Diameter and All Flat-Oval Elbows: Fabricate gored elbows unless space restrictions require mitered elbows.

2.6 SHOP- AND FIELD-FABRICATED PLENUMS

A. Description: Provide galvanized steel (unless noted otherwise) air plenums in accordance with Chapter 9 of SMACNA *HVAC Duct Construction Standards – Metal and Flexible*. Air plenums required for this project include:

1. Return air / outdoor air mixing plenums for attachment to the inlet end of air handling units, with connection points for outdoor and return air ducts. Construction shall be 2-inch

insulated double wall with solid inner liner; coordinate size, orientation, and layout with Division 23 Section “Modular Packaged Air-Handling Units” and the Drawings.

2. Outdoor air intake plenums for attachment to exterior outdoor air intake louvers, with connection point(s) for outdoor air duct(s). Construction shall be single wall with exterior insulation; coordinate size, orientation, and layout with Division 08 Section “Louvers and Vents” and the Drawings.
3. Exhaust air plenums for attachment to exterior exhaust louvers, with connection point(s) for exhaust air duct(s). Construction shall be single wall uninsulated; coordinate size, orientation, and layout with Division 08 Section “Louvers and Vents” and the Drawings.
4. Other HVAC plenums as indicated on Drawings.

B. Shop fabricate plenums to greatest extent possible with a minimum of joints and to minimize field fabrication and assembly.

C. Fabricate plenums with standing seam construction and angle reinforcement. Fabricate close-off sheets from plenum sides, top, and bottom to damper frames. Bolt close-off sheets to frame flanges and housings.

D. Fabricate plenums with sheet metal walls, top, and bottom panels. Do not use building walls, ceilings or floors as a portion of the plenum boundary, except where expressly shown on Drawings.

E. Reinforce plenums with galvanized or painted steel angles.

F. Seal joints as required in Part 3 of this Section.

G. Fabricate drain pans for air plenums adjacent to exterior louvers with external connection and vented deep-seal trap for drainage piping with a 3/4-inch (20-mm) pipe connection. Fabricate and reinforce drain pans of same material and thickness as housing, 2 inches (50 mm) deep with rolled edges. Solder seams.

H. Fabricate plenums with reinforced openings for access doors at least 20 inches (500 mm) wide by 48 inches (1200 mm) high and located for access to each item of equipment housed. Each plenum shall have at least one access door; more if shown on Drawings. Access doors shall swing out for negative pressure plenums and in for positive pressure plenums. Refer to Division 23 Section “Duct Accessories” for access doors.

I. Mount automatic control dampers in air mixing plenums where applicable. Control dampers are supplied as the work of Division 23 Section “Control System.”

J. Mount automatic control dampers in air mixing plenums where applicable. Control dampers are supplied as the work of Division 23 Section “Duct Accessories.”

2.7 HANGERS AND SUPPORTS

A. General: Support all ductwork in accordance with Chapter 5 of SMACNA *HVAC Duct Construction Standards – Metal and Flexible* except where more stringent requirements are specified herein.

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (100 mm) thick.
2. Exception: Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.

C. Hanger Materials: Galvanized sheet steel or threaded steel rod. Primary duct hanger systems consisting of cable or wire are not acceptable; use steel angles, straps, and/or threaded rods.

1. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
2. Strap and Rod Sizes: Comply with SMACNA *HVAC Duct Construction Standards – Metal and Flexible* for steel sheet width and thickness and for steel rod diameters.

D. All supporting material surfaces in direct contact with supported ductwork (or flexible duct, or duct insulation, as applicable) shall be designed to maintain a minimum of one-inch (25 mm) contact width along full length of contact.

E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

F. Trapeze and Riser Supports: Steel shapes complying with ASTM A36.

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

PART 3 - EXECUTION

3.1 DUCT PRESSURE CLASS SCHEDULE

A. Static-Pressure Classes: Unless otherwise indicated, construct ducts according to the following:

1. Supply Air Ducts downstream of blower coil units: 3-inch wg (750 Pa).
2. Variable-volume Supply Ducts upstream of VAV boxes: 3-inch wg (750 Pa).
3. Variable-volume Supply Ducts downstream of VAV boxes: 2-inch wg (500 Pa).
4. Outdoor Air Ducts: 4-inch wg (1000 Pa), positive or negative pressure as applicable.
5. Transfer Ducts: 1/2-inch wg (125 Pa).
6. All Exhaust Ducts located in Mechanical Room and Roof: 6-inch wg (1500 Pa), positive or negative pressure as applicable.
7. Exhaust Ducts located outside of Mechanical Room: 3-inch wg (750 Pa), positive or negative pressure as applicable.
8. Flat Oval Ducts: 10-inch wg (2500 Pa), positive or negative pressure as applicable.

3.2 DUCT MATERIAL SCHEDULE

A. All ducts shall be galvanized steel.

3.3 DUCT INSTALLATION

A. Construct and install ducts according to SMACNA *HVAC Duct Construction Standards – Metal and Flexible* unless otherwise indicated.

B. Install round and flat-oval ducts in lengths not less than 12 feet (3.7 m) unless interrupted by fittings.

C. Install ducts with fewest possible joints. Install fabricated fittings for changes in directions, size, and shape and for connections.

D. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12-inches (300 mm), with a minimum of 3 screws in each coupling.

E. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

F. Install ducts with a clearance of 1-inch (25 mm), plus allowance for insulation thickness.

G. Duct sizes shown on plans are free area sizes and do not include the thickness of internal duct liner, if any. For double wall duct and/or internally lined ductwork, increase the indicated duct dimensions to account for the liner thickness.

H. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.

I. Install duct accessories as required by Division 23 Section “Duct Accessories.”

J. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.

K. Drawings are diagrammatic in nature. Not necessarily all fittings and offsets are shown. Provide all required fittings and offsets as required by field conditions and coordination with the work of other trades, whether specifically shown or not, for a complete and functional installation.

L. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.

M. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures.

N. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1½ inches (38 mm).

O. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers, sleeves, and firestopping sealant. Fire and smoke dampers are specified in Division 23 Section “Duct Accessories.” Firestopping materials and installation methods are specified in Division 07 Section “Penetration Firestopping.”

P. Protect duct interiors from the elements and foreign materials throughout construction. Follow SMACNA’s “Duct Cleanliness for New 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.

Q. Paint interiors of metal ducts that do not have duct liner, for 24-inches (600 mm) upstream of registers and grilles. Apply one coat of flat, black, latex finish coat over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 Painting Sections.

3.4 SEAM AND JOINT SEALING SCHEDULE

A. General: Ducts noted as welded in the Duct Material Schedule above shall be made liquid-tight with all joints and seams full-penetration welded continuously along the entire length of the seam or joint. Otherwise, seal duct seams and joints according to the duct pressure class indicated and as described in SMACNA *HVAC Duct Construction Standards – Metal and Flexible* except where more stringent requirements are specified herein.

B. Seal externally insulated ducts before insulation installation.

C. Seal Class Schedule: Seal Class A and Leakage Class 6 is required for all ducts except as noted below.

1. Spiral lock-seams need not be sealed.
2. Transfer air ducts and transfer air boots need not be sealed.

D. Rectangular Duct: Sealant materials and methods shall be at contractor's option, chosen from among the products specified in Part 2 of this Section; provided that the above seal class and leakage class schedule is met.

E. Round or Flat Oval Duct: Transverse joints shall be made with a SMACNA RT-1 interior slip coupling beaded at center, fastened to duct with screws; in addition, apply Two-Part Sealing System continuously around exterior side of joint.

1. Contractor's Option: Furnish prefabricated round duct connection system consisting of self-sealing gasketed fittings. Round duct joints made with this type of fitting do not require the additional sealant specified above, provided that specified seal class is achieved.

3.5 HANGING AND SUPPORTING

A. Install rigid round, rectangular, and flat-oval metal duct with support systems indicated in SMACNA *HVAC Duct Construction Standards – Metal and Flexible.*

B. Support horizontal ducts within 24-inches (600 mm) of each elbow and within 48-inches (1200 mm) of each branch intersection.

C. Support vertical ducts at one- or two-story intervals (i.e., 12 feet (3.66 m) to 24 feet (7.32 m).

D. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.

E. Install concrete inserts before placing concrete.

F. Install powder-actuated concrete fasteners after concrete is placed and completely cured. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4-inches (100 mm) thick.

G. 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.

3.6 CONNECTIONS

A. Make connections to equipment with flexible connectors according to Division 23 Section "Duct Accessories."

B. Comply with SMACNA *HVAC Duct Construction Standards – Metal and Flexible* for branch, outlet and inlet, and terminal unit connections.

3.7 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections according to SMACNA's *HVAC Air Duct Leakage Test Manual* and prepare test reports:

1. 25% of all outdoor ducts.
2. 25% of all indoor ducts if design pressure rating is greater than 3-inch w.g.

B. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.

C. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.

D. Maximum Allowable Leakage: Comply with requirements for Leakage Class **6.**

E. Remake leaking joints and retest until leakage is equal to or less than maximum allowable.

3.8 CLEANING NEW SYSTEMS

A. Mark position of dampers and air-directional mechanical devices before cleaning, and perform cleaning before air balancing.

B. Use service openings, as required, for physical and mechanical entry and for inspection.

1. Create other openings to comply with duct standards.
2. Disconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling sections to gain access during the cleaning process.

C. Vent vacuuming system to the outside. Include filtration to contain debris removed from HVAC systems, and locate exhaust down wind and away from air intakes and other points of entry into building.

D. Clean the following metal duct systems by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, and actuators except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.

E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet.
5. Clean coils and coil drain pans according to ACR 2006. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.

F. Cleanliness Verification:

1. Visually inspect metal ducts for contaminants.
2. Where contaminants are discovered, re-clean and reinspect ducts.

3.9 CLEANING EXISTING SYSTEMS

A. Use service openings, as required, for physical and mechanical entry and for inspection.

1. Use existing service openings where possible.
2. Create other openings to comply with duct standards.
3. Disconnect flexible ducts as needed for cleaning and inspection.
4. Reseal rigid fiberglass duct systems according to NAIMA recommended practices.
5. Remove and reinstall ceiling sections to gain access during the cleaning process.

B. Mark position of dampers and air-directional mechanical devices before cleaning, and restore to their marked position on completion.

C. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron size (or larger) particles.
2. When venting vacuuming system to the outside, use filtration to contain debris removed from HVAC system, and locate exhaust down wind and away from air intakes and other points of entry into building.

D. Clean the following metal duct systems by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, and actuators except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to ACR 2006. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide operative drainage system for washdown procedures.
7. Biocidal Agents and Coatings: Apply biocidal agents if fungus is present. Apply biocidal agents according to manufacturer’s written instructions after removal of surface deposits and debris.

F. Cleanliness Verification:

1. Verify cleanliness after mechanical cleaning and before application of treatment, including biocidal agents and protective coatings.

2. Visually inspect metal ducts for contaminants.
3. Where contaminants are discovered, re-clean and reinspect ducts.

G. Gravimetric Analysis: At discretion and expense of Owner, sections of metal duct system, chosen randomly by Owner, may be tested for cleanliness according to NADCA vacuum test gravimetric analysis.

1. If analysis determines that levels of debris are equal to or lower than suitable levels, system shall have passed cleanliness verification.
2. If analysis determines that levels of debris exceed suitable levels, system cleanliness verification will have failed and metal duct system shall be re-cleaned and re-verified.

H. Verification of Coil Cleaning: Cleaning must restore coil pressure drop to within 10 percent of pressure drop measured when coil was first installed. If original pressure drop is not known, coil will be considered clean only if it is free of foreign matter and chemical residue, based on thorough visual inspection.

END OF SECTION 23 3113

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SECTION 23 3300 – DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Manual volume dampers.
   2. Automatic control dampers.
   3. Fire/smoke dampers.
   4. Turning vanes.
   5. Duct-mounted access doors.
   6. Flexible connectors.
   7. Flexible ducts.
   8. Duct accessory hardware.

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 23 0100 “Basic Mechanical Requirements,” and Section 23 0500 “Basic Mechanical Materials and Methods” 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 “Control Systems” for actuators associated with automatic control dampers.
   2. Division 26 Section “Fire Alarm Systems” for duct-mounted fire detectors.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Comply with NFPA 90A, “Installation of Air Conditioning and Ventilating Systems.”

B. Comply with AMCA 500-D testing for damper rating. All manufactured dampers of every type shall bear the AMCA Certified Ratings Program seal for Air Performance, Air Leakage, and Efficiency.

1.5 REFERENCED STANDARDS

A. Sheet Metal and Air Conditioning Contractors’ National Association. HVAC Duct Construction Standards – Metal and Flexible. 3rd ed. Chantilly, VA: SMACNA, 2005.

1.6 EXTRA MATERIALS

A. Furnish extra fusible links that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Furnish quantity equal to 10 percent of amount installed, but not less than two (2).

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. HVAC Dampers (all types):
      a. Air Balance Inc.; a division of Mestek, Inc.
      b. Greenheck Inc.
      c. Nailor Industries Inc.
      d. Pottorff; a division of PCI Industries, Inc.
      e. Ruskin Company.
   2. Turning Vanes:
      a. Ductmate Industries, Inc.
      b. DuroDyne Inc.
      c. Metalaire, Inc.
      d. Semco Incorporated.
      e. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
   3. Duct-Mounted Access Doors:
      a. American Warming and Ventilating; a division of Mestek, Inc.
      b. Cesco Products; a division of Mestek, Inc.
      c. Ductmate Industries, Inc.
      d. Flexmaster U.S.A., Inc.
      e. Greenheck Fan Corporation.
      f. McGill AirFlow LLC.
      g. Nailor Industries Inc.
      h. Pottorff; a division of PCI Industries, Inc.
      i. Ventfabrics, Inc.
      j. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
      k. Ruskin Company.
   4. Flexible Connectors:
      a. Ductmate Industries, Inc.
      b. Duro Dyne Inc.
      c. JP Lamborn Co.
      d. Ventfabrics, Inc.
      e. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
   5. Flexible Ducts:
      a. #087 by Atco Rubber Products, Inc.
      b. Type 8M by Flexmaster USA, Inc.
      c. “M-KE” by ThermaFlex.

2.2 MATERIALS

A. Comply with SMACNA’s “HVAC Duct Construction Standards – Metal and Flexible” for acceptable materials, material thicknesses, and duct construction methods unless otherwise

indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A653/A653M and having G90 (Z275) coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.

C. Aluminum Sheets: Comply with ASTM B209 (ASTM B209M), Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

D. Extruded Aluminum: Comply with ASTM B221 (ASTM B221M), Alloy 6063, Temper T6.

E. Minimum Thickness: All sheet steel used on this project shall be a minimum of 24-gage thickness, and all aluminum sheets shall be a minimum of 0.04-inch thickness, regardless of whether or not SMACNA standards permit thinner gage material.

F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

G. Tie Rods: Comply with Articles 2.5 through 2.9, including all accompanying Tables and Figures, of the SMANCA HVAC Duct Construction Standards.

2.3 MANUAL VOLUME DAMPERS

A. Manual volume dampers shall be standard leakage rating, with linkage outside airstream, suitable for horizontal or vertical applications. Volume dampers may be factory-manufactured or contractor-fabricated per SMACNA Fig. 7-4/7-5.

B. Material: Match material options throughout this subsection to the material of adjacent ductwork. For duct material, refer to Division 23 Section “Metal Ducts.”

C. Frames: Hat-shaped channels with mitered and welded corners, flanges for attaching to walls, and flangeless frames for installing in ducts.
   1. Galvanized-steel, 16-gage or 0.064-inch (1.62-mm) minimum thickness, for use in galvanized steel ducts.
   2. Aluminum sheet, 12-gage or 0.100-inch- (2.5-mm-) minimum thickness, for use in aluminum ducts.
   3. Stainless-steel, 16-gage or 0.064-inch (1.62-mm) minimum thickness, for use in stainless steel ducts.
   4. The above requirements may be reduced to 20-gage for round dampers installed in round ducts.

D. Blades: Multiple-blade; single-blade if duct dimension is 12-inch or less in the direction perpendicular to damper axis. Parallel or opposed-blade design (contractor’s choice, unless a specific type is indicated). Stiffen damper blades for stability.
   1. Galvanized-steel, 16-gage or 0.064-inch (1.62 mm) thick, for use in galvanized steel ducts.
   2. Roll-Formed Aluminum, 12-gage or 0.10-inch- (2.5-mm-) thick aluminum sheet, for use in aluminum ducts.
   3. Stainless-steel, 16-gage or 0.064-inch (1.62 mm) thick, for use in stainless steel ducts.
   4. The above requirements may be reduced to 20-gage for round dampers installed in round ducts.

E. Blade Axles: Galvanized steel, aluminum, or stainless steel, as required to match blade material. Dampers shall have axles full length of damper blades, and bearings at both ends of operating shaft.

F. Bearings: Oil-impregnated bronze, molded synthetic, and stainless-steel sleeve-type are acceptable.

G. Tie Bars and Brackets: Galvanized steel or aluminum.

H. Jackshaft:

1. Size: 1-inch (25-mm) diameter.
2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

I. Damper Hardware:
1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- (2.4-mm-) thick zinc-plated steel, and a ¾-inch (19-mm) hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.4 AUTOMATIC CONTROL DAMPERS

A. Low-leakage Ultra Low-Leakage Class 1A rating, with linkage outside airstream. Subject to compliance with requirements, an example of an acceptable product is Ruskin Model 60.
1. Leakage Rating: Maximum 3 cfm per square foot of damper area at 1-inch pressure when tested in accordance with AMCA Publication 500.
2. Temperature Class: -40 to +200ºF.

B. Frames: Minimum 16 gage galvanized sheet steel frame formed into a structural hat channel reinforced at the corners; with mitered and welded corners.

C. Blades: Airfoil-shaped or triple-v-groove blades of galvanized steel construction.
1. Multiple blade with maximum blade width of 6-inches (150 mm).
2. Action: Parallel or opposed action as scheduled; opposed if not scheduled.
3. Blade Edging: Ruskiprene type or equivalent edging, mechanically locked into blade edge.
4. Blade Thickness: 14- gage or 0.079-inch 2.00 mm).

D. Blade Axles: ½-inch- (13-mm-) diameter; plated steel; square or hex-shape mechanically locked to blade; and blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.

E. Bearings: High impact molded synthetic, or stainless-steel sleeve type, with thrust bearings at each end of every blade. Dampers shall have axles full length of damper blades and bearings at both ends of operating shaft.

F. Jamb Seals: Stainless steel flexible compression type.

G. Damper Motors: Furnished and installed as the work of Division 23 Section “HVAC Instrumentation and Controls.”

H. Minimum Outdoor Air Dampers: In addition to the requirements specified herein, outdoor air dampers shall feature an integral airflow measuring station. Airflow measuring station shall include integral flow straightener and built-in measuring ports accurate to within 5%. Airflow measuring station shall produce a 2-10 VDC output signal when provided a 24 VDC power connection. Example of acceptable product is Ruskin Model IAQ-50.

2.5 FIRE DAMPERS

A. Type: Dynamic; rated and labeled according to UL 555. Label according to UL 555C if used in a rated ceiling application.

B. Closing rating in ducts up to 4-inch wg (1-kPa) static pressure class and 2000-fpm (10-m/s) velocity.

C. Fire Rating: 1½ hours.

D. Frame: SMACNA Type A, B or C as indicated; fabricated with roll-formed, 20-gage galvanized steel; with mitered and interlocking corners. If no indication is given, use Frame Type B for rectangular ducts and Frame Type C for round ducts.

E. Mounting Orientation: Vertical or horizontal as indicated.

F. Blades: Roll-formed, interlocking, galvanized sheet steel.

G. Horizontal Dampers: Include blade lock and stainless-steel negator closure spring.

H. Single-use Fusible Link: Replaceable, 165ºF (74ºC) rated, fusible links.

I. Mounting Sleeve: Factory-supplied, factory or field-installed, galvanized sheet steel sleeve; length as indicated. Include factory-supplied, field-installed two-piece "picture-frame" mounting angles with pre-punched fastener holes.
   1. Direct Grille Mounts: Where specifically indicated, furnish integral factory sleeve/ mounting angle assembly UL-listed for direct grille attachment.
   2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.

J. Multiple-Section Assembly: Where indicated fire damper size exceeds the maximum UL-approved dimensions of the manufacturer's UL-listed product line, provide multiple-section dampers including mullions and other hardware necessary for a UL-approved multi-section fire damper assembly.

2.6 COMBINATION FIRE AND SMOKE DAMPERS

A. General Requirements: Dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL. Low-leakage rating, with linkage outside airstream. Subject to compliance with requirements, an example of an acceptable product is Ruskin Model FSD-36.

B. Leakage Rating: Class II.

C. Closing rating in ducts up to 4-inch wg (1-kPa) static pressure class and minimum 2000-fpm (10-m/s) velocity.

D. Fire Rating: 1½ hours.

E. Heat-Responsive Device: Replaceable, 165ºF (74ºC) rating, fusible link or similar UL-approved bimetal resettable heat-responsive device.

F. Frames: Galvanized sheet steel frame formed into a structural hat channel reinforced at the corners; with mitered and welded corners.

G. Blades: Multiple-blade type; horizontal airfoil-shaped or triple-v-groove blades with maximum blade width of 6-inches (150 mm).

H. Blade Axles: ½-inch- (13-mm-) diameter; galvanized steel; square or hex-shape mechanically locked to blade; and blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.

I. Bearings: High impact molded synthetic, or stainless-steel sleeve type, with thrust bearings at each end of every blade. Dampers shall have axles full length of damper blades and bearings at both ends of operating shaft.

J. Jamb Seals: Stainless steel flexible compression type.

K. Damper Motors: Furnished and installed as the work of Division 23 Section "Control Systems"

L. Smoke Detector: Furnished and installed as the work of Division 26.

M. Mounting Sleeve: Factory-installed, galvanized sheet steel; length to suit wall or floor application.

N. Damper Motors: Two-position action.

O. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section “Motors.”
   1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
   2. Temperature Class: -40 to +200ºF.
   3. Action: Parallel or opposed action as scheduled; opposed if not scheduled.
   4. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.
   5. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
   6. Equip with an integral spiral-spring mechanism for fail-safe position as indicated or scheduled. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 150 in. x lbf (17 N x m).
   7. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40ºF (minus 40ºC).
   8. Electrical Connection: 24 or 120-Volt AC.
   9. Test and reset switches, damper-mounted.

P. Accessories: Auxiliary switches for fan control or position indication.

2.7 TURNING VANES

A. All turning vanes, where required, shall be single-thickness type, 2-inch (50-mm) radius, 1½-inch (38-mm) spacing, at least 24-gauge thickness, and curved through an arc matching the change of direction (i.e., a vane curved through 90-degrees for a 90-degree elbow). Construct of material matching that of the adjacent duct (i.e., galvanized steel turning vanes in a galvanized steel duct, stainless steel turning vanes in a stainless steel duct, etc.).

B. Where two or more changes of direction occur with less than four duct widths (measured in the plane of the change of direction) between each elbow, each turning vane shall also include a straight trailing edge extension of 1-inch (25 mm). At contractor’s option, all turning vanes may include this straight trailing edge extension even if not required.

C. Include vane rails or runners for attachment of vane blades to duct.

D. Either contractor-fabricated or factory-manufactured turning vanes meeting these specifications will be acceptable.

2.8 DUCT-MOUNTED ACCESS DOORS

A. Duct-Mounted Access Doors: Factory-manufactured doors, airtight and suitable for duct pressure class.

B. Door: Double wall, rectangular, galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.

C. Insulation: 1-inch (25-mm-) thick, fibrous-glass or polystyrene-foam board.

D. Hinges and Latches: 1-by-1-inch (25-by-25-mm) butt or piano hinge and cam latches.

E. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.

F. Number of Hinges and Locks: Two hinges, or continuous piano hinge, and two sash locks.

G. Size: 18 by 10-inches (460 by 250 mm) unless noted otherwise

2.9 FLEXIBLE CONNECTORS

A. Materials: Flame-retardant or noncombustible fabrics.

B. Coatings and Adhesives: Comply with UL 181, Class 1.

C. Metal-Edged Connectors: Factory fabricated with a fabric strip 5¾-inches (146 mm) wide attached to 2 strips of 2¾-inch- (70-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized sheet steel or 0.032-inch- (0.8-mm-) thick aluminum sheets. Provide metal compatible with connected ducts.

D. Fabric: Glass fabric double-coated with neoprene or polychloroprene. Fabric layers shall be shielded with metal on both sides at the seam, attached with a mechanical metal-to-fabric bond.
   1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).
   2. Tensile Strength: 480 lbf/inch (84 N/mm) in the warp and 360 lbf/inch (63 N/mm) in the filling.
   3. Service Temperature: Minus 40 to plus 200ºF (Minus 40 to plus 93ºC).
   4. Insulated Service: Flexible ductwork connections shall be constructed of two layers of fabric as specified above, encapsulating 1-inch nominal thickness of R-4.2 fiberglass insulation. Required if the adjacent ductwork is specified to be insulated or internally lined.
   5. Outdoor Service: Glass fabric shall be double-coated with weatherproof, synthetic rubber resistant to UV rays and ozone. Required if installed outdoors.

E. Thrust Limits: As specified in Division 23 Section “Mechanical Vibration Isolation.”

2.10 FLEXIBLE DUCTS

A. General: Comply with UL 181, Class 1. Factory-fabricated, insulated, round duct, with an outer jacket enclosing glass-fiber insulation around a continuous inner liner.
   1. Reinforcement: Galvanized steel wire helix encapsulated in inner liner.
   2. Outer Jacket: Polyethylene vapor-barrier film.
   3. Inner Liner: CPE film, acoustically transparent to mid-range sound energy.

B. Required Pressure Ratings:
   1. Sizes 12-inch and smaller: At least 8-inch wg positive and 1-inch wg negative.
   2. Sizes larger than 12-inch: At least 4-inch wg positive and ½-inch wg negative.
   3. Burst Rating: 2.5 times working pressure rating above.

C. Velocity Rating: 4000 fpm.

D. Temperature Rating: -20°F to +250°F.

E. Thermal Rating: Minimum R-4.2 thermal resistance.

F. Flexible Duct Connector Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 through 18-inches, to suit duct size.

G. Provide flexible ducts with Flexflow elbow by Thermaflex for connections to air devices.

2.11 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards – Metal and Flexible."

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts.
   1. Locate dampers at least two duct diameters from fittings and as far away as possible from outlets.
   2. Install steel volume dampers in steel ducts.
   3. Install aluminum volume dampers in aluminum ducts.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install test holes at fan inlets and outlets and elsewhere as indicated.

G. Install fire/smoke dampers according to UL listing.

H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
   1. Adjacent to and close enough to fire dampers, to reset or reinstall fusible links.
   2. Downstream of in-duct coils.
   3. Elsewhere as indicated.

I. Install access doors with swing against duct static pressure.

J. Label access doors according to Division 23 Section "Basic Mechanical Materials and Methods" to indicate the purpose of access door.

K. Install flexible connectors to connect ducts to equipment using metal-edged connections or flanges.

L. For fans developing static pressures of 5-inch wg (1250 Pa) and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

M. Connect air devices to ducts with flexible duct clamped or strapped in place.

N. Connect air devices to ducts directly or with a minimum 36-inch (900-mm) and a maximum 72-inch (1800-mm) length of flexible duct clamped or strapped in place.

O. Install flexible ducts in accordance with the following:
   1. Turn radius of flexible duct at duct centerline shall not exceed one times nominal duct diameter.
   2. At least one support shall be installed for every run of flexible duct that is 60-inches (1500 mm) long or longer; more if needed to comply with next paragraph.
   3. Support flexible duct so that it does not contact nor rest upon light fixtures, sprinkler and other piping, ceilings and ceiling hanger wires, electrical conduits and cable tray, and similar items.

P. All supporting material surfaces in direct contact with supported flexible duct shall maintain a minimum of one-inch in contact width along full length of contact.

Q. Comply with Figures 3-10 and 3-11 in SMACNA's HVAC Duct Construction Standards – Metal and Flexible. 3rd ed. except where more stringent details are given on the Drawings.

R. Comply with Specifications 3.5, 3.6, and 3.7, paragraphs S3.19 through S3.40, of SMACNA's HVAC Duct Construction Standards – Metal and Flexible. 3rd ed., except where more stringent requirements are specified herein.

S. Install duct test holes where required for testing and balancing purposes.

3.2 FIELD QUALITY CONTROL

A. Operate dampers to verify full range of movement.

B. Inspect locations of access doors and verify that purpose of access door can be performed.

C. Operate fire dampers to verify full range of movement and verify that proper heat-response device is installed.

D. Inspect turning vanes for proper and secure installation.

END OF SECTION 23 3300

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SECTION 23 3423 – FANS AND VENTILATORS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Centrifugal roof ventilators.

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 23 0100 “Basic Mechanical Requirements,” and Section 23 0500 “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 “Duct Accessories” for duct flexible connectors.
   3. Division 23 Section “Control Systems” for control devices.
   4. Division 26 Section “Variable Frequency Drives” for variable speed motor controllers.

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.

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.

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.

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 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. PennBarry, division of Air System Components.
   4. 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 CENTRIFUGAL ROOF VENTILATORS

A. Description: Centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.

1. Provide direct-drive or belt-drive as indicated via Schedule on Drawings.
2. Provide upblast or downblast discharge as indicated via Schedule on Drawings.
3. Provide Fabra style hood as indicated via Schedule on Drawings.

B. 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 base with venturi inlet cone. The aluminum base shall have continuously welded curb cap corners.

C. Hood:
1. Construction material: Aluminum.
2. Fabra Hood hinged to provide access to motor and drive assembly.
3. Galvanized steel supports.
4. Inter-locking rib design combines four material thicknesses with I beam design.
5. Hood panels are interlocked and attached to sturdy aluminum rails.
6. Leak resistant.

D. 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.

E. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.

F. Shaft Bearings: Pre-lubricated and sealed, self-aligning, pillow-block-type ball bearings with ABMA 9, L_{10} of 40,000 hours.

G. 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.

H. 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. Tie-Down Points:
   a. Four heavy gauge aluminum brackets to secure the fan in heavy wind applications.
6. Any other accessories as indicated via Schedule on Drawings.

I. Roof Curbs: Galvanized steel; mitered and welded corners; 1½-inch- (40-mm-) thick, rigid, fiberglass insulation adhered to inside walls; and 1½-inch (40-mm) wood nailer. Size as required to suit roof opening and fan base.

1. Configuration: Built-in cant and mounting flange.
2. Overall Height: 12 inches (300 mm).
3. Pitch Mounting: Manufacture curb to allow level fan mounting on a roof slope.
4. Metal Liner: Galvanized steel.
5. Mounting Pedestal: Galvanized steel with removable access panel.

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-control devices are specified in Part 2 of this Section.

C. 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.

D. See Division 23 Section "Basic Mechanical Materials and Methods" for additional anchorage and concrete base requirements.

E. Install units with clearances for service and maintenance.

F. Label units according to requirements specified in Division 23 Section "Mechanical Identification."

G. 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 23 3423

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SECTION 23 3600 – AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Shutoff single-duct air terminal units.

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 23 0100 “Basic Mechanical Requirements,” and Section 23 0500 “Basic Mechanical Materials and Methods” apply to the work of this Section as if fully repeated herein.

C. Related sections include Division 23 Section “Control Systems” for control devices and installation associated with air terminals.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated, include rated capacities; furnished specialties and accessories; shipping, installed, and operating weights; and sound-power ratings for each model indicated. Detail equipment assemblies and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection. Include a schedule showing unique model designation, room location, model number, size, and accessories furnished.

B. Shop Drawings: For air terminal units. Include plans, elevations, sections, details, and attachments to other work. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection. Hangers and supports, including methods for duct and building attachment and vibration isolation.

C. Verify compliance with each third-party test or rating Standard referenced in the “Quality Assurance” subsection below.

D. Wiring Diagrams: Detail wiring for power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.

E. Field quality-control reports.

F. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01, include instructions for resetting minimum and maximum air volumes and for adjusting software set points.

1.4 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of air terminal units and are based on the specific system indicated. Refer to Division 23 Section “Basic Mechanical Requirements.”

B. NFPA Compliance: Install air terminal units according to NFPA 90A-2015 *Standard for the Installation of Air Conditioning and Ventilating Systems*.

C. AHRI Certification: Only air terminals that are certified under the AHRI Standard 880-2017 Certification Program and carry the AHRI Seal will be accepted.

D. Controls: Test and rate air terminal unit controls in accordance with ANSI/ASHRAE 195-2013 *Method of Test for Rating Air Terminal Unit Controls*. This standard specifies instrumentation, facilities, test installation methods, and procedures for determining the accuracy and stability of airflow control systems for pressure independent terminal units at various airflow setpoints for variable-air-volume and constant-volume air-moving systems.

E. Control sequences shall be in complete and strict accordance with ASHRAE Guideline 36-2018 *High Performance Sequences of Operation for HVAC Systems*.

1.5 COORDINATION

A. Coordinate layout and installation of air terminal units and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide Air Terminal Units by one of the following:

1. Air System Components Inc. (Titus, Krueger, and Tuttle & Bailey brands).
2. Carnes Co., Inc.
3. Environmental Technologies, Inc.
4. Hart & Cooley, Inc.
5. Greenheck Inc.
6. Price Industries Inc.
7. Trane Technologies plc.

2.2 AIR TERMINAL UNITS, general

A. Configuration: Pressure independent terminal unit as scheduled; including volume-damper assembly inside unit casing with control components located inside a protective metal shroud. Unit sizes, capacities, maximum and minimum airflows, maximum noise ratings, and maximum air pressure drops shall be as scheduled on the Drawings.

B. Casing: Minimum 22-gage galvanized steel or 0.032-inch (0.8-mm) aluminum.

1. Air Inlets: Beaded round stub connection of length at least 2-inches beyond airflow sensor taps for inlet duct attachment.
2. Air Outlets: Rectangular S-slip and drive connections.
3. Access: Removable access door for access to damper, heating coil, and other parts requiring service, adjustment, or maintenance; with airtight gasket.

C. Oversize Casing Sizing Criteria: For any and all Air Terminal Units specified or scheduled to include a hydronic heating coil, the Air Terminal Unit casing size and hydronic coil physical size shall both be increased one standard size increment without increasing the duty-sized inlet diameter.

1. For example, a terminal whose duty calls for 8-inch nominal size shall be furnished as a 10-inch nominal size terminal but with an 8-inch inlet, airflow sensor, and damper.
2. It is not acceptable to increase the entire terminal size to satisfy the above criteria. For example, it is not acceptable to furnish to a complete 10-inch terminal size where duty calls for 8-inch inlet, airflow sensor, and damper; product must be a 10-inch nominal terminal with an 8-inch inlet.
3. The above oversizing criteria is not required for cooling-only terminals; nor terminals with an electric-resistance heating coil.
4. Subject to compliance with requirements, examples of acceptable products include Titus Model DESVE and Price Model HSG.

D. Volume Damper: Minimum 22-gage galvanized steel with peripheral edge gasket and self-lubricating bearings. Include a mechanical hard stop to prevent over-stroking. Include permanent markings on damper shaft to indicate damper position by simple visual inspection.

E. Maximum allowable damper leakage is given below, when tested according to AHRI 880-2017, based on 4-inch wg (1000-Pa) differential static pressure (inlet to outlet) and 2500 fpm (12.7 m/s) air velocity at nominal box inlet diameter.

1. 3% for nominal size 4-inch (100 mm).
2. 2% for nominal sizes 5-inch (125 mm) through 7-inch (175 mm).
3. 1% for nominal sizes 8-inch (200 mm) and larger.

F. Maximum allowable casing leakage is given below, when tested according to AHRI 880-2017, based on 3-inch wg (750-Pa) differential static pressure (inlet to outlet) and 2500 fpm (12.7 m/s) air velocity at nominal box inlet diameter.

1. 3% for nominal size 4-inch (100 mm).
2. 2% for nominal sizes 5-inch (125 mm) through 9-inch (225 mm).
3. 1% for nominal sizes 10-inch (250 mm) and larger.

G. Airflow Sensor: Multipoint, multi-axis inlet velocity sensor with center-averaging feature, factory installed and connected to the controller with UL-listed fire-retardant pneumatic tubing. Single axis sensor is not acceptable for inlet diameters 6-inch and larger. The sensor shall output an amplified differential pressure signal that is at least 2.3 times the equivalent velocity pressure signal obtained from a conventional pitot tube. Balancing taps and airflow calibration charts shall be provided for field airflow measurements.

2.3 UNIT INSULATION

A. Fibrous-Glass Liner: All Air Terminal Units of all types shall include factory-installed internal liner. Comply with NFPA 90A and UL 181.
1. Materials: Rigid, rectangular, fibrous-glass duct board; factory molded and faced on airstream side with fire-resistive, reinforced, foil-scrim-kraft barrier. 4-pound density, 475 flexural rigidity, standard duty. All cut edges or exposed fibers not encapsulated by the foil scrim surface shall be sealed from the airstream by mechanically bonded metal edge strips or nosings.
2. Alternative Materials: Subject to compliance with other requirements specified herein, including but not limited to acoustic requirements, manufacturer's standard internal fiberglass liner will be accepted if entirely isolated from the airstream by an inner solid liner constructed of 26-gage galvanized sheet metal or 0.032-inch aluminum sheet.
3. Thickness: 1/2-inch (13 mm) minimum; thicker if required to meet specified or scheduled values for thermal and/or acoustic performance.
4. Thermal Conductivity (k-Value): 0.26 at 75ºF (0.037 at 24ºC) mean temperature per ASTM C518.

5. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E84.
6. Liner Adhesive: Comply with NFPA 90A and with ASTM C916.

2.4 INTEGRAL HYDRONIC HEATING COILS

A. Casing: Minimum 20-gauge galvanized steel, factory-installed, with flanged connection for outlet ductwork. See “Air Terminal Units, General” subsection above for sizing criteria.

B. Pressure Rating: Leak test to 300 psi air under water; minimum burst pressure of 2000 psi.

C. Performance Ratings: As scheduled on Drawings. Coils shall be designed, tested and rated according to AHRI Standard 410-2001 *Forced-Circulation Air-Cooling and Air-Heating Coils*.

D. Tube Construction: Copper, ½-inch O.D. with 0.016-inch minimum wall.

E. Fin Construction: Aluminum, 0.006-inch minimum thickness, not more than 12 per inch, mechanically-bonded to tubes.

F. Piping Connections: Male solder header. Coil connections shall be on the side of the unit indicated on the Drawings.

G. Circuit Arrangement: Self-draining and self-venting coil fabricated according to AHRI 410. Number of rows shall not be less than two (2) rows unless noted otherwise.

2.5 AIR TERMINAL UNIT CONTROLS

A. DDC Controls: Factory-furnish and factory-install air terminal unit manufacturer’s airflow sensor and unit damper without actuator. The DDC controller, damper actuator, room temperature sensor, and 24-volt power supply are the work of Division 23 Section “Control Systems.” The manufacturer of the air terminal unit shall receive shipment of actuator and controller, and factory-install same as the work of this Section.

1. Coordination: The air terminal unit manufacturer shall advise the party responsible for the work of Division 23 Section “Control Systems” as to the particular characteristics of the unit’s damper, shaft, and airflow sensor. The party responsible for the work of Division 23 Section “Control Systems” shall furnish data sheets on all components to be mounted, indicating component dimensions, mounting hardware and instructions, and wiring and piping diagrams for each application. The air terminal unit manufacturer shall check and verify all wiring and tubing connections prior to final shipment to the jobsite.

2.6 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electro-galvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Steel Cables: Galvanized steel complying with ASTM A603.

D. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

E. Air Terminal Unit Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

F. Trapeze and Riser Supports: Steel shapes and plates for units with steel casings; aluminum for units with aluminum casings.

2.7 SOURCE QUALITY CONTROL

A. Identification: Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and AHRI certification seal.

B. Verification of Performance: Test and rate air terminal units according to AHRI 880-2017 *Standard for Performance Rating of Air Terminals*.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install air terminal units level and plumb, according to manufacturer's written instructions, rough-in drawings, original design, and referenced standards. Maintain sufficient clearance for normal service and maintenance.

B. Protect all openings of air terminal units with filters or temporary covers throughout project storage, handling, and placement, to keep clean the interiors of air terminal units.

C. Terminal units shall be continuously insulated with thermal insulation and vapor barrier, in unbroken path from inlet duct through to outlet duct, so that no bare metal surfaces are left uninsulated. Field-insulate any portions of terminal unit if not factory-insulated, including but not limited to heating coil casing and duct inlet collar. Field insulation and vapor barrier are specified in Division 23 Section "Mechanical Insulation."

D. After completing system installation, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes. Vacuum clean the interior of air terminals if the openings were not protected during construction.

3.2 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible," Chapter 4, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

C. Where practical, install concrete inserts before placing concrete.

D. Install powder-actuated concrete fasteners after concrete is placed and completely cured.

E. Use powder-actuated concrete fasteners for standard-weight aggregate concretes and for slabs more than 4 inches (100 mm) thick.

F. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes and for slabs less than 4 inches (100 mm) thick.

G. Hangers Exposed to View: Threaded rod and angle or channel supports.

H. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.3 CONNECTIONS

A. Ductwork: Connect ductwork to air terminals according to Division 23 ductwork Sections and Details on Drawings.

B. Hot Water Piping: Connect heating coils in accordance with Details on Drawings. Install piping adjacent to air terminal units to allow service and maintenance. Piping installation requirements

are specified Division 23 Section “Hydronic Piping.” Drawings indicate general arrangement of piping, fittings, and specialties.

C. Controls: Field-installed controls specified herein shall be installed and connected as the work of Division 23 Section “Control Systems.”

3.4 IDENTIFICATION

A. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Division 23 Section “Basic Mechanical Materials and Methods” for equipment labels and warning signs and labels.

3.5 FIELD QUALITY CONTROL

A. Complete installation and startup checks according to manufacturer’s written instructions, and perform the following field tests and inspections:

1. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
2. Verify that controls and control enclosure are accessible.
3. Verify that control connections are complete.
4. Verify that nameplate and identification tag are visible.
5. Verify that controls respond to inputs as specified.
6. After installing air terminal units, and after electrical circuitry (where applicable) has been energized, test for compliance with requirements.
7. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
8. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Remove and replace malfunctioning units and retest as specified above.

3.6 CLEANING

A. After completing system installation, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes.

B. Vacuum clean the interior of air terminals if the openings were not protected during construction.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner’s maintenance personnel in proper adjustment, operation, troubleshooting, and maintenance of air terminal units. Refer to Division 01 for requirements.

END OF SECTION 23 3600

SECTION 23 3713 – DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles.

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 23 0100 “Basic Mechanical Requirements,” and Section 23 0500 “Basic Mechanical Materials and Methods” 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 08 Section “Louvers and Vents” for fixed and adjustable louvers and wall vents installed in exterior walls, whether or not they are connected to ducts.
2. Division 23 Section “Duct Accessories” for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.
3. Division 23 Section “Testing, Adjusting, and Balancing” for balancing diffusers, registers and grilles.

1.3 DEFINITIONS

A. Diffuser: Circular, square, or rectangular air distribution outlet, generally located in the ceiling and comprised of deflecting members discharging supply air in various directions and planes and arranged to promote mixing of primary air with secondary room air.

B. Grille: A louvered or perforated covering for an opening in an air passage, which can be located in a sidewall, ceiling, or floor.

C. Register: A combination grille and damper assembly over an air opening.

1.4 SUBMITTALS

A. Product Data: For each product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate Drawing designation, room location, quantity, model number, size, and accessories furnished.

1.5 QUALITY ASSURANCE

A. Testing: Test and publish performance according to ANSI/ASHRAE Standard 70-2006 *Method of Testing the Performance of Air Outlets and Air Inlets*.

B. NFPA Compliance: Install diffusers, registers, and grilles according to NFPA 90A-2015 *Standard for the Installation of Air-Conditioning and Ventilating Systems*. Where located less

than 84 inches above finish floor, diffusers, registers and grilles shall be designed to prohibit passage of a ½-inch sphere.

C. Single-Source: Unless noted otherwise, a single manufacturer shall furnish all diffusers, registers, and grilles.

PART 2 - PRODUCTS

2.1 COMMON REQUIREMENTS, ALL UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Air System Components Inc. (Titus, Krueger, and Tuttle & Bailey brands).
2. Carnes Co.
3. Hart & Cooley, Inc.
4. Greenheck Inc.
5. Nailor Industries, Inc.
6. Price Industries.

B. Diffusers, registers, and grilles are scheduled on Drawings. All model numbers, finish designations, border types, and accessory designations are based one manufacturer identified therein. Products by other manufacturers listed above may be furnished, but must be equal in all respects to the device identified, including but not limited to NC, pressure, and cfm ratings.

C. Diffusers, Registers, and Grilles Finish: Acrylic baked enamel paint, pencil hardness HB to H, color as scheduled. The finish shall pass a 250-hour ASTM 870 Water Immersion Test, a 100-hour ASTM D117 Corrosive Environments Salt Spray Test, and a 50 inch-pound ASTM D2794 Reverse Impact Cracking Test.

D. Integral Balancing Damper: Where dampers are scheduled as an integral part of diffusers and grilles (registers), provide multi-blade gang-operated opposed-blade type, radial-style if used with round ducts; 24 gage galvanized steel, except that aluminum dampers shall be used with aluminum diffusers and registers. Integral dampers shall be operable from the room side of the diffuser or register without special tools.

E. Diffusers, Registers, and Grilles Mounting: Provide border frame mounting type as scheduled. If not scheduled, provide border frame mounting type compatible with ceiling or wall type indicated on Architectural Drawings. Distinguish between flush flat-tee lay-in ceilings, drop-face lay-in ceilings, and the narrow-tee or screw-slot lay-in ceilings by providing a border type specifically designed for each as applicable; a generic standard lay-in border frame will not be acceptable for multiple lay-in ceiling types.

2.2 PRODUCT SPECIFICATIONS

A. Square Plaque Ceiling Diffuser: 22-gage steel (use 0.040-inch aluminum where scheduled) face panel that captures a secondary panel of equal material and thickness. The face panel shall be removable via four hanger brackets. The exposed surface of the face panel shall be smooth, flat, and free of visible fasteners. The face panel shall project not more than ¼-inch below the outer border of the diffuser back pan. The back of the face panel shall have a rolled edge, shaped for horizontal discharge. Face panel shall be no smaller than 18-inch by 18-inch for diffusers nominally 24-inch by 24-inch. Face panel shall be no smaller than 9-inch by 9-inch for diffusers nominally 12-inch by 12-inch. The back pan shall be one-piece die-stamped and include an integrally drawn inlet (welded-in inlets and corner joints are not acceptable). Include

a diffuser neck of minimum 1¼-inch depth for connection and attachment of round or rectangular (as scheduled) duct.

1. Include round damper constructed of heavy gauge steel. Damper shall be operable from the face of the diffuser.

2. Include directional blow clips to restrict the discharge air in certain directions.
3. Where an aluminum or stainless steel grille or diffuser is indicated by Schedule or note, the entire product shall be constructed of aluminum or stainless steel as applicable, including but not limited to face plate, pattern controllers, border, back pan, neck, collar, etc.

B. Standard-Performance Grille: Adjustable double-deflection supply grilles, single fixed deflection return grilles, of sizes and performance as scheduled. Blades shall be 24-gage steel; supply grille blades shall be individually adjustable and held in place without rattling or slip by tension wire or metal friction pivots. Frame shall be roll-formed 24-gage steel or with 1-inch minimum flange and full penetration welds at the corners. Exposed screw holes shall be countersunk for flush finish surface.

C. Other grilles, registers and diffusers not specified above may be specified on the Drawings or by virtue of make and model number on the Schedule.

2.3 FIELD-PROVIDED ACCESSORIES

A. Sight/Sound Screen: Provide contractor-fabricated galvanized steel return air screen or boot for all unducted return air grilles or sections of the diffuser used for unducted return air, as detailed on the Drawings.

B. Other accessories may be required by virtue of notations on the Schedule or as detailed on the Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Install diffusers, registers, and grilles level and plumb.

C. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

D. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

E. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

F. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.

END OF SECTION 23 3713

SECTION 23 7313 – MODULAR PACKAGED AIR-HANDLING UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes packaged modular air-handling units with coils for indoor installations as further described herein.

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 23 0100 “Basic Mechanical Requirements,” and Section 23 0500 “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.”
2. Division 23 Section “Duct Accessories” for dampers used as an integral part of factory-packaged air-handling units specified in this Section.
3. Division 23 Section “Control Systems” for temperature controls, wiring, devices, components, and actuators for dampers furnished under this Section.
4. Division 26 Section “Variable Frequency Drives” for motor controllers utilized to vary the speed of the fan motors in response to a temperature control signal.

1.3 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 01 Specification Sections.

B. Product Data: For each type of modular packaged air-handling unit indicated. Include the following:

1. Certified fan-performance curves with system operating conditions indicated.
2. Certified fan-sound power ratings.
3. Certified coil-performance ratings with system operating conditions indicated.
4. Motor ratings, electrical characteristics, and motor and fan accessories.
5. Material gages and finishes.
6. Filters with performance characteristics.
7. Dampers, including housings, linkages, and operators.
8. Leakage class rating as determined via ASHRAE Standard 111.
9. Product data for all specified accessories.

C. Shop Drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection.

D. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.

E. Coordination Drawings: Submit with Shop Drawings. Show mechanical-room 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.

F. Source quality-control reports.

G. Field quality-control reports.

H. Operation and Maintenance Data: For air-handling units to include in emergency, operation, and maintenance manuals.

I. Air-handling units shall be brought into the building through the existing front door and corridor. If any component requires disassembly to move into the building, Contractor shall have manufacturer representative available to monitor disassemble and resemble to maintain manufacturer's warranty and scheduled performance. Components of unit shall not be cut to bring into the building. Refer to the schedule sheet for largest allowed unit component size.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain modular packaged air-handling units through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of factory-packaged air-handling units and are based on the specific system and model indicated. Refer to Division 23 Section "Basic Mechanical Requirements" for guidelines concerning the use of other systems or models.

C. NFPA Compliance: Factory-packaged air-handling units and components shall be designed, fabricated, and installed in compliance with NFPA 90A *Installation of Air Conditioning and Ventilating Systems*.

D. AHRI Certification: Air-handling unit and component product lines shall be factory-tested according to the applicable portions of AHRI 430 and shall be listed and bear the label of the Air-Conditioning Heating and Refrigeration Institute (AHRI).

E. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2016, Section 6 – "Heating, Ventilating, and Air-Conditioning."

F. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2016, Section 5 – "Systems and Equipment" and Section 7 – "Construction and Startup."

G. Fan Performance Ratings: Rate according to ASHRAE Standard 51-2016 (ANSI/AMCA Standard 210-2016) *Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating*. In addition, all airfoil fans shall comply with AMCA standard 99-2408-69 and 99-2401-82 and shall bear the AMCA Seal.

H. Sound Power Level Ratings: Rate according to AHRI 260-2017 *Sound Rating of Ducted Air Moving and Conditioning Equipment*.

I. Air-Handling Unit Casing Leakage Ratings: Rate and publish leakage ratings for air-handling unit product line in accordance with ASHRAE Standard 111-2008 *Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems*. All units furnished for this project shall comply with ASHRAE 111-2008 Class 6 leakage rating.

J. Air Coils: Certify capacities, pressure drops, and selection procedures in accordance with AHRI 410.

K. UL and NEMA Compliance: Provide motors required as part of air-handling units that are listed and labeled by UL and comply with applicable NEMA standards.

L. Comply with NFPA 70 for components and installation.

M. Listing and Labeling: Provide electrically operated components specified in this Section that are listed and labeled. The terms "Listed" and "Labeled" are defined in the National Electrical Code, Article 100.

1.5 COORDINATION

A. Coordination: Coordinate layout and installation of factory-packaged air-handling units with piping and ductwork and with other installations.

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 size and location of structural-steel support members.

1.6 DELIVERY, STORAGE, AND HANDLING:

A. Deliver air-handling unit as a factory-assembled module with shipping splits only as necessary and with protective crating and covering. All unit openings shall be tightly covered with shrink-wrap or similar means to protect against moisture, dirt, and dust penetration throughout delivery, storage, shipping, and handling.

B. Comply with ASHRAE 62, Section 7 (practices to be followed during construction and startup). Protect equipment from moisture by appropriate in-transit and on-site procedures.

C. Provide shrink-wrap around unpainted units. The membrane shall cover entire air handling unit during shipping and storage. Cover equipment, regardless or size or shape. Tarping is not acceptable.

D. Shrink-wrap equipment, including electrical components, for protection against rain, snow, wind, dirt, sun fading, road salt/chemicals, rust and corrosion. Keep equipment clean and dry.

E. Deliver air-handling unit as a factory-assembled module with shipping splits only as necessary and with protective crating and covering.

F. Store per air handling unit Manufacturer's written recommendations. Store air handling unit indoors in a warm, clean, dry place where units will be protected from weather, construction traffic, dirt, dust, water, moisture. If units will be stored for more than 6 months, follow manufacturer's instruction for long-term storage.

G. Lift and support units with manufacturer's designated lifting or supporting points.

1.7 SEQUENCING AND SCHEDULING

A. Coordinate installation of equipment located in building. Contractor shall coordinate with existing conditions of facility to determine shipping splits of all unit components to bring equipment into building. Contractor is solely responsible for any required disassembly and reassembly of equipment to install new equipment. Disassembly and reassembly shall be performed by a manufacturer's factory-trained and factory-employed service technician only.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Filters: Furnish two (2) additional set for each central station air-handling unit. This shall include complete sets of pre-filters and final filters as described below for each air handling unit and blower coil unit.
   2. Gaskets: Furnish one (1) additional complete set for each access door on each modular air-handling unit.
   3. Lighting: Provide six (6) matching light fixtures matching unit install type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Carrier Global Corp.
   2. Daikin Applied.
   3. Johnson Controls, Inc. (including York brand).
   4. Trane Technologies plc.

2.2 MANUFACTURED UNITS

A. General Description: Factory-assembled, 2-inch solid double-wall units consisting of fans, motor and drive assembly, coils, dampers, plenums, filters, and condensate pans. Refer to Schedule Sheet and plans for each unit configurations and individual components.

B. Pressure Class: Meet requirements of this Specification at all of the following water column static pressure conditions:

   1. Exterior Cabinet Wall: 6-inch positive and 4-inch negative water column static pressure differential across casing of the air-handling unit; or the largest static pressure capability of the unit fan(s) at any point on their operating curve; whichever is greater.

   2. Internal Cabinet Walls between the Economizer and Mixing Box Sections: 10-inch static pressure differential (i.e., 4-inch positive and 6-inch negative) water column across this internal compartment wall of the air-handling unit; or the largest static pressure capability of the unit's supply and return fans at any point on their operating curves; whichever is greater.
   3. Structural Performance: Casing panels shall be self-supporting and capable of withstanding static pressures indicated above, without panel joints exceeding a deflection of L/200 where "L" is the unsupported span length within completed casings.
   4. Leakage Performance: As specified in Part 1 of this Section.

2.3 CABINET

A. Materials: Formed and reinforced G-90 mill galvanized steel wall and top panels, fabricated to allow access to and removal of internal fans, coils, other parts, and components, without affecting the structural integrity of the unit, with joints between sections sealed.

   1. Outer Casing: Galvanized steel formed and reinforced panels, 18-gage galvanized steel panel, minimum 2-inch thick.

   2. Outer Casing Framing: Galvanized steel, 16-gage.
   3. Inner Casing: Galvanized steel, 20-gage solid in all sections.
   4. Floor Plate: Galvanized steel, 18-gage solid.
   5. Floor Plate: Galvanized steel, 16-gage solid. Provide an additional 0.125 inch (3.2 mm) aluminum diamond tread plate floor liner in all access sections. Floor must be capable of supporting maintenance personnel.
   6. Cooling Coil Section require: 20-gauge 304 stainless steel inner skin.

B. Base Rail: The entire unit shall be supported on a 14-gage galvanized steel rail channel or rustproof-painted structural steel rail. Minimum rail height shall be 10-inches unless otherwise noted on Drawings. Provide integral lifting lugs.

1. Increase the base rail height if necessary to achieve required condensate drain trap dimension. Coordinate with detail on drawings for required trap height.

C. Insulation: Glass-fiber insulation, complying with ASTM C612 and NFPA 90A.

1. Thermal Performance: k-value 0.26 BTU-in/(hr-sf-degF) at 75°F mean temperature.
2. Thickness: 2 inches (50 mm), 3-pound density.
3. Option: Closed-cell injected polyurethane foam insulation of at least 2-pound density and R-12 thermal performance will also be acceptable.
4. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50, when tested according to ASTM C411.
5. Location and Application: Encased between outside and inside casing.
6. Insulate frame in the same manner as panels, roof and floors.

D. Access Doors: Insulated double wall construction, same materials and finishes as cabinet and complete with hinges, latches, handles, and gaskets. All doors shall have direction of swing chosen to provide a seating head pressure against the door gasket.

1. The following locations, and other unit sections as indicated on Drawings, shall have access doors sized and located to allow periodic maintenance and inspections. Access doors shall be on the same side of the unit as the coil connections unless indicated otherwise. Provide access doors at fan section (motor side), access sections, coil sections, damper sections, and filter sections.
   a. Fan sections, motor side.
   b. Access section.
   c. Coil section (Both sides of all coils. Upstream and downstream of all coils.)
   d. Damper section.
   e. Inlet plenum.
   f. Filter section.
   g. Blank (access sections).
2. Latches: Minimum of two (2) heavy-duty industrial-type roller cam mechanisms per door, operable from inside and outside. Latch handles shall be Ventlock 310.
3. Hinges: A minimum of two heavy-duty stainless-steel piano hinge. Door hinges shall allow full 180-degree swing.
4. Gasket: 3/8 inch bulb-type neoprene gasket complying with UL 723, applied around entire perimeters of panel frames.
5. Size: **MINIMUM WIDTH 24 inches (610mm)** wide by full height of unit casing, but need not be taller than 60 inches (1500 mm) unless otherwise noted on Drawings.
6. Not Acceptable: Access panels which do not remain attached to the unit when opened. Bolted or screwed access panels.
7. Note there are units that use access doors to allow access through unit to opposite side of unit. Refer to Drawings for these units and the access door locations. These units the access doors shall be located on each side of the unit section. Access latches must be accessible from inside and outside of unit. These access doors shall be a minimum 24 inches (610 mm).

E. Drain Pans: Readily cleanable, formed sections of stainless steel sheet complying with ASHRAE Standard 62.1. Fabricate pans in sizes and shapes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) when units are operating at maximum catalogued face velocity across cooling coil. Pans shall be sloped in two

planes at a minimum of two percent slope for complete drainage to a single outlet without standing water regardless of whether the fan is on or off.

1. Double-Wall Construction: Fill space between walls with 2-inches insulation and seal moisture tight having a minimum R-value of 12 ft2-hr-F/Btu ft, complying with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," for insulation
2. Drain Connection: Same side of unit as coil connection side, unless noted otherwise. Factory pre-pipe without trapping to exterior of unit at a location above (not through) the specified unit base rail. Locate at lowest point of pan and size to prevent overflow, but not smaller than NPS 1¼ (DN 32) in any case. Terminate with threaded nipple.
3. Units with stacked coils shall have an intermediate drain pan or drain trough to collect condensate from top coil.
4. All portions of the drain pan, including intermediate pans and any hardware subject to contact with condensate, shall be constructed of Type 304 stainless steel.
5. Fasteners: All fasteners exposed to weather shall be corrosion-resistant.
6. Length: Extend drain pan long enough downstream from leaving face to comply with ASHRAE 62.1-2016 Paragraph 5.10.4; but not less than 10-inches of drain pan shall be exposed beyond the leaving edge of the cooling coil in any case.
7. Depth: A minimum of 2 inches (50 mm) deep.
8. Provide drain pan under the complete width and length of cooling coil section.
9. Insulate plumbing associated with drain pan and connections.
10. Provide a minimum of 1 inch clearance between the drain pan and any coil casing, coil support or any other obstruction.

F. Access Sections: Provide access sections as indicated on drawings and/or schedules. Access sections shall meet all cabinet construction requirements specified elsewhere in this Section.

1. In addition, access sections which immediately both sides of each coil section and fan section and shall include a drain pan constructed as described in “Drain Pan” paragraphs above.
2. Exception: NPS-1 (DN 25) drain outlet connection will be accepted in lieu of NPS 1¼ (DN 32) for access section drain pans.

2.4 FAN SECTION

A. Refer to Schedule Sheets for acceptable fan types. Only fan types shown on Schedules Sheets are acceptable. Substitutions will not be allowed. Refer to the following section for specifics for each type of fan. The fan section described below shall apply for all supply fan sections of a Modular-Packaged Air-Handling Units. Refer to Drawings for required unit sections.

B. Fan-Section Construction: Fans consisting of housing, wheel, fan shaft, bearings, motor, drive assembly, and support structure and equipped with formed-steel channel base for integral mounting of fan, motor, and casing panels. Mount fan scroll, wheel, shaft, bearings, and motor on structural-steel frame, with frame mounted on base with vibration isolation.

1. Install fans on housed spring vibration isolators, minimum 2-inch (50-mm) static deflection, with seismic snubbers. Vibration isolators shall be Mason Industries Model SLF or equal.
2. Install duct flexible connector at point of connection of fan discharge to the unit cabinet.

C. Fans, General: All fans shall be housed, double-width, double-inlet type with airfoil blades; unless another type of fan is expressly indicated on Drawings or elsewhere in these Specifications.

D. Centrifugal Fan Housings: Formed- and reinforced-steel panels to make curved scroll housings with shaped cutoff, spun-metal inlet bell, and access doors or panels to allow entry to internal parts and components.

1. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
2. Performance Class: AMCA 99-2408, Class II as scheduled; If the fan selection indicates an operating point within 10 percent of the maximum operational rpm limit for the fan class indicated by the selection point, the fan manufacturer shall provide a fan of the next-higher class designation.
3. Horizontal Flanged Split Housing: Bolted construction.
4. Plug Fans: With steel cabinet. Fabricate without fan scroll and volute housing.

E. Fan Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and motor horsepower.

F. Plenum “Plug” Fans: Permitted only where expressly indicated on Drawings or elsewhere in these Specifications. Steel construction with smooth-curved inlet flange, heavy backplate, and hollow die-formed airfoil-shaped blades continuously welded at tip flange and backplate; cast-iron or cast-steel hub riveted to backplate and fastened to shaft with set screws. Fabricate without fan scroll and volute housing. Single-width, single-inlet style.

G. Shafts: Statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.

1. Turned, ground, and polished hot-rolled steel with keyway. Ship with a protective coating of lubricating oil.
2. Designed to operate at no more than 70 percent of first critical speed at top of fan’s speed range.

H. Grease-Lubricated Shaft Bearings: Self-aligning, pillow-block-type, ball or roller bearings with adapter mount and two-piece, cast-iron housing; rated for duty at maximum fan speed.

1. Tapered roller bearings with double-locking collars meeting the above requirements will be acceptable.
2. Pre-lubricated and sealed-type ball bearings meeting the above requirements will also be acceptable.
3. Bearing Rating Life: ABMA 9, L_{10} of 200,000 hours.
4. Bearing lubrication lines and grease fittings shall be extended to, and mounted adjacent to, unit access door(s) for easy accessibility.

I. Piezometer Ring Fan Inlet Airflow Sensor:

1. Provide each individual fan with airflow measurement integral to fan inlet cones for continuous measurement of air volume flow rate.
2. Multiple pressure sensor points strategically placed along the circumference of the inlet cone and internally connected to an averaging ring manifold located behind the inlet cone.
3. Sensor points shall not protrude beyond the surface of the inlet cone nor be adversely affected by particle contamination present in the airstream.
4. Sensor shall produce steady, non-pulsating signals to achieve accuracy within 5 percent of actual airflow when fan is operating within its stable range.
5. Sensor shall be non-intrusive and not impact fan performance nor acoustics.
6. Product shall be a standard offering of the fan manufacturer and include published literature with supporting test data to validate sensor performance.
7. Include output transducer with selectable 4-20 mA or 0-10 VDC proportional signal.

J. Fan-Section Source Quality Control:
   1. Sound Power Level Ratings: Comply with AHRI 260-2017 *Sound Rating of Ducted Air Moving and Conditioning Equipment*. Rate fans according to AMCA 300 *Reverberant Room Method for Sound Testing of Fans*.
   2. Establish ratings for flow rate, pressure, power, air density, rotation speed, and efficiency according to ASHRAE Standard 51-2016 (ANSI/AMCA Standard 210-2016) *Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating*.

K. Fans will be selected to provide highest efficiency and lowest noise characteristics practical while meeting specific system requirements. Sound level shall not exceed 85db, three (3) feet from unit.

L. The fan-system operating point shall fall within range recommended for proper operation as indicated in Figure 5-4, AMCA Standard 201-90 “Fans and Systems”. Fan type and characteristics will be selected to assure stable non-pulsing performance in required operating range. Fan’s Class shall be high enough for 10% over speed without exceeding RPM for the class. Fan shall be selected low enough on the fan curve to allow 5-10% increase in static pressure without causing the fan to go into the unstable range.

2.5 MOTORS

A. General: Refer to Division 23 Section “Motors” for general requirements, which are fully applicable to the work of this Section as if repeated herein.

B. 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.

C. Location: Motor, drive, and access door shall be on the same side of the fan as the coil connection side, unless otherwise indicated. Provide motor on an adjustable base, inside the air handling unit housing. Motors external to the air-handling unit housing are not acceptable.

D. Provide inverter-ready motors with shaft grounding rings as specified in Division 23 Section “Motors” everywhere variable speed drives are indicated.

E. Noise Rating: Quiet.

F. Starters, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 26 Sections.

G. Power Cable Raceway: Any and all power cable installed inside the unit proper, such as (but not limited to) power cabling to the fan/motor assembly, shall be installed inside flexible or rigid conduit as further specified in Division 26 Section “Raceways.” Cabling installed inside a separate dedicated power or control enclosure need not be installed in raceway.

2.6 HYDRONIC COILS

A. Coil Sections: Individual, insulated casings for each heating coil and cooling coil separately. Design and construct casing to facilitate removal and replacement of coil for maintenance and to assure full airflow through coils.

B. All coils shall be piped counterflow and be drainable.

C. Coil Casing: Same as cabinet construction for heating coil sections; same as cabinet construction but with all stainless steel materials for cooling coil sections.

D. Circuit Arrangement: Self-draining and self-venting coil fabricated according to AHRI 410. Number of rows shall be determined by manufacturer to meet scheduled performance requirements. Unless noted otherwise, do not exceed 2 rows for heating coils or 8 rows for cooling coils.

1. Exception: All cooling coils shall be exactly 8-rows and 10-fins per inch, regardless of whether or not the scheduled performance requirements can be met with fewer rows and/or fewer fins.

E. Piping Connections: Threaded or grooved, on same side. Coil connections shall be on the side of the unit indicated on the Drawings.

F. Tubes: Copper, 5/8-inch O.D. with 0.025-inch minimum wall. Select coils for not less than 1 fps water velocity and not more than 6 fps water velocity.

G. Fins: Aluminum of minimum thickness 0.006-inch. Spacing shall not exceed 8 per inch for heating coils nor 10 per inch for cooling coils.

H. Fin and Tube Joint: Mechanical bond created via thermal expansion.

I. Headers: Non-ferrous, such as seamless copper tube with brazed joints, with drain and air vent tappings. Headers and return bends shall be enclosed within the air handling unit casing. Drain and air vent tappings shall extend through the unit exterior casing, with cabinet sealed around the penetration.

J. Frames: Stainless steel, 0.0625-inch (1.58 mm) is required for cooling coils. Galvanized-steel channel frame, 0.052-inch (1.3 mm) is acceptable for heating coils.

K. Stacked Coils: Where two or more coils are stacked vertically within a unit cabinet, provide a design which seals any gap between coils to prevent bypass of air. Any metal hardware used for this purpose shall meet the same construction requirements as for coil frames.

L. Ratings: Designed, tested and rated according to ASHRAE 33 and AHRI 410.

M. Working-Pressure Ratings: 200 psig (1380 kPa), 325ºF (163ºC).

N. Source Quality Control: Test to 300 psig (2070 kPa) and to 200 psig (1380 kPa) underwater.

O. Insulate gap between coil stub out connection and air handling unit casing with a spool shaped sleeve grommet. Adhesive rings applied to the casing walls are not acceptable.

P. All coils within air handling units, will be capable of being pulled without obstruction of equipment, pipes, conduits, etc., or requiring removal of any other coil in the same unit.

2.7 DAMPER SECTION

A. Damper Section: Furnish and factory-install outdoor air dampers, return air dampers, and relief air dampers in an economizer arrangement within air handling units. Dampers shall bear AMCA's Certified Ratings Seal for both air performance and air leakage. Refer to Division 23 Section "Duct Accessories" for specification of automatic control dampers, whose requirements govern as if fully reproduced herein.

B. Provide parallel-blade dampers in a reinforced, galvanized steel cabinet. Damper blades shall be galvanized steel mechanically fastened to steel operating rod. Connect operating rods for each set of dampers together with a common linkage and interconnect linkage so dampers operate simultaneously and in the opposite direction (one opens when the other closes).

C. It is the intent of this specification that damper actuators will be furnished and field-installed as the work of Division 23 Section "Control Systems" as part of an overall building temperature control system.

2.8 INLET PLENUM SECTION

A. Provide inlet plenum section for connection to outside air duct. Provide inlet plenum with factory mounted damper where indicated on the Drawings. Refer to Division 23 Section "Duct Accessories" for specification of automatic control dampers, whose requirements govern as if fully reproduced herein.

B. It is the intent of this specification that damper actuators will be furnished and field-installed as the work of Division 23 Section “Control Systems” as part of an overall building temperature control system.

2.9 FILTER SECTION

A. Provide solid double-wall, insulated, galvanized steel casing for filter section to match cabinet construction indicated above, with magnehelic gauges for indicating the operating pressure drop across each filter bank (two magnehelic gauges are required for air handling unit). Magnehelic gauges shall be installed with a manifold and valves to isolate lines to each side of the filter. Magnehelic gauges shall be Dwyer Model 2002 with air filter gauge accessory package.

B. Pre-Filters: Pre-Filters shall be 2 inch thick, high density glass micro fibers laminated to an all glass woven mesh backing with welded wire media support grid, clean airflow resistance of 0.10 inch wg at face velocity of 300 fpm and ASHRAE 52.1 filter-arrestance efficiency of 70 to 82 percent. Filter media shall have an average efficiency of 30%. Filters shall comply with NFPA 90A. Provide filter media holding frames arranged for flat orientation. Filter shall be Farr type 30/30 or equal by American Air Filter. All filters shall be 24 inches by 24 inches or 24 inches by 12 inches, where possible.

C. Final Filters: Final filters for supply airstream shall be 12 inch thick, cartridge type filters with filter media consisting of high density microfine glass fibers, laminated to a reinforcing backing. Filter media shall have an average efficiency of 85% (MERV 13) on ASHRAE Test Standard 52.1, and it shall have an arrestance of not less than 97% on that same standard. Provide filter media holding frames arranged for flat orientation. Filter shall be Farr RIGA-FLO or equal by American Air Filter. All filters shall be 24 inches by 24 inches or 24 inches by 12 inches, where possible.

2.10 AIR HANDLING UNIT ACCESSORIES

A. View Windows: Each access door shall include a window for viewing, capable of withstanding unit operating pressures specified.
   1. Fabricate windows of double-glazed, wire-reinforced safety glass with an air space between panes and sealed with interior and exterior rubber seals.
   2. Minimum size 6-inches (150 mm) by 6-inches (150 mm) if rectangular, or 6-inches (150 mm) diameter if round.

B. Marine Lights: Each section which includes an access door shall also include a factory-mounted, enclosed and gasketed, vapor-tight, compact LED light. Include junction box, globe, aluminum globe guard, receptacle, and bulb ready for field wiring. Unit shall be wired such that one (1) electrical toggle disconnect switch shall turn on and off all lights in the entire unit. Comply with Division 26. Field wiring of the disconnect switch is the work of Division 26.

C. Antimicrobial UV-C Lamp System: Factory-installed and pre-engineered UV-C lamp system consisting of power supply, power supply housing, wiring, UV lamp(s), lamp plug, lamp plug protector, encapsulated lamp, and lamp holder used for UV germicidal irradiation of cooling coil and condensate drain pan.

   1. Standard: UL Category Code ABQK, HVAC accessories, air-duct mounted.
   2. Lamps: High output, hot cathode.
   3. Lamp-Holder Construction: UV- and moisture-resistant materials and designed to connect the lamp to the plug; with adjustable positioning.
   4. Lamp-Clamp Construction: UV- and moisture-resistant materials, water-tight connection, and adjustable positioning.

5. Lamp Protection: Hermetically sealed to provide protection against lamp breakage and to ensure lamp contents from a broken lamp are contained.
6. Lamp Output: UV-C energy, primarily at the 254-nm wavelength with a 360-degree energy distribution.
7. Access Door Interlocks: Automatic disconnect on all access doors into UV-installed casing sections to shield servicing personnel from contact with light.
8. Power Supply: UL-listed, single-point electrical connection with service disconnect.
9. Power Consumption: Maximum of 15 W/sf (161 W/m^2).

D. GFCI Receptacle: Provide duplex GFI receptacle; 20 amp / 120 volt, on the unit exterior. The exterior receptacle shall be weatherproof. Comply with Division 26 Section "Wiring Devices." Field wiring of the receptacle is the work of Division 26.

2.11 BLOWER COIL UNITS

A. General Description: Factory assembled, consisting of fan, motor and drive assembly, chilled water cooling coil, hot water heating coil, filters and drain pans.

B. Units shall be Horizontal, Reduced-Footprint Blower Coils by approved manufacturers listed section 2.1 above.

C. Cabinet: Cabinet shall be constructed of minimum 18-gauge galvanized steel, insulated with 1-inch, 1-1/2 lb. density, closed cell foam insulation material to provide thermal and acoustical insulation.
1. Insulation must meet all requirements of ASTM C1071 (including C665), UL 181 for erosion, and carry a 25/50 rating for flame spread/smoke developed per ASTM E-84, UL723 and NFPA 90A. In addition to using adhesive complying with NFPA 90A, the insulation shall incorporate a secondary mechanical fastener attached to the unit casing wall. Adhesive as the only method of fastening the insulation to the casing is not acceptable.
2. All units shall be provided with 9/16-inch diameter hanger rod holes in the top and bottom panels for through-bolt type suspension installation.
3. Spring type unit mounting vibration isolators shall be provided by the manufacturer.
4. All units shall have a minimum 1-inch duct collar on both the discharge and return.

D. Fans: All units shall be furnished with double inlet forward curved, centrifugal blowers statically and dynamically balanced for smooth operation. Blower wheels shall be mounted directly on the motor shaft. Belt driven blowers are not acceptable.

E. Motors: Motor shall be electronically commutated with thermal overload protection and a constant torque operation. RPM control shall not be acceptable. Motors shall feature permanently lubricated ball bearings; internal current and thermal overload protection, a minimum 1.15 service factor and 56 frame resilient base.

F. Coil Sections: Provide insulated, galvanized steel casings for cooling coil and heating coil. Design and construct to facilitate removal and replacement of coils for maintenance and to assure full airflow through coils.

G. Coil Construction: Rigidly supported across full face, pitched to allow drainage.
1. Coil Casing: Same as cabinet construction, but with all stainless steel materials for cooling coil sections. Coil header and return bend casings for chilled water shall be stainless steel.
2. Coil Construction: Rigidly supported across full face, pitched to allow drainage.
3. Circuit Arrangement: Self-draining and self-venting coil fabricated according to ARI 410. Number of rows shall be determined by manufacturer to meet scheduled performance requirements unless noted otherwise.

4. Piping Connections: Threaded on same side. Coil connections shall be on the side of the unit indicated on the Drawings.
5. Tubes: Copper, 5/8" O.D. with 0.025" minimum wall thickness. Select coils for not less than 1 fps water velocity and not more than 6 fps water velocity.
6. Fins: Aluminum of minimum thickness 0.006". Spacing shall not exceed 8 per inch for heating coils nor 10 per inch for cooling coils.
7. Fin and Tube Joint: Mechanical bond created via thermal expansion.
8. Headers: Chilled water coil header shall be stainless steel. Heating coil shall be non-ferrous, such as seamless copper tube with brazed joints. Provide drain and air vent tappings. Headers and return bends shall be enclosed within the air handling unit casing.
9. Frames: Stainless steel, 0.0625 inch (1.58 mm) is required for cooling coils. Galvanized-steel channel frame, 0.052 inch (1.3 mm) is acceptable for heating coils.
10. Ratings: Design tested and rated according to ASHRAE 33 and ARI 410.
11. Working-Pressure Ratings: 200 psig (1380 kPa), 325ºF (163 C).
12. Source Quality Control: Factory test coils to 315 psig (2070 kPa) air pressure under warm water, according to ARI 410, "Forced-Circulation Air-Cooling and Air-Heating Coils."
13. Drain Pan: Provide stainless steel, insulated pan, sloped in both directions and fully drainable.

H. Filters: 2-inch- (50-mm-) thick, high density glass micro fibers laminated to an all glass woven mesh backing with welded wire media support grid, clean airflow resistance of 0.10 inch wg (25 Pa) at face velocity of 300 fpm (1.52 m/s), and ASHRAE 52.1 filter-arrestance efficiency of 70 to 82 percent. Filters shall be Farr 30/30 or equal by American Air Filter. All filters shall be 24 inches by 24 inches or 24 inches by 12 inches, where possible.

I. Unit Controls: Controllers for blower coil units shall be furnished and installed as work of Section 230900 " Control Systems."

J. Condensate Overflow Switch: Provide unit with condensate overflow switch factory wired for field mounting in an auxiliary drain pan to shut off the supply fan in the event of condensate overflow from the main pan to the auxiliary pan.

K. Disconnect Switch: Provide a factory-installed and pre-wired NEMA 1 non-fused disconnect switch.

L. Units shall sit on field fabricated stand. Refer to Drawings for stand requirements.

M. All piping connections, filter access, controls shall be from one side of the unit.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance. Examine roughing-in of piping systems and electrical services to verify actual locations of connections before installation. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Install factory-packaged air-handling units level and plumb, according to manufacturer's written instructions.

C. Arrange installation of units to provide access space around air-handling units for service and maintenance.

D. Adjust damper linkages for proper damper operation.

E. Concrete Bases: Install floor-mounted units on concrete housekeeping bases. See Division 23 Section “Basic Mechanical Materials and Methods” for concrete base materials and fabrication requirements.

1. Secure units to anchor bolts installed in concrete housekeeping base. See Division 23 Section “Basic Mechanical Materials and Methods” for anchorage and concrete base requirements.
2. Coordinate size of housekeeping bases with Division 03 installer to match actual unit sizes provided. Base shall be 4-inches (100 mm) larger than overall dimensions of supported unit on all sides. Thickness shall be as indicated, but not less than 6 inches in any case.

F. Suspended Units: Suspend units from structural-steel support frame using threaded steel rods and spring hangers.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

1. Coil piping shall not block access doors.
2. Coil piping shall offset beyond the limits of the coil pull access space in as short a distance as practical, to minimize the amount of pipe disassembly required to accomplish coil removal. All coil service valves, control valves, balance valves, strainers, and other appurtenances shall be installed outside the limits of the coil pull access space.

C. Connect condensate drain pans using Type L copper tubing. Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction. Condensate drain sizing:

1. Up to 20 tons (240 MBh) scheduled unit capacity, use ¾-inch (DN 20).
2. Up to 40 tons (480 MBh) scheduled unit capacity, use 1-inch (DN 25).
3. Up to 90 tons (1080 MBh) scheduled unit capacity, use 1¼-inch (DN 32).
4. Up to 125 tons (1500 MBh) scheduled unit capacity, use 1½-inch (DN 40).
5. Up to 250 tons (3000 MBh) scheduled unit capacity, use 2-inch (DN 50).

D. Hot- and Chilled-Water Piping: Comply with applicable requirements in Division 23 Section “Hydronic Piping.” Connect to supply and return coil tappings with shutoff or balancing valve and union or flange at each connection.

1. Hydronic piping shall be connected to hydronic coils in a counterflow arrangement, such that direction of water flow is opposite the direction of air flow.

E. 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 connections.

F. Electrical: Comply with applicable requirements in Division 26 Sections for power wiring, switches, and motor controls. Connect wiring and ground equipment according to Division 26 Sections.

G. Temperature control wiring and interlock wiring is specified in Division 23 Section “Control Systems.”

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.

1. Leak Test: After installation, fill water and steam coils with water and test coils and connections for leaks. Repair leaks and retest until no leaks exist.
2. Charge refrigerant coils with refrigerant and test for leaks. Repair leaks and retest until no leaks exist.
3. Fan 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.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 STARTUP SERVICE

A. Final Checks before Startup: Perform the following:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Perform cleaning and adjusting specified in this Section.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify free fan wheel rotation and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.
5. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
6. Set outside- and return-air mixing dampers to minimum outside-air setting.
7. Comb coil fins for parallel orientation.
8. Install clean filters.
9. Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.

B. Starting procedures for modular packaged air-handling units shall include the following:

1. Energize motor; verify proper operation of motor, drive system, and fan wheel.
2. Measure and record motor electrical values for voltage and amperage.
3. Manually operate dampers from fully closed to fully open position and record fan performance.

C. 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 motor to meet operating conditions indicated. Remove, size, select, and install the proper pulley/sheave sizes, to match specified performance.

3.5 CLEANING

A. After completing installation, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes including chips, scratches, and abrasions.

B. Clean modular packaged air-handling units internally, on completion of installation, according to manufacturer's written instructions. Clean fan interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheels, cabinets, and coils entering air face.

C. After completing system installation and testing, adjusting, and balancing modular packaged air-handling and air-distribution systems, clean filter housings and install new filters.

3.6 COMMISSIONING

A. Final Checks before Startup: Perform the following before startup:
   1. Verify that shipping, blocking, and bracing are removed.
   2. Verify that unit is secure on mountings and supporting devices and that connections for piping, ductwork, and electrical are complete. Verify that proper thermal overload protection is installed in motors, starters, and disconnects.
   3. Verify integrity of condensate trap for positive or negative pressures operation.
   4. Verify filter gages are set to zero.
   5. Perform cleaning and adjusting specified in this Section.
   6. Disconnect fan drive from motor, verify proper motor rotation direction, and verify free fan wheel rotation and smooth bearings operations. Reconnect fan drive system, align belts, and install belt guards.
   7. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
   8. Comb coil fins for parallel orientation.
   9. Install new filters of the specified type in each air handling unit.
   10. Verify that manual and automatic volume control, and fire dampers in connected ductwork systems are in fully open position.

3.7 DEMONSTRATION

A. Engage the services of a factory-authorized service representative to train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.

   1. Review data in the operation and maintenance manuals. Refer to Division 01 for requirements.
   2. Schedule training with Owner, through Architect, with at least 7 days' advance notice.

END OF SECTION 23 7313

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SECTION 23 8239 – IN-ROOM TERMINAL EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the following types of in-room terminal equipment:
   1. Hydronic finned-tube heaters.
   2. Propeller unit heaters with hot-water coils.

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 23 0100 “Basic Mechanical Requirements,” and Section 23 0500 “Basic Mechanical Materials and Methods” apply to the work of this Section as if fully repeated herein.

1.3 DEFINITIONS

A. BAS: Building automation system.

B. CWP: Cold working pressure.

C. PTFE: Polytetrafluoroethylene plastic.

D. TFE: Tetrafluoroethylene plastic.

1.4 SUBMITTALS

A. Product Data: For each type of product, include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings:

   1. Include plans, elevations, sections, and details.
   2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include location and size of each field connection.
   4. Include details of anchorages and attachments to structure and to supported equipment.
   5. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.
   6. Indicate location and arrangement of piping valves and specialties.
   7. Indicate location and arrangement of integral controls.

C. Wiring Diagrams: Power, signal, and control wiring.

D. Samples: For each exposed product and for each color and texture specified.

E. Field quality-control reports.

F. Operation and Maintenance Data: For in-room terminal units to include in emergency, operation, and maintenance manuals.

1.5 PERFORMANCE REQUIREMENTS

A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - “Systems and Equipment” and Section 7 - “Construction and Startup.”

B. Airstream Surfaces: All surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - “Heating, Ventilating, and Air-Conditioning.”

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.

PART 2 - PRODUCTS

2.1 IN-ROOM TERMINAL EQUIPMENT, GENERAL (ALL UNITS)

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hydronic In-Room Terminal Equipment:

a. Airtherm; a Mestek company.
b. Daikin Applied Americas Inc.
c. Sterling Hydronics; a Mestek company.
d. Trane Technologies plc.

B. Capacities and Characteristics: As Scheduled on the Drawings.

2.2 FINNED-TUBE RADIATION HEATERS

A. Description: Factory-packaged units constructed according to UL 499, UL 1030, and UL 2021.

B. Performance Ratings: Rate finned-tube radiation heaters according to Hydronics Institute’s “I=B=R Testing and Rating Standard for Finned-Tube (Commercial) Radiation.”

C. Hydronic Heating Elements: Copper tubing mechanically expanded into flanged collars of evenly spaced aluminum fins resting on element supports. One end of tube shall be belled.

D. Element Supports: Ball-bearing cradle type to permit longitudinal movement on enclosure brackets.

E. Front Panel: Minimum 0.0528-inch- (1.35-mm-) thick steel.

F. Wall-Mounted Back Panel: Minimum 0.0329-inch- (0.85-mm-) thick steel, full height, with full-length channel support for front panel without exposed fasteners.

G. Floor-Mounted Pedestals: Conceal conduit for power and control wiring at maximum 36-inch (914-mm) spacing. Pedestal-mounted back panel shall be solid panel matching front panel.

H. Support Brackets: Locate at maximum 36-inch (914-mm) spacing to support front panel and element.

I. Finish: Baked-enamel finish in manufacturer’s standard color as selected by Architect.

J. Damper: Knob-operated internal damper at enclosure outlet.

K. Access Doors: Factory made, permanently hinged with tamper-resistant fastener, minimum size 6 by 7 inches, integral with enclosure.

L. Enclosure Style: Sloped top.

1. Top Outlet Grille: Extruded-aluminum linear bar grille; pencil-proof bar spacing.

    a. Mill-finish aluminum.
    b. Anodized finish, color as selected by Architect from manufacturer's standard colors.
    c. Painted to match enclosure.

M. Unit Controls: Integral line-voltage thermostat with minimum range of 60°F to 90°F.

N. Required Accessories: Integral disconnect switch, filler sections, corners, relay sections, and splice plates all matching the enclosure and grille finishes.

2.3 PROPELLER UNIT HEATERS

A. Description: Assembly including casing, coil, fan, and motor in vertical discharge configuration with adjustable discharge louvers.

B. Housing Finish: Manufacturer's standard baked enamel applied to factory-assembled and -tested propeller unit heaters before shipping.

C. Discharge Louver: Adjustable fin diffuser for horizontal units and conical diffuser for vertical units.

D. Coil Requirements: Test and rate hot-water propeller unit-heater coils according to ASHRAE 33.

E. Hot-Water Coil: Copper tube, minimum 0.025-inch (0.635-mm) wall thickness, with mechanically bonded aluminum fins spaced no closer than 0.1 inch (2.5 mm) and rated for a minimum working pressure of 200 psig (1380 kPa) and a maximum entering-water temperature of 325°F (163°C), with manual air vent. Test for leaks to 350 psig (2413 kPa) underwater.

F. Fan: Propeller type with aluminum wheel directly mounted on motor shaft in the fan venturi.

G. Motor: Permanently lubricated, multispeed; and as further specified in Division 23 Section "Motors" whose requirements apply to the work of this section as if fully reproduced herein.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive in-room terminal equipment for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for piping and electrical connections to verify actual locations before unit-heater installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install in-room terminal equipment to comply with NFPA 90A.

B. Suspend in-room terminal units from structure with elastomeric hangers.

3.3 CONNECTIONS

A. Piping installation requirements are specified in Division 23 Section "Hydronic Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install valves, unions, fittings, and other specialty items as indicated by detail on the Drawings.

C. Install piping adjacent to machine to allow service and maintenance.

D. Comply with safety requirements in UL 1995.

3.4 FIELD QUALITY CONTROL

A. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

B. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment. Units will be considered defective if they do not pass tests and inspections. Prepare test and inspection reports.

END OF SECTION 23 8239

SECTION 26 0500 - 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. This section is also applicable to Division 27 “Communications” and Division 28 “Electronic Safety and Security”

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 2020edition 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 Division 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 ELECTRICAL COORDINATION DRAWINGS

A. Prepare a set of coordination drawings showing major elements, components, and systems of electrical equipment and materials in relationship with other building components. Prepare drawings to an accurate scale of 1/4 inch = 1 foot-0 inches or larger. Indicate the locations of all equipment and materials, including clearances for servicing and maintaining equipment.

B. Prepare floor plans, reflected ceiling plans, elevations, sections and details to conclusively coordinate and integrate all installations. Show National Electrical Code-required clearances, maintenance access, and equipment removal clearances. Indicate locations where space is limited and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:

1. Equipment room layouts.
2. Specific equipment installations, including, but not limited to the following:

   a. Control panels
   b. Equipment connections
   c. Panelboards

3. Wiring diagrams: Indicating field-installed electrical power and control wiring and cabling layouts, overcurrent protective devices, equipment and equipment connections.
4. Work in pipe spaces, chases, trenches and tunnels.
5. Ceiling plenums which contain piping, ductwork, or equipment in congested arrangements.
6. Locate, identify and protect electrical services passing through remodeling or demolition area and serving other areas required to be maintained operational. When transit services must be interrupted, provide temporary services for the affected areas and notify the Owner prior to changeover.

C. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls and other structural components as they are constructed.

D. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."

E. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

1.5 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.

1.6 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.

1.7 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 and 28 Section for additional submittal requirements.

1.8 PRODUCT OPTIONS AND MATERIAL SUBSTITUTIONS

A. Where two or more materials are listed in the “Part 2 – Products” subsection of any Division 26, 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.

I. Only UL or equivalent approved appliances and equipment shall be specified.

1.9 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.

1.10 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.

1.11 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. Sheet metal.
4. Cable trays, including access space.
5. Other piping.
6. 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.

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.

D. Equipment in unfinished areas such as boiler room, mechanical spaces, and storage rooms furnished with a suitable factory finish need not be painted.

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. Reimburse the Engineer, based on the Engineer's standard hourly rates as defined in their contract with the Owner, for additional time and expenses when additional trips are required because the project jobsite was not ready for final observation and additional trips are required by the Engineer for review of final conditions.
3. 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.

END OF SECTION 26 0500

SECTION 26 0519 - 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. Remote Control and Signal Cable.

1.3 SUBMITTALS

A. Product Data: Include for each type of cable.

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.

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. 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. 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.

B. CopperConductors: Comply with NEMA WC 70.

C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN

D. Multiconductor Cable: Comply with NEMA WC 70 for metal-clad cable, Type MC with ground wire.

2.2 CONDUCTORS AND CABLES

A. General: Provide wire and cable suitable for the temperature, conditions and location where installed.

B. Minimum Conductor size is #12 AWG.

C. Minimum Insulation rating is 90°C.

D. For 100 amps and below: Conductor shall be rated per the 60°C table.

E. For over 100 amps: Conductor shall be rated per the 75°C table.

F. Feeders: Copper, 600 volt insulation, colored per 260553 IDENTIFICATION FOR ELECTRICAL SYSTEMS. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

G. Branch Circuits: Copper, 600 volt insulation, colored per 260553 IDENTIFICATION FOR ELECTRICAL SYSTEMS. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

H. Control Circuits: Copper, stranded conductor, 600 volt insulation IDENTIFICATION FOR ELECTRICAL SYSTEMS.

I. 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. Concealed in Ceilings, Walls, Partitions, Raised Flooring and Crawlspaces: Type THHN-THWN, single conductors in raceway.

B. Exposed, Including in Crawlspaces: Type THHN-THWN, single conductors in raceway.

C. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

D. Class 1 Control Circuits: Install per NEC Article 725.

E. 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. 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.

P. Support cables according to Division 26 Section "Hangers and Supports."

Q. 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. Length of metal clad cable extending from the local room junction box to the final in-wall device shall not exceed 50 feet.

D. Metal clad cable is allowed for flexible whip connection to luminaires in lengths not to exceed 6’-0”. Lighting is allowed to be daisy chained with full sized MC cable and no more than two MC cables are allowed to be terminated per light fixture.

E. Metal clad cable shall only be run concealed in dry locations, above suspended accessible ceilings, in walls with cavities between and through structural members.

F. Metal clad cable shall not be daisy chained from receptacle-to-receptacle. Metal clad cable runs shall be from a junction box to the final device or luminaire.

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.

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.

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 26 0519

SECTION 26 0526 - 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. Product Data: Include for each product.

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. 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: Grounding conductors larger than # 8 AWG should be stranded, and conductors small than # 8 AWG should be nonstranded (solid).
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 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: 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.

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. Do not use aluminum conductors in direct contact with earth, concrete, masonry or similar materials.

3.2 GROUNDING BUS

A. Grounding Bus: Install in electrical and telecom 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.

A. 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.

3.3 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.

B. Conductor Terminations and Connections:

1. Equipment Grounding Conductor Terminations: Bolted connectors.

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.

3.4 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.

END OF SECTION 26 0526

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SECTION 26 0529 - 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. RMC: Rigid metal conduit.

C. 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. 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, 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

Raceway Size (Inches)	No. of Conduits in Run	Location	RMC	EMT
1/2, 3/4	1 or 2	Flat ceiling or wall.	5	5
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
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

*Maximums for EMT apply.

END OF SECTION 26 0529

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SECTION 26 0533 - 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. Low Voltage Cabling Support.
   4. Communications Raceway Accessories.

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" 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/NFPA 70 - National Electrical Code.
   5. ANSI/NEMA FB 1 – Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable.
   6. NECA "Standard of Installation."
   7. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.
   8. TIA/EIA-569-A – Commercial Building Standard for Telecommunications pathways and spaces.
   9. TIA/EIA-606-A – The Administrative Standard for the Telecommunications Infrastructure of Commercial Buildings.
   10. “Telecommunications Distribution Methods Manual” published by the Building Industry Consulting Services International (BICSI).

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.
   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. 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
   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.

C. Flexible Metal Conduit: Zinc-coated steel
   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

D. 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.

2.3 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.

2.4 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. 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 CONDUIT APPLICATION

A. The following 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 EMT will also not be allowed below 7 feet AFF in areas where raceway may receive physical abuse (such as hallways, mechanical rooms, storage rooms, and janitor closets), unless the conduit is 2” or larger in diameter. Utilize RMC in these scenarios.
    b. Finished spaces, concealed above suspended ceilings and interior walls and partitions: EMT.
    c. Wet or Damp Locations: RMC.
    d. Connections to vibrating equipment: FMC, except use LFMC in wet or damp locations.
    e. Communications Cable: EMT or Flexible type, listed for purpose.

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: 1 inch, unless otherwise noted.

3.2 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. This contractor shall be responsible for all openings required in masonry or exterior walls for conduit routing. A qualified contractor capable of repairing all openings in a manner that matches existing conditioned shall be hired by the electrical contractor.

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. 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. No conduit will be allowed to be embedded in a 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, slabs and bar joists. Do not support conduits from non-structural members, such as ductwork, water or fire suppression piping, or ceiling grid support system.
1. 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.
2. Conduit will be supported from the building structure. Attachment to other pipes, conduits, ductwork, etc. will not be allowed.
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

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. 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 COMMUNICATION RACEWAY INSTALLATION REQUIREMENTS

A. General: These guidelines are intended to supplement the requirements listed in other portions of this specifications section.

B. Ensure construction drawings include details for all the proposed firestopping systems that could be encountered on the project based on the construction type and rating of the assemblies being penetrated.
1. Horizontal Pathways
a. Pathways must support cables and provide protection. Pathways should be planned to facilitate original installation as well as ongoing maintenance, additions, and relocations.

b. Conduit, trays, or other pathway hardware are to be used above the ceilings. Appropriate design of horizontal pathways should accommodate the hanging of cables loosely above suspended ceilings requires appropriate hardware (J-hooks, rings, etc.). Support hardware must not have sharp edges.
c. Cable trays should have twelve (12) inches of clearance above the tray. The designer should ensure that other building components fixtures, structural supports, air ducts do not restrict access to the cable tray.
d. Cable routing, support, and sealing of penetrations must meet applicable UMC codes.
e. EZ Path series 44 fire wall sleeves are requires where a cable tray path crosses a firewall. The quantity of EZ Path series 44 fittings will equal the capacity of the cable tray, not just the initial cabling demands.
f. Conduit, cable tray, and J-hooks will be designed to allow a 40% growth.
g. Hanging cable supports must be no more than 5 feet apart as the installed cable must exhibit some sag in hanging. This provides visual evidence that cable tension is within 25 pounds as required in EIA-568-A.
h. Bundles of cables supported by typical J-hooks should not be larger than 50 cables, unless additional support is provided.
i. Horizontal pathway design should take into consideration the horizontal cabling distance limitations of 90 meters (295 feet) from the telecommunications room to the outlet.
j. When conduit is used, sections of conduit shall be no longer than 150 ft and must not have more than or the equivalent of 270° bends between pull points or pull boxes.
k. Conduit inside bend radius must be:
    1) Six times the inside diameter for conduits 2” or less
    2) Ten times the inside diameter for conduits 2” or larger
l. Pull boxes should be placed directly after a bend or sized accordingly if the pull box is located at the bend.
m. Conduit fill limits must be followed to avoid over-packing cables:
    1) 1” - 3 cables max
    2) 1-1/4” - 4 cables max
    3) 1-1/2” - 6 cables max
    4) 2” - 12 cables max
    5) 3” - 20 cables
n. At a minimum, 1” conduit shall be extended from the outlet location box into the ceiling for entrance into the building cable distribution system. The conduit should turn 90° then bushed. This conduit must terminate before passing through a fire rated wall.
o. When possible, outlet locations should be placed above the work surfaces for easy access. Outlet boxes built into the floor are not recommended.
p. Cabling shall be supported above drop ceiling completely by cable tray or J-hooks.

C.

1. Minimum raceway size shall be as necessary to comply with fill ratio of referenced standards, but in no case less than 1 inch
2. Provide specified pull wires in all cabling pathways.
3. Conduit terminations for all low voltage wiring shall have nylon bushings installed on each end.
4. Ground and bond all systems in accordance with the NEC and ANSI/TIA/EIA 607.
5. 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).
6. Coordinate work with the building structural systems and electrical installation.

7. All work shall fully comply with these Specifications and related Drawings and all manufacturers' recommended installation practices.
8. Do not install conduit in concrete slab.
9. There shall not be more than the equivalent of 180 degrees of bends in any single run of conduit between adequately sized pull.
10. 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.
11. 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.
12. 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.
13. A conduit run shall not be longer than 100 feet between pull boxes for conduit runs inside a building.
14. 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.
15. Mount all conduit a minimum of 3 inches above any accessible type ceiling.
16. 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.

D. 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 37 inches separation from electrical motors and transformers and communications pathways.
    b. 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.

E. 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 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. Under no condition shall there be more than 12 inches of vertical cable sag between supports.

3.4 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."

3.5 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.

3.6 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.

3.7 MARKING AND IDENTIFICATION

A. Mark and identify conduits in accordance with Section 26 0553 “Identification for Electrical Systems.”

3.8 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 26 0533

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SECTION 26 0534 – 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. Product Data: Include for each type and accessories.

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 FB 1: Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable.
   4. 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. Cast Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy or aluminum, type FD with gasketed cover and threaded hubs.

D. 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.

E. Outlet boxes shall be 4” x 4” x 2½” and shall have plaster rings to accommodate a 2” x 4” faceplate. A sample faceplate will be provided upon request. Joint power and telecom boxes are not allowed, even with separation.

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 FLOOR BOXES

A. Metal Floor Boxes: Cast metal, fully adjustable, rectangular.

2.3 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 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 1with continuous-hinge cover with flush latch, unless otherwise indicated.
   1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

2.4 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 Engineeror Ownershall 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. Floor Box Installation:
   1. Metal Floor Boxes: Set level and flush with finished floor surface.

C. Outlet Box Installation:
   1. All devices (receptacles, switches, occupancy sensors, fire alarm devices, low voltage devices, 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) Exposed interior locations within 7 feet-0 inches of finished floor.
        3) Wet or damp locations.
        4) Direct contact with earth or concrete slabs on grade.

D. 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.

E. 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 26 0553 “Identification for Electrical Systems.”

END OF SECTION 26 0534

SECTION 26 0536 - CABLE TRAYS

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. Cable trays.
   2. Cable tray accessories.

1.3 SUBMITTALS

A. Product Data: Include for each tray type, dimensions, support points, clamps, hangers, connectors, fittings, expansion joint assemblies, accessories and finishes.

B. Shop Drawings: For each type of cable tray.
   1. Show fabrication and installation details of cable tray, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.

C. Coordination Drawings: The contractor shall be responsible for coordinating the cable tray layout with all building components (ducts, pipes, fire protection, columns, beams, walls, etc.). Make changes in cable tray direction and elevation as required. Provide floor plans and sections, drawn to scale. Include scaled cable tray layout and relationships between components and adjacent structural, electrical, and mechanical elements. Show the following:
   1. Vertical and horizontal offsets and transitions.
   2. Clearances for access above and to side of cable trays.
   3. Vertical elevation of cable trays above the floor or bottom of ceiling structure.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain cable tray components through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with the following codes and standards:
   1. NFPA 70.
   2. ASTM B 633.
   3. ASTM F 593.
   4. ASTM F 594.
   5. ASTM F 1136.

1.5 DELIVERY, STORAGE AND HANDLING

A. Store indoors to prevent water or other foreign materials from staining or adhering to cable tray. Unpack and dry wet materials before storage.

B. Steel, electrogalvanized cable tray shall be stored in a well-ventilated, dry location. Unpack and dry wet materials before storage.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes in cable tray installed outdoors.
   1. Temperature Change: 120 degrees F, ambient; 180 degrees F, material surfaces.

2.2 GENERAL REQUIREMENTS FOR CABLE TRAYS

A. Cable Trays and Accessories: Identified as defined in NFPA 70 and marked for intended location, application, and grounding.
   1. Source Limitations: Obtain cable trays and components from single manufacturer.

B. Sizes and Configurations: See the drawings for specific requirements for types, materials, sizes, and configurations in specific locations.

C. Structural Performance: See articles on individual cable tray types for specific values for the following parameters:
   1. Uniform Load Distribution: Capable of supporting a uniformly distributed load on the indicated support span when supported as a simple span and tested according to NEMA VE 2.
   2. Concentrated Load: A load applied at midpoint of span and centerline of tray.
   3. Load and Safety Factors: Applicable to both side rails and rung capacities.

2.3 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Legrand Cablofil.
   2. PW Industries.
   3. Cooper B-Line, Inc.
   4. Cope, T. J., Inc.; a subsidiary of Allied Tube & Conduit.
   5. MONO-SYSTEMS, Inc.
   6. MPHusky.
   7. Chalfont Manufacturing Company.
   8. Thomas & Betts.

2.4 LADDER-TYPE CABLE TRAYS

A. Description:
   1. Configuration: Two I-beam side rails with transverse rungs welded to side rails.
   2. Rung Spacing: **12 inches** on center.
   3. Radius-Fitting Rung Spacing: 9 inches at center of tray's width.
   4. Minimum Cable-Bearing Surface for Rungs: 7/8-inch width with radius edges.

5. No portion of the rungs shall protrude below the bottom plane of side rails.
6. Structural Performance of Each Rung: Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a200-lb (90-kg) concentrated load, when tested according to NEMA VE 1.
7. Minimum Usable Load Depth: **4 inches**
8. Straight Section Lengths: **10 feet** except where shorter lengths are required to facilitate tray assembly.
9. Width: **12 inches** unless otherwise indicated on Drawings.
10. Fitting Minimum Radius: **12 inches**
11. The maximum uniform load and the support span are indicated by the cable tray class. In the following classes the number refers to the cable tray span length (12ft or 20ft) and the letter refers to the weight (B=75lbs/ln.ft and C=100lbs/ln.ft). For low voltage only cable trays, Class 12B is typically sufficient. For power cable trays, a heavy class my be necessary. See Karl Miller for cable tray loading calculation software.
12. Class Designation: Comply with NEMA VE 1, Class 12B
13. Splicing Assemblies: Bolted type using serrated flange locknuts.
14. Hardware and Fasteners: **Steel, zinc plated**
15. Splice Plate Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.

B. Materials and Finishes:
   1. Steel:
      a. Straight Section and Fitting Side Rails and Rungs: Steel complies with the minimum mechanical properties of ASTM A 1011/A 1011M, SS, Grade 33
      b. Steel Tray Splice Plates: ASTM A 1011/A 1011M, HSLAS, Grade 50, Class 1.
      c. Fasteners: Steel complies with the minimum mechanical properties of ASTM A 510/A 510M, Grade 1008.
      d. Finish: Factory-standard primer, ready for field painting, with chromium-zinc-plated hardware according to ASTM F 1136.

C. Cable Tray Accessories:
   1. Accessories: Provide all supporting, hanging, tee, cross, level change, reducing, drop outs, and miscellaneous hardware as required for a complete and functioning installation to manufacturer's recommendations.
   2. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.
   3. Barrier Strips: Same materials and finishes as for cable tray.
   4. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

D. Cable Drop-outs ("Waterfalls"):
   1. Shall mount securely to ladder rack rails and shall maintain minimum bend radius on all cables entering or exiting the Ladder Rack.

E. Cable Fencing:
   1. Minimum 7 inches high, at 3 feet-0 inches on center for entire route of cable tray.

2.5 WELDED WIRE MESH CABLE TRAYS

A. Tray: Continuous, rigid, welded steel wire mesh cable tray with continuous top wire safe edge with T-weld.

B. Wire mesh shall be welded at all intersections.

C. Size: Depth, loading depth, and width to be as shown on drawings. Mesh to be 2 inch x 4 inch nominal.

D. Provide grounding clip for continuous grounding of tray.

E. Load Span Criteria: Install and support cable management system in accordance with span load criteria of L/240.

F. Material and Finishes:
   1. Steel:
      a. Straight Section and Fitting Side Rails and Rungs: Steel complies with the minimum mechanical properties of ASTM A 1011/A 1011M, SS, Grade 33
      b. Steel Tray Splice Plates: ASTM A 1011/A 1011M, HSLAS, Grade 50, Class 1.
      c. Fasteners: Steel complies with the minimum mechanical properties of ASTM A 510/A 510M, Grade 1008.
      d. Finish: Electrogalvanized before fabrication.
         1) Standard: Comply with ASTM B 633.
         2) Hardware: Galvanized, ASTM B 633.

G. Cable Tray Accessories:
   1. Accessories: Provide all supporting, hanging, tee, cross, level change, reducing, drop outs, and miscellaneous hardware as required for a complete and functioning installation to manufacturer's recommendations.
   2. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials Indicate required locations for barrier strips on Drawings.
   3. Barrier Strips: Same materials and finishes as for cable tray.
   4. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

2.6 WARNING SIGNS

A. Provide manufacturer's standard, permanent, legible warning label indicating the following:

> WARNING! DO NOT USE AS A WALKWAY, LADDER, OR SUPPORT FOR PERSONNEL. TO BE USED ONLY AS MECHANICAL SUPPORT FOR CABLES AND TUBING!

B. Label shall also indicate cable tray NEMA load class. Label shall be a maximum of 10' on center.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General Installation Requirements
   1. Refer to the drawings for specific cable tray routings, sizes, types, and accessories to be installed in specified locations.
   2. Cable tray shall be installed parallel and perpendicular to building structural and wall lines.
   3. Install cable tray in accessible locations only. Where portions of a cable tray route will be inaccessible, provide conduit sleeves for the duration of the inaccessible route. Conduit sleeves shall have cable capacity equal to or greater than the capacity of the cable tray being supplemented.
   4. Install in conformance with NEMA VE 2 requirements and in accordance with manufacturer's instructions.

5. Support cable tray at each connection point, at the end of each run, and at other points to maintain spacing between supports of 8 feet maximum.
6. Tray shall be electrically continuous from source to termination and shall not change elevation, direction or otherwise expose cables to travel without support.
7. All splices of tray shall be provided with splice washers, bars or springs as recommended by the manufacturer.
8. Provide bonding continuity between cable tray sections, fittings and conduit terminations in accordance with manufacturer's instructions.
9. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.
10. Remove burrs and sharp edges from cable trays.
11. Seal penetrations through fire and smoke barriers.
12. Install capped sleeves for future cables through firestop sealed cable tray penetrations of fire and smoke barriers as shown on drawings.
13. Install cable trays with sufficient space to permit access for installing cables. Install tray bottom within 12 inches of access ceiling paneling for ease of access. Adjust mounting height only momentarily for field coordination with other trades and systems as required.
14. Install cable trays according to NEMA VE 2.
15. Install cable trays as a complete system, including fasteners, hold-down clips, support systems, barrier strips, adjustable horizontal and vertical splice plates, elbows, reducers, tees, crosses, cable dropouts, adapters, covers, and bonding.
16. Install cable trays so that the tray is accessible for cable installation and all splices are accessible for inspection and adjustment.
17. Fasten cable tray supports to building structure.
18. Design fasteners and supports to carry cable tray and a concentrated load of 200 lb. Comply with requirements in Section 26 0529 "Hangers and Supports for Electrical Systems."
19. Place supports so that spans do not exceed maximum spans and provide clearances as required. Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.
20. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.
21. Install center-hung supports for single-rail trays designed for 60 versus 40 percent eccentric loading condition, with a safety factor of 3.
22. Locate and install supports according to NEMA VE 2. Do not install more than one cable tray splice between supports.
23. Make connections to equipment with flanged fittings fastened to cable trays and to equipment. Support cable trays independent of fittings. Do not carry weight of cable trays on equipment enclosure.
24. Install expansion connectors where cable trays cross building expansion joints and in cable tray runs that exceed dimensions recommended in NEMA VE 2. Space connectors and set gaps according to applicable standard.
25. The contractor shall be required to make changes in direction and elevation in order to provide a continuous cable tray routing as indicated on the construction documents and engineer approved coordination drawings. Changes in direction and elevation shall be made using manufacturer's recommended fittings.
26. Make cable tray connections using manufacturer's recommended fittings.
27. Seal penetrations through fire and smoke barriers. Comply with requirements in Section 07 8413 "Penetration Firestopping."
28. Install capped metal sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.

29. Install cable trays with enough workspace to permit access for installing cables.
30. Install permanent covers, if used, after installing cable. Install cover clamps according to NEMA VE 2.
31. Clamp covers on cable trays installed outdoors with heavy-duty clamps.
32. Install warning signs in visible locations on or near cable trays after cable tray installation.

3.2 CABLE TRAY GROUNDING

A. Ground cable trays according to NFPA 70 unless additional grounding is specified. Comply with requirements in Section 26 0526 "Grounding and Bonding for Electrical Systems."

B. Cable trays with electrical power conductors shall be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers.

C. Cable trays with single-conductor power conductors shall be bonded together with a grounding conductor run in the tray along with the power conductors and bonded to the tray at 72-inch (1800-mm) intervals. The grounding conductor shall be sized according to NFPA 70, Article 250.122, "Size of Equipment Grounding Conductors," and Article 392, "Cable Trays."

D. When using epoxy- or powder-coat painted cable trays as a grounding conductor, completely remove coating at all splice contact points or ground connector attachment. After completing splice-to-grounding-bolt attachment, repair the coated surfaces with coating materials recommended by cable tray manufacturer.

E. Bond cable trays to power source for cables contained within with bonding conductors sized according to NFPA 70, Article 250.122, "Size of Equipment Grounding Conductors."

3.3 CABLE INSTALLATION

A. In existing construction, remove inactive or dead cables from cable trays.

3.4 CONNECTIONS

A. Remove paint from all connection points before making connections. Repair paint after the connections are completed.

B. In existing construction, remove inactive or dead cables from cable tray.

C. Ground cable trays according to manufacturer's written instructions.

D. Install an insulated equipment grounding conductor with cable tray, in addition to those required by NFPA 70.

3.5 WIRE MESH TYPE CABLE TRAY

A. Cut standard straight sections to length in field.

B. Tray shall be field cut using the manufacturer’s approved cutting device and methods. Cutting device shall be an offset blade bolt cutter. The use of standard bolt cutters is strictly prohibited.

C. Bends in tray shall be accomplished by utilizing manufacturer’s cutting guides.

3.6 REQUIREMENTS FOR TELECOMMUNICATIONS SPACES

A. This section is designed to provide the contractor/vendor with a standard of quality and functionality for the installation of technology systems infrastructure. Not all procedures will be

necessary for the installation of this Project. However, this standard will be considered in force for the original response as well as for any additions or changes to this Project.

B. Telecommunications Room and Communications Space Requirements:
   1. Provide ladder rack for all telecommunications cabling in the TR(s) as shown on the drawings.
      a. Fill capacity (as designated by the manufacturer) shall not be exceeded.
      b. Utilize properly sized supports with adequate strength to exceed the maximum recommended weight capacity.
   2. Ladder rack minimum requirements are as shown on the drawings.
      a. Provide and secure ladder rack for cable support Technology Systems.
      b. Technology systems include but are not limited to:
         1) Voice/Telephone Systems.
         2) Network/Data Systems.
         3) RF Broadband Video Distribution Systems.
         4) Intercom and Central Sound Systems.
         5) Paging and Sound Masking Systems.
         6) Security Systems including CCTV, Access Control, Intrusion Detection Systems.
         7) Sound Reinforcement Systems.
         8) Audio-Visual Systems.
         9) Teleconferencing Systems.

C. Ladder Rack Installation:
   1. Horizontally mounted:
      a. Ladder rack shall mount approximately 6 inches above equipment racks, cabinets or enclosures or as indicated on the drawings.
      b. Rack mounted with a side along a backboard; mount with wall brackets; utilize threaded rod and manufacturer's bracket kits for suspension of all remaining ladder rack sections.
      c. Provide support for the ladder rack at a minimum of 5 feet on center and within 2 feet of each end of all splices, tees, elbows, bends, intersections, and transitions.
         1) Support with threaded rod and U-channel supports systems: 12 inch width, 1/2 inch ATR; 24 inch width, 5/8 inch ATR.
         2) Rod lengths over 6 feet will require a "Rod Stiffener" installation.

            a) A section of U-Channel stock is placed around the rod and stiffener clamp assemblies used to clamp to rod. Place clamps a minimum of 6 inches from the top and bottom of the rod and every 18 inches in between.
      d. Ground and bond the system in accordance with the NEC and ANSI/TIA/EIA 607.
      e. Provide side posts at 3 feet on center to both sides of the rack lengths.
      f. Provide end caps as specified.
      g. Install "waterfall" type protection for cable exit downward between rungs.
      h. Paint fittings as required to maintain aesthetic integrity of the installation.

3.7 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements.
   2. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable trays, vibrations, and thermal expansion and contraction conditions, which may cause or have caused damage.

3. Verify that there are no intruding items such as pipes, hangers, or other equipment in the cable tray.
4. Remove dust deposits, industrial process materials, trash of any description, and any blockage of tray ventilation.
5. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorque in suspect areas.
6. Check for improperly sized or installed bonding jumpers.
7. Check for missing, incorrect, or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
8. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable trays. Test entire cable tray system for continuity. Maximum allowable resistance is 1 ohm.

3.8 PROTECTION

A. Protect installed cable trays
   1. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.

END OF SECTION 26 0536

SECTION 26 0553 - 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. Warning labels and signs.
   4. Instruction signs.
   5. Equipment identification labels.
   6. 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. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch (50 by 50 by 1.3 mm), with stamped legend, punched for use with self-locking cable tie fastener.

E. Write-On Tags: Polyester tag, 0.015 inch (0.38 mm) thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.

1. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

F. Snap-Around, Color-Coding Bands (Raceways and Cables): Slit, pre-tensioned, flexible, solid-colored acrylic sleeve, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

G. Colored Adhesive Marking Tape (Raceways, Wires, and Cables): Self-adhesive plastic coated cloth tape similar to Brady 441XX or 442XX series.

H. 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.

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. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application with 1/4-inch (6.4-mm) grommets in corners for mounting, nominal 7 by 10 inches in size unless noted otherwise.

D. Metal-Backed, Butyrate Warning Signs: Weather-resistant, non-fading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch (1-mm) galvanized-steel backing; and with colors, legend, and size required for application. Provide 1/4-inch (6.4-mm) grommets in corners for mounting, nominal 10 by 14 inches in size unless noted otherwise.

E. Plasticized Card Stock Tags: Vinyl cloth with preprinted and field-printed legends to suit the application. Orange background, except as otherwise indicated, with eyelet for fastener.

F. 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.

C. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. 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 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.

3.3 RACEWAY IDENTIFICATION

A. Identify Raceways of Certain Systems with Color Banding: Band exposed and accessible raceways of the following systems for identification. Bands shall be pre-tensioned, snap-around colored plastic sleeves, colored adhesive marking tape, or a combination of the two. Make each color band 2 inches wide, completely encircling conduit and place adjacent bands of two-color markings in contact, side by side. Install bands at changes in direction, at penetrations of walls and floors and at 20-foot maximum intervals in straight runs. Apply the following colors:
1. Normal Distribution System (480/277V): Orange.
2. Normal Distribution System (208/120V): White.
3. Ground: Green.

4. Fire Alarm System: Red.
5. At contractor option, manufacturer painted EMT conduit (when EMT conduit is allowed or required to be used for the above systems), may be utilized in lieu of the banding noted above. Fittings would not have to be painted. All painting shall comply with Division 09 requirements.

B. Where conduits leave a switchboard, panelboard, motor control center, etc., identification shall be provided on each conduit indicating the load being served.

C. 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.

D. 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.

B. At each junction, pull and connection box, identify the following: with self-adhesive vinyl labels or permanent marker (color coded) neatly hand-printed. 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.

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.

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.

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 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. Outdoor Equipment: Provide engraved, laminated acrylic or melamine label.
3. 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.
4. 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.

5. Fusible Switches: Install fuse manufacturer-supplied labels inside the door of the fusible switch indicating the proper type and fuse required for replacement.
6. 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. 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

END OF SECTION 26 0553

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SECTION 26 0573 - 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, overcurrent protective device coordination 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 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 latest IEEE Standard 1584-2018, 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 and as noted herein.

C. Provide analysis of the equipment indicated on the One-Line Diagram of the drawings and as noted below:
   1. Panelboards
   2. Switchboards
   3. Starters
   4. Variable Frequency Drives (VFD's)
   5. Fused Disconnects
   6. Fused Disconnects for Motors
   7. Air Conditioning Packaged Units
   8. Control Panels: Pumps

D. Perform study starting at each metered service from the Owner. Obtain necessary information from the Owner.

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, IEEE 1584 and NFPA 70E.

B. Qualification Data: For Power System Analysis 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. First Submittal: A Short Circuit and Coordination Analysis shall be submitted at the same time as the electrical equipment shop drawings are submitted. Approval of shop drawings will not be provided until study has been submitted.

D. Second Submittals: The following submittals shall be made after system electrical equipment and associated protective devices have been reviewed and approved in the shop drawing review

stage. A Power System Study Report shall be submitted no later than six (6) weeks after the short circuit and coordination analysis and 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.

    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 and Bus Evaluation Tables.
        4) Protective Device Coordination Methodology Analysis Results and Recommendations.

        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. 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. Include written conformation from Utility of Fault Current and Associated Data.

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. Power System Analysis 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 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. Study shall include stamp or seal, date and signature of the preparing Engineer and shall be reviewed and approved by the Engineer of Record. The Power System Engineer shall be an employee of the approved Engineering firm.

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/ 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), latest software edition.
   2. Easy Power latest software edition.

2.2 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

A. Comply with IEEE 399, 242, 551, 1584 and NFPA 70E.

B. 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.

C. 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, and as required by the applicable latest edition of the National Electrical Code NFPA 70.

1. Proceed with coordination study only after relevant equipment submittals (vendor preliminary Bill of Materials and Equipment Data) have been provided. Additionally, coordinate with the Engineer of Record to facilitate this process.
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 HVAC equipment as noted previously.

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, etc. 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 the service entrance equipment 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), automatic transfer switches, generators, disconnect switches and others equipment noted herein.

D. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system. 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 with all large motors (50 HP or greater) running. Motors of lesser horsepower may also be included.

F. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with the latest edition of the following:
   1. IEEE 242 – IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems

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 other equipment noted herein.
   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 242 – IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems

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 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 the latest edition of NFPA70E, 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 (including, but not limited to, switchboards, switchgear, motor-control centers, panelboards, busway, automatic transfer switches and as noted herein) where work could be performed on energized parts.

C. Based on the latest version of IEEE 1584 do include 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. Generator Data: Where generators are provided, make every attempt to obtain the equipment's actual decrement data from the manufacturer for input to the Software Analysis Program.

G. The fault calculations and resulting arc flash hazard calculation results shall be compared for multiple scenarios (different switching operations as an example), 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. When utility fault current data is provided and believed to be truly representative (that is, not just an infinite value) the following shall be utilized:
1. A minimum calculation shall assume a minimum motor contribution (all motors off).
2. A maximum calculation shall assume the maximum amount of motors to be operating.
3. Where applicable, calculations must take into consideration the parallel operation of synchronous generators with the electric utility source.

H. Where fault current data from the utility is not available or the data provided is an infinite value and believed not to be a true representation of the actual current magnitude, two scenarios shall be analyzed to determine which produces the worst-case incident energy level.
1. Scenario 1: Based on infinite bus on primary side of utility transformer.
2. Scenario 2: Based on 50% of maximum secondary fault current at the utility transformer.

I. 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.

J. 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).

K. For equipment with a separately enclosed main device (where there are adequate physical barriers between the line side terminals of the main protective device and the attached adjacent vertical sections), calculations for incident energy and flash protection boundary shall include both the line and load side of the overcurrent main device. Separate labels shall be provided, one for the main overcurrent device and the remaining attached vertical sections.

L. When performing incident energy calculations on the line side of a main overcurrent protective device (as required per the above), the line side and load side contributions must be included in the fault calculation.

M. 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.

N. Arc flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time shall be capped at 2 seconds based on IEEE 1584.

O. 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.

P. Create and install NFPA 70E compliant labels at all switchboards, panelboards, disconnect switches, etc. and other electrical equipment as previously noted including HVAC equipment where work could be performed on energized parts.
   1. The label shall include worst-case incident energy calculated in the analysis when equipment is 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 two (2) separate labels on an overcurrent device when an ARC ENERGY REDUCTION SWITCH IS UTILIZED. This second label for this reduction switch shall include nomenclature in its heading: “VALUE AT DOWNSTREAM LOAD WITH ARC ENERGY REDUCTION SWITCH ACTIVATED.”
   3. Provide labels on the front of each individual section of floor standing and wall mounted equipment.
   4. Install labels on the front of each individual section of floor standing and wall mounted equipment.
   5. For automatic transfer switches, provide separate label with “Normal Power” heading and required information versus label with an “Emergency Power” one.

Q. 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 26 0573

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SECTION 26 0600 - 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 26 0500

SECTION 26 0923 - LIGHTING CONTROL 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. Section Includes:

1. Digital Low Voltage Lighting Control System
2. Low Voltage dimmer and wall switches.

B. Related Requirements:

1. Section 26 2726 "Wiring Devices" for manual light switches.

1.3 SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show installation details for occupancy and light-level sensors.

1. Installation details.
2. Wiring Schematics
3. Programming information

C. For products used in lieu of basis of design, submit a lighting plan clearly marked by manufacturer showing proper product, location and orientation of each sensor.

D. Operation and Maintenance Data: For each type of lighting control device to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Products supplied shall be from a single manufacturer that has been continuously involved in manufacturing of lighting controls for a minimum of five (5) years. Mixing of manufacturers shall not be allowed.

B. All components shall be U.L. listed, offer a five (5) year warranty and meet all state and local applicable code requirements.

1.5 COORDINATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including luminaires, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.

PART 2 - **PRODUCTS**

2.1 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables."

C. Category 5e, CMP, UTP cabling and terminations between relay panels, modules, sensors, and control stations. Provide wiring, terminations, and connections between modules, sensors, and control stations as recommended per manufacturer's installation instructions.

2.2 DIGITAL LOW VOLTAGE LIGHTING CONTROL SYSTEM

A. Basis-of-Design Product: Subject to compliance with requirements, UL listed under UL916, provide as listed per each sensor type or comparable product by one of the following

1. Wattsopper Digital Lighting Management
2. nLighting
3. Eaton Room Controller

B. Room Controller and Isolated Relay Interface
Room Controller (Tag RC) shall be capable of normal and emergency power, encompasses (1), (2), or three (3) single pole relays with a total device rating of 20A. Controller includes Plug n' Go automatic system configuration. Each port provides a daisy-chained connection for up to 48 local communication devices, 64 loads, and 4 series room controllers. Communicating devices (occupancy sensors, daylight sensors, etc.) connected via standard Cat5e cable with RJ45 connectors. Communicating devices are auto-configured and can be connected in any order. As an option the room controller can supply one (1) 0-10 volt output per relay through a class 2 dimming signal that sinks up to 100mA per channel (50 if each ballast sources 2mA). This room controller mounts to a 4" x 4" x 2 1/8" deep electrical junction box for easy installation.
Isolated Relay Interface (Tag IR) shall be capable of integrating digital lighting management system with integrated third party controls, and HVAC system by operation of single-pole, double throw isolated relay with normally open, normally closed and common output, networkable, Wattstopper #LMRL-100.

C. Two (2) Button Switch (Tag: Refer to symbols Sheet): Wall mounted, low voltage, on/off two (2) button Wall switch

D. One (1) Button Dimming Switch (Tag: Refer to symbols sheet): Single function, wall mounted, low voltage dimming switch, Confirm dimmer is compatible with LED drivers.

E. Occupancy Sensor (Tag OD) - Dual Technology PIR/Ultrasonic Sensor Type: 360-degree coverage,ceiling mounted; detects occupants in coverage area by their heat and movement.

F. Daylighting Sensor (Tag DS) – Automatically switch or dim up to three zones

G. Provide wireless configuration tool with USB, Wattstopper #LMCT-100-2.

2.3 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables."

C. Category 5e, CMP, UTP cabling and terminations between relay panels, modules, sensors, and control stations. Provide wiring, terminations, and connections between modules, sensors, and control stations as recommended per manufacturer’s installation instructions.

PART 3 - **EXECUTION**

3.1 SENSOR INSTALLATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.

B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions. Ultrasonic sensors to remain minimum of 6 feet from supply air.

3.2 WIRING INSTALLATION

A. Wiring Method: Comply with Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch (13 mm).

B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated. Components

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.3 IDENTIFICATION

A. Identify components and power and control wiring according to Section 26 0553 "Identification for Electrical Systems."

1. Identify controlled circuits in lighting contactors.
2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Verify occupancy sensors operate per design intent.

B. Lighting control devices will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.

3.6 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 26 0923

SECTION 26 2416 - 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. Lighting and appliance branch-circuit panelboards.

1.3 SUBMITTALS

A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings and finishes.

B. Shop Drawings: For each panelboard and related equipment.

   1. Include dimensioned plans, elevations, sections and details. Show tabulations of installed devices, equipment features and ratings such as voltage, main bus ampacity, integrated short circuit ampere rating, overcurrent protective device arrangement and sizes.
   2. Include make and model of the main breaker and trip unit. Include time-current coordination curves for each type and rating of main overcurrent protective device included in panelboards. Submit electronically compatible with SKM PowerTOOL's software; include selectable ranges for each type of main overcurrent protective device.
   3. 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.
   4. 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.
   5. 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.

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.

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

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
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.

4. 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.

D. 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.

E. 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 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. ABB
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. 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.

D. 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.

E. 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.

F. Box: Box shall be nominally 5-3/4 inches deep by 20 inches wide.

G. 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.

H. 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. 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.

I. 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.

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.

E. Install filler plates in unused spaces.

F. 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 26 2416

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SECTION 26 2419 - MOTOR CONTROL

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. Combination magnetic motor starters.

1.3 SUBMITTALS

A. Product Data: For each type of controller and each type of MCC. Include shipping and operating weights, features, performance, electrical ratings, operating characteristics, and furnished specialties and accessories.

B. Shop Drawings: Include dimensioned plans, elevations, and sections; and conduit entry locations and sizes, mounting arrangements, and details, including required clearances and service space around equipment.
   1. Show tabulations of installed devices, equipment features, and ratings. Include the following:
      a. Each installed unit's type and details.
      b. Factory-installed devices.
      c. Enclosure types and details.
      d. Nameplate legends.
      e. Each starter and switch in the motor control center elevation shall have a nameplate with the same mark (designation) as indicated on the construction documents. Refer to Specification Section 26 0553.
      f. Short circuit current (withstand) rating of complete MCC and for bus structure and each unit.
      g. Features, characteristics, ratings and factory settings of each installed controller and feeder device, and installed devices.
      h. Specified optional features and accessories.
   2. Connection Wiring Diagrams: For power, signal, and control wiring for each installed controller.
   3. Nameplate legends.
   4. Vertical and horizontal bus capacities.
   5. Features, characteristics, ratings, and factory settings of each installed unit.

C. Warranty: Sample of special warranty.

D. Submit manufacturer's instructions under provisions of Section 26 0500.

1.4 OPERATION AND MAINTENANCE DATA

A. Operation and Maintenance Data: Include data for all installed devices, and components to include in operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data" include the following:

1. Manufacturer's Record Drawings: Include field modifications incorporated during construction by manufacturer, Contractor, or both.
2. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.
3. Manufacturer's written instructions for setting field-adjustable overload relays.
4. Manufacturer's written instructions for testing, adjusting and reprogramming reduced-voltage, solid-state controllers.
5. Manufacturer's written instructions for testing, adjusting and reprogramming microprocessor control modules.
6. Manufacturer's written instructions for setting field-adjustable timers, controls and status and alarm points.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site.

B. Deliver in 60 inch maximum width shipping splits, or per site restrictions, individually wrapped for protection, and mounted on shipping skids.

C. Store and protect products.

D. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from fumes, dirt, water, construction debris, traffic and physical damage.

E. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to motor control center components, enclosure and finish.

PART 2 - PRODUCTS

2.1 Manufacturers

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton
2. ABB
3. Square D Co.
4. Siemens.

2.2 MAGNETIC MOTOR STARTERS

A. Magnetic Motor Starters: NEMA ICS 2; AC general-purpose Class A magnetic controller for induction motors rated in horsepower.

B. Full Voltage Starting: Non-reversing type unless otherwise indicated.

C. Coil Operating Voltage: 120 volts, 60 Hertz, obtained from integral control power transformer of sufficient capacity to operate connected pilot, indicating, and control devices, plus 100 percent spare capacity.

D. Size: NEMA ICS 2; size as shown on the drawings.

E. Overload Relay:
1. Adjustable Overload Relay: Dip switch selectable for motor running overload protection with NEMA ICS 2, Class 10 tripping characteristic, and selected to protect motor against

voltage and current unbalance and single phasing. Provide relay with Class II ground-fault protection, phase loss protection, with start and run delays to prevent nuisance trip on starting.

F. Enclosure: NEMA ICS 6 Type 1.

G. Combination Motor Starters: Combine motor starters with disconnect switch in common enclosure. Provide with disconnecting means as indicated on drawings.

H. Auxiliary Contacts: NEMA ICS 2; two normally open, field convertible contacts in addition to seal-in contact.

I. Pushbuttons: NEMA ICS 2; START/STOP in front cover.

J. LED Indicating Lights: NEMA ICS 2; RUN: red in front cover; OFF: green in front cover.

K. Selector Switches: NEMA ICS 2; HAND/OFF/AUTO, in front cover.

L. Relays: NEMA ICS 2;

M. Control Power Transformers: 120 volt fused secondary, fused primary, minimum VA as scheduled:
   1. Size 1: 100 VA.
   2. Size 2: 100 VA.
   3. Size 3: 150 VA.
   4. Size 4: 300 VA.
   5. Size 5: 300 VA.
   6. Size 6: 300 VA.

2.3 CONTROLLER OVER-CURRENT PROTECTION AND DISCONNECTING MEANS

A. Non-fusible Switch Assemblies: 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.

B. Fusible Switch Assemblies: NEMA KS 1, 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: Provide with Class' R' rejection clips. Select and size fuses to provide Type 2 protection according to IEC 947-4-1, as certified by a nationally recognized testing laboratory.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install motor control equipment in accordance with manufacturer's instructions on concrete bases.

B. Install fuses in fusible switches.

C. Set field-adjustable switches and circuit-breaker trip ranges per drawings or Engineer’s instructions.

D. Motor Data: Provide neatly typed label inside each motor starter enclosure door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor and voltage/phase rating.

E. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.

END OF SECTION 26 2419

SECTION 26 2726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Receptacles, receptacles with integral GFCI and associated device plates.
2. Twist-locking receptacles.
3. USB charger devices.
4. Cord and plug sets.
5. Floor service outlets, poke-through assemblies

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

D. RFI: Radio-frequency interference.

E. TVSS: Transient voltage surge suppressor.

F. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

A. Product Data: For each wiring device type.

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.

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 USB CHARGER DEVICES

A. Tamper-Resistant, USB Charger Receptacles: 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, UL 1310, and FS W-C-596.

1. Products: Subject to compliance with requirements, provide one of the following (catalog numbers provide general type and may vary based upon receptacle quantities):

   a. Hubbell: USB20X2.
   b. Pass & Seymor: TR5362USB.
   c. Leviton: T5832.

2. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap.
3. USB Receptacles: Single Type A and Type C (one of each).
4. Line Voltage Receptacles: Dual, two pole, three wire, and self-grounding.

2.5 TWIST-LOCKING RECEPTACLES

A. Locking or special type to be of NEMA configuration called out for the specific application on the drawings.

B. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Cooper: L520R.
   b. Hubbell: HBL2310.
   c. Leviton: 2310.
   d. Pass & Seymour: L520-R.

2.6 CORD AND PLUG SETS

A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.

1. Cord: Rubber-insulated, stranded-copper conductors with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
2. Plug: Male configuration with nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.7 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).

2.8 WALL PLATES

A. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: Smooth, high-impact thermoplastic
3. Material for Unfinished Spaces: Galvanized steel
4. Material for Damp Locations: Thermoplastic 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.

2.9 POKE-THROUGH ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hubbell.
2. Walker.
3. Wiremold.
4. Thomas & Betts.

B. Description: Factory-fabricated and -wired assembly of below-floor junction box with multi-channeled, through-floor raceway/firestop unit and detachable matching floor service outlet assembly.

1. Service Outlet Assembly: Flush type with two duplex receptacles and space for two RJ-45 jacks.
2. Size: Selected to fit nominal 4-inch (100-mm) cored holes in floor and matched to floor thickness.
3. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
4. Closure Plug: Arranged to close unused 4-inch (100-mm) cored openings and reestablish fire rating of floor.
5. Wiring Raceways and Compartments: For a minimum of four No. 12 THHN AWG conductors and a minimum of two 4-pair, Category 6A voice and data communication cables.
6. Cover Options: Color coordinated with architect.

C. 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.

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. 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.

H. 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 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.

3.4 CLEANING

A. General: Internally clean devices, device outlet boxes, and enclosures. Replace stained or improperly painted wall plates or devices.

END OF SECTION 26 2726

PART 1 -

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SECTION 26 2813 - FUSES

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. Fuses.

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. Source Limitations: All fuses shall be the product of a single manufacturer.

B. Comply with NEMA FU 1 and NFPA 70.

1.5 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 degrees F (5 degrees C) or more than 100 degrees F (38 degrees C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Bussmann, Inc.
2. Edison Cooper, Inc.
3. Mersen.
4. Littelfuse, Inc.

2.2 FUSES

A. Characteristics: NEMA FU 1 nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

B. Cartridge Fuses: Cartridge fuses shall be as described below and shall have a minimum interrupting rating of 200,000 symmetrical amperes for the a.c. voltage at which they are rated.

1. Fuses rated less than or equal to 200 amperes (not including control circuits): Provide UL class RK-5 fuses.
2. Fuses rated greater than 200 amperes and less than or equal to 600 amperes: Provide UL class RK-1 dual element time delay fuses.
3. Fuses rated above 600 amperes: Provide UL class L dual element time delay fuses.
4. Control circuit fuses: Provide UL class CC (time delay) fuses.
5. Where the Drawings show a specific fuse type, the Drawings shall supersede the above types.
6. Renewable fuses will not be used.
7. As much as possible, equipment should be specified with fuse holders that will accept fuses dimensionally the same as Class H fuses.
8. A box to store fuses will be required for fuses over 400 amps. The box shall be a metal box, designed to store fuses, mounted in a highly visible location, and labeled appropriately.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

3.2 INSTALLATION

A. Install fuses in fusible devices in accordance with manufacturer instructions. Arrange fuses such that label and rating information is readable without removing fuse.

END OF SECTION 26 2813

SECTION 26 2816 - 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.

1.3 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.

1.4 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.

1.5 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. ABB.
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.

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 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 26 2816

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SECTION 26 2923 - VARIABLE-FREQUENCY DRIVES

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 AC Motor Variable Frequency Drives rated 600 V and less.

1.3 REFERENCES

A. ANSI/UL Standard 508.

B. ANSI/NEMA ICS 6 - Enclosures for Industrial Controls and Systems.

C. IEEE Standard 519-1981 - Guide for Harmonic Control and Reactive Compensation of Static Power Converters.

D. FCC Rules and Regulations, Part 15, Subpart J - Radio Frequency Interference.

E. NEMA ICS 7.1 - Safety Standards for Construction and Guide for Selection, Installation, and Operation of Adjustable Speed Drive Systems; National Electrical Manufacturers Association.

F. NEMA ICS 7 - Industrial Control and Systems: Adjustable-Speed Drives; National Electrical Manufacturers Association.

G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); National Electrical Manufacturers Association.

H. NFPA 70 - National Electrical Code; National Fire Protection Association.

1.4 DEFINITIONS

A. BAS: Building automation system.

B. CPT: Control power transformer.

C. EMI: Electromagnetic interference.

D. IGBT: Insulated-gate bipolar transistor.

E. LAN: Local area network.

F. LED: Light-emitting diode.

G. MCP: Motor-circuit protector.

H. NC: Normally closed.

I. NO: Normally open.

J. OCPD: Overcurrent protective device.

K. PCC: Point of common coupling.

L. PID: Control action, proportional plus integral plus derivative.

M. PWM: Pulse-width modulated.

N. RFI: Radio-frequency interference.

O. TDD: Total demand (harmonic current) distortion.

P. THD(V): Total harmonic voltage demand.

Q. VFD: Variable-frequency drive.

1.5 SUBMITTALS

A. Submit shop drawing and product data in accordance with Conditions of Contract, Division 01 and Division 26 Specifications.

B. Product Data: Provide catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details.

C. Shop Drawings: Indicate front and side views of enclosures with overall dimensions and weights shown; conduit entrance locations and requirements; and nameplate legends.

D. Test Reports: Indicate field test and inspection procedures and test results.

E. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

F. Manufacturer's Field Reports: Indicate start-up inspection findings.

G. Operation Data: NEMA ICS 7.1. Include instructions for starting and operating controllers, and describe operating limits that may result in hazardous or unsafe conditions.

H. Maintenance Data: NEMA ICS 7.1. Include routine preventive maintenance schedule.

I. Coordination Drawings: Prepare floor plan coordination drawings drawn to scale that identify the arrangement of the new VFD’s to be provided in relationship to existing equipment and elements within the existing electrical room.

1.6 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data in accordance with Conditions of Contract, Division 01 and Division 26 Specifications prior to final project closeout.

B. Operation and Maintenance Data: For VFDs to include in emergency, operation and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data" include the following:

1. Manufacturer's written instructions for testing and adjusting thermal-magnetic circuit breaker and MCP trip settings.
2. Manufacturer's written instructions for setting field-adjustable overload relays.
3. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
4. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.
5. Operation Data: NEMA ICS 7.1. Include instructions for starting and operating controllers and describe operating limits that may result in hazardous or unsafe conditions.
6. Maintenance Data: NEMA ICS 7.1. Include routine preventive maintenance schedule.

C. Shop Drawings for each VFD.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Provide VFD's from manufacturers regularly engaged in the manufacture of equipment of the types and capacities indicated, with such products in satisfactory use in similar service for not less than 5 years. Manufacturer shall maintain, within 200 miles of the project site, a service center capable of providing training, parts and emergency maintenance and repairs.

B. Single-source Responsibility: Obtain VFD's from a single manufacturer. Manufacturer must have a minimum of 25 years of documented experience, specializing in variable frequency drives.

C. The drive manufacturing facility shall be ISO 9001 and 14001 certified

D. The drive shall be UL listed.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site in accordance with Conditions of Contract, Division 01 and Division 26 Specifications.

B. Accept drives on-site in original packing. Inspect for damage.

C. Store in a clean and dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect each drive from dirt, water, construction debris and traffic.

D. Handle in accordance with manufacturer's written instructions. Lift only with lugs approved for the purpose. Handle carefully to avoid damage.

1.9 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Power Fuses: Equal to three (3) of each size and type.
2. Control Power Fuses: Equal to two (2) of each size and type.
3. Air filter: Equal to two (2) of each size.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace VFDs that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five (5) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Manufacturer:

1. Toshiba; Model Q9 Plus:

2. ABB; Model ACH580:

3. Yaskawa; Model HV600

B. General Requirements for VFDs: Comply with NEMA ICS 7, NEMA ICS 61800-2 and UL 508C.

C. Application: Variable torque.

D. Variable Frequency Controllers: Enclosed controllers suitable for operating the indicated loads, in conformance with requirements of NEMA ICS 7. Select unspecified features and options in accordance with NEMA ICS 3.1.

1. Employ microprocessor-based inverter logic isolated from power circuits.
2. Employ pulse-width-modulated inverter system.
3. Include a DC link reactor for reduction of harmonic distortion.
4. The controller, and all associated components, shall be supplied by a single vendor.
5. The controller will be operating a variable volume fan motor, or water pump motor for HVAC application.
6. System voltage shall be indicated on front of VFD, using minimum of 1-inch high letters.

E. Enclosures: NEMA 250, Type 1, suitable for equipment application in places regularly open to the public. No disconnects in VFD cabinet. Disconnect must be in separate enclosure.

2.2 OPERATING REQUIREMENTS

A. Rated Input Voltage for motors rated below 40 HP: 200 volts, three phase, 60 Hertz, with a voltage tolerance of +/- 10% and a frequency tolerance of +/- 2 Hz.

B. B. Rated Output: Output frequency shall vary between 0.1 Hz and 400 Hz. Frequency resolution shall be 0.01 Hz digital and 0.03 Hz analog with an accuracy of +/-0.2% of maximum frequency at 25 degrees Celsius. Maximum voltage frequency shall be adjustable from 25 Hz to 400 Hz. Voltage boost shall be adjustable from 0% to 30% with starting frequency adjustable from 0 Hz to 10 Hz. The output current shall be 100% continuous and 110% for 60 seconds, based on NEC table 430-150 (Full-Load Current, Three-Phase Alternating Current Motors) for 200 volts or 460 volts.

C. The controller shall contain three critical frequency jump points with individual bandwidth. Upper and lower frequency limits shall be capable of being varied.

D. The PWM carrier frequency shall be adjustable from 5000 Hz to 15000 Hz.

E. The drive shall contain two separate acceleration/deceleration times (0.1 to 6000 seconds) with a choice of linear, S, or C curves. The drive shall have a standard dynamic electric braking for motors rated 30 HP or below. The drive shall restart into a rotating motor by sensing the coasting motor speed and matching that frequency. The drive shall have adjustable soft stall (10%-150%) and adjustable electronic overload protection (10%-100%).

F. The drive shall have external fault input, be capable of re-setting faults remotely and locally.

G. Input Signal:
1. 0 to 10 v DC
2. 0 to 5 v DC
3. 4 to 20 mA DC

H. Manual bypass is not required on VFD unless indicated on bid documents.

2.3 HARMONICS

A. Reference IEEE 519-2014 Total Demand Distortion (TDD) limit at the PCC (point of common coupling). VFD supplier must provide harmonic calculations to show compliance with IEEE 519-2014.

B. VFDs provided shall have 5% reactor (or DC choke) as integral to the VFD.

C. Additional harmonic mitigation equipment in order to achieve compliance with IEEE 519-2014 shall include, but not be limited to, the following:
   1. 1. 5% THD passive harmonic filter with contactor. The passive harmonic filter shall be mounted in the same enclosure as the drive.
   2. A capacitor drop-out contactor shall be included to open at reduced loads.
   3. Active front end “ULH” technology the incorporates DC bus capacitors, IGBTs, LCL filtering, and LCL contactor. Maintain unity power factor at full load while complying with IEEE 519-2014.VFDs that do not utilize this technology are not allowed.
   4. VFDs that cannot produce an output voltage that is equal to the motor nameplate voltage while operating at full speed are not allowed

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, surfaces, and substrates to receive VFDs, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine VFD before installation. Reject VFDs that are wet, moisture damaged or mold damaged.

C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFD installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install in accordance with NEMA ICS 7.1, manufacturer's instructions, and per drawings.

B. Tighten accessible connections and mechanical fasteners after placing controller.

C. Provide engraved plastic nameplates; refer to Section 260553 for product requirements and location.

D. The ground wire should be of the same size as the power conductors from the motor to the VFD and from the VFD to the source.

E. Neatly type label inside each motor controller door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating. Place in clear plastic holder.

F. The service disconnect switch must be installed on the line side of the VFD. The disconnect must be in a separate enclosure from the VFD. If conditions do not allow this disconnect to be located near the motor within NEC requirements, then a second remote disconnect may be required at the motor. Consult the project manager or University Engineer if this condition arises. All remote disconnects must be provided with auxiliary contacts hardwired to VFD safety circuit to shut down VFD when disconnect is opened. This may affect warranty on the drive so every attempt should be taken to install it per these design guidelines.

3.3 IDENTIFICATION

A. Identify VFDs, components, and control wiring. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

B. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.

C. Label each VFD with engraved nameplate.

D. Label each enclosure-mounted control and pilot device.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to be present at start up and inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Prior to initial energization, provide the service of the manufacturer's field representative to prepare and start controllers.

3.5 ADJUSTING

A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

B. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to six times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Engineer before increasing settings.

3.6 Maintenance

A. Furnish two extra of each air filter.

B. Provide service and maintenance of controllers for one year from Date of Substantial Completion.

END OF SECTION 26 2923

SECTION 26 5100 - LIGHTING

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 26 0923 "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 driver housing if provided.

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 LEDs
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.

1.4 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.

1.5 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.

1.6 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.

1.7 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 exit signs: 5 years from date of substation completion.

C. Warranty Period for Luminaires: 5 from date of substantial completion.

D. Warranty Period for Poles: 3 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. Driver compartments shall be accessible from below the ceiling.

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.

D. Exterior Luminaires: Housings shall be rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Doors shall be removable for cleaning or replacing lenses, designed to disconnect driver when door opens.

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 Luminaire Schedule for color temperature of the luminaires.

B. Color changing LED chip arrays shall have chip colors as noted on the Luminaire Schedule.

C. LED chips shall be wired so that operation of chip array is not prohibited by failure of one chip.

D. 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. 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.

1.2 EMERGENCY LIGHTING UNITS

A. General Requirements for Emergency Lighting Units: Self-contained units complying with UL 924.

1. Battery: Sealed, maintenance-free, lead-acid type.
2. Charger: Fully automatic, solid-state type with sealed transfer relay.

3. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
6. 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 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. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.

F. 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.

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, and reinstall.

C. 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.

D. 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.

E. When installing luminaires, the contractor shall use the luminaire manufacturer's mounting hardware and follow all manufacturer's installation direction.

F. 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.

G. All recessed downlights shall have self-flanged reflectors unless otherwise noted.

H. When luminaires are installed in continuous rows of 2 or more, luminaires shall be approved for use as wireway.

I. Raise and set poles using web fabric slings (not chain or cable), or non-chafing ropes.

J. 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.

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. Illumination Observations: Verify normal operation of luminaires after installing luminaires and energizing circuits with normal power source.

C. 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. 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.

B. Inspect each installed luminaire for damage. Replace damaged luminaires and components.

END OF SECTION 26 5100

SECTION 28 3111 - 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.

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, notification devices and circuits, monitoring devices and circuits, power supplies, batteries, auxiliary devices and control circuits for other building systems such as dampers, magnetic door hold open devices, fan shut down, elevator recall, etc. 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 voltage drop calculations for notification appliance circuits.
5. Include battery-size calculations including total available capacity, used capacity and future capacity available.
6. 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.
7. 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.
8. Manufacturer wiring requirements, such as size, type and manufacturer.
9. Photocopy of NICET certification of person overseeing the preparation of fire alarm drawings, shop drawings, installation and testing.
10. 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 alarm systems by fire alarm system manufacturer specified and selected. Installation shall be by personnel certified by NICET as fire-alarm Level III technician.

C. Source Limitations for Fire-Alarm System and Components: Obtain system from single source from single manufacturer. Components shall be compatible with, and operate as an extension of existing system.

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.

B. Alarm Indication: By synchronized sounding of horns and synchronized flashing of strobes. Horn and visual signals shall be synchronized throughout the facility.

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. Subject to compliance with requirements, provide products from a single source. Approved manufacturers include the following:

1. Honeywell.

B. 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. Manual Fire Alarm Boxes:

1. Comply with UL 38.

2. Boxes shall be directly connected to a SLC loop and finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
3. Double-action mechanism requiring two actions to initiate an alarm pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
4. Station Reset: Key- or wrench-operated switch.

B. 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.

C. Duct Smoke Detectors:

1. Comply with UL 268A.
2. The smoke detector housing shall accommodate an intelligent photoelectric smoke detector having the same features specified for standard smoke detectors with the following additional features required below.
3. Provide sampling tubes and mounting hardware to match the duct to which it is attached. Sampling tube design and dimensions shall be as recommended by manufacturer for specific duct size, air velocity and installation conditions where applied. Where the detector housing is larger than the duct height, the Contractor shall fabricate a mounting bracket for the detector and attach according to the fire alarm manufacturer’s recommendations.
4. 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.
5. Remote Indication: Provide a remote LED indicator device if detector is not visible from a floor standing position. If detector is located above a suspended ceiling, mount remote indicator in ceiling directly below detector with a white single-gang faceplate, labeled to indicate device type and mechanical equipment being monitored.

D. Heat Detectors:

1. Comply with UL 521.
2. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 degrees F or a rate of rise that exceeds 15 degrees F per minute unless otherwise indicated.
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 NOTIFICATION APPLIANCES

A. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated and with screw terminals for system connections.

B. All wall-mounted audible, visual and combination notification devices shall be red] in color, with white lettering.

C. All ceiling-mounted audible, visual and combination notification devices shall be white in color, with red lettering.

D. Audio Horn Devices:

1. Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille.
2. Device shall be capable of providing a ‘high’ and ‘low’ dBA setting via an integral selector switch.
3. Comply with UL 464.
4. Horns shall produce a sound-pressure level of 85 dBA, measured 10 feet from the horn, using the coded signal prescribed in UL 464 test protocol. Sound pressure levels shall not exceed 120dBA in an occupied area.

E. Visual Notification Appliances:

1. Xenon strobe lights or equivalent in compliance with UL 1971 and ADAAG with clear or nominal clear lens for fire alarm systems
2. The maximum pulse duration shall be two-tenths of one second (0.2 second) with a maximum duty cycle of 40 percent. The flash rate shall be 1 Hertz.
3. Visual alarm notification appliances shall be flash in a temporal pattern and fully synchronized with all other units.
4. Rated Light Output:

    a. 15/30/75/110 Candela, selectable in the field, as indicated on drawings.

5. Mounting: As indicated on drawings.
6. Strobe Leads: Factory connected to screw terminals.

F. Combination Audible/Visual Notification Appliances:

1. Single device with integral audible and visual notification, meeting the requirements for each component (audible and visual) per this specification.

2.4 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.

2.5 NOTIFICATION APPLIANCE CIRCUIT EXTENDER PANELS

A. This Contractor and Vendor shall be responsible for furnishing and installing notification appliance circuit extender panels as necessary to provide remote power supply for notification appliance circuits, based on calculations performed by the Vendor.

B. Notification appliance circuit extender panels may be installed only in back-of-house areas such as janitor, electrical, mechanical and telecommunications closets. Coordinate final locations with Architect/Engineer prior to rough-in where not indicated on drawings. Indicate locations of extender panels on shop drawing submittals.

C. Notification appliance circuit extender panels shall be self-contained remote power supplies with batteries and charger mounted in a surface or recessed lockable cabinet. Manufacturer shall match fire alarm control panel.

D. Battery capacity shall be sufficient for operation for 24 hours of non-alarm state, followed by alarm for 5 minutes.

E. Notification appliance circuit extender panels shall be provided with 25 percent spare capacity for future devices.

F. Power for notification appliance extender panels shall be from a 120VAC circuit supplied by the nearest panelboard. Extend two #12 conductors and 1#12 ground in 3/4 inch conduit to each notification appliance circuit extender panel from a dedicated 20A, single pole circuit breaker.

Provide red handle-lock device for each circuit breaker serving notification appliance extender panels.

2.6 WIRING

A. All fire alarm wiring and cables shall be furnished and installed by the Contractor.

B. 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.

C. 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. Connecting new equipment to existing monitoring equipment at the supervising station.
3. 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.
4. 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. Do not install pull stations, fire alarm annunciators and signaling appliances before all dust producing construction in the area has ceased.
b. 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 notify the Engineer to coordinate a different acceptable location.
c. 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.
d. 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.

e. 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.

2. Manual Fire Alarm Boxes:

a. Mount semi-flush in recessed back boxes, installed 48 inches above the finished floor.

3. 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. Provide access panels as required. Coordinate with General Contractor.
c. Provide a smoke detector at each Fire Alarm Panel and Notification Appliance Circuit Extender Panel location whether shown on drawings or not.
d. Smoke detectors must be located at least 3 feet-0 inches from each supply air diffuser and return grille.
e. Smoke detectors shall be installed at least 12 inches from any part of a lighting fixture.

4. Duct Smoke Detectors:

a. Duct smoke detectors with respective sampling tubes shall be installed on the duct where shown on drawings in compliance with manufacturer's requirements. Sampling tubes shall extend the full width of the duct. All duct penetrations shall be sealed air-tight.

5. 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. Notification Appliance Devices:

1. Devices shall be located where shown on drawings.
2. Wall mounted devices shall be installed on flush-mounted backboxes.
3. Ceiling mounted devices shall be installed flush with ceiling, centered within ceiling tile if installed in a grid-type system. Devices installed within hard ceilings shall be arranged in a neat and uniform pattern.

4. Where devices are to be installed in a location having a ceiling exceeding a 30 foot-0 inch height, provide stem-mounting device and support hardware, installed such that the entire device is below 30 feet-0 inches.

F. 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.

G. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.

H. Device Location-Indicating Lights: Locate in public space near the device they monitor.

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. Wiring shall be installed in conduit from devices to the accessible ceiling. Exposed plenum-rated cable (FPLP) 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).

D. 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.

E. Notification appliance circuits shall not span floors.

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. DC Power Supply.
6. 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. Panel/Annunciator Alarm, Trouble, Supervisory Indication:

1. Respective system Alarm, Trouble or Supervisory LED indicator light shall cycle on/off at the following locations:

   a. Fire Alarm Control Panel.
   b. Remote Annunciator Locations.

2. Event date, time and type of occurrence shall be recorded within the Fire Alarm**.**

C. Fire Alarm Visual Alarm Sequence:

1. Visual alarms throughout the building shall flash. Strobes within the building shall be synchronized.
2. Visual alarms within the floor where the alarm signal was initiated along with the adjacent areas and floors shall flash. Strobes within the building shall be synchronized.

D. Fire Alarm Audible Alarm Sequence:

1. Audible alarms throughout the building shall sound.
2. Audible alarms within the floor where the alarm signal was initiated along with the adjacent areas and floor shall sound.

E. Air Handling Unit Shutdown Sequence:

1. Utilizing addressable relays, the fire alarm system shall directly shut down the air handling units through the each unit's local motor controller.
2. All air handling units shall simultaneously shutdown throughout the building.
3. Once alarm state has been reset, air handling units shall automatically be re-energized and resume normal operation.

F. Smoke Damper Sequence:

1. Utilizing an addressable relay, the power connection to smoke and/or fire/smoke dampers shall be interrupted, allowing them to close. Coordinate all interconnection requirements with the mechanical contractor. All wiring between smoke dampers and any HVAC equipment shall be part of division 26/28. All smoke dampers shall be driven open whenever their associated air handling unit is operating and shall be driven tightly closed whenever the air handling unit is off. This shall be accomplished via hardwire interlock with the air handling unit start circuit.
2. In the event a smoke damper is located in a main air duct and closure of this damper will completely block airflow to the ductwork system being served by that particular air handling unit, the smoke damper sequence shall also initiate the air handling unit shutdown sequence for that unit.
3. If all of the smoke and/or fire/smoke dampers associated with a particular air handling unit are closed, the air handling unit shutdown sequence shall be initiated for that unit.
4. All smoke and/or fire/smoke dampers shall be closed throughout the building.

G. Sound Masking System Shutdown Sequence:

1. Utilizing addressable relays or twisted pair conductor interface, the signal source shall be disconnected to shutdown all sound masking systems. Alternatively, the amplifiers may be de-energized. Coordinate all interconnection and interface requirements with the masking system supplier at all equipment locations.

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.

END OF SECTION 28 3111

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UNIVERSITY *of* MISSOURI

ENVIRONMENTAL HEALTH AND SAFETY

APPENDIX A

Hazardous Building Material Survey
Lottes Health Sciences Library Renovation
CP211852
02-28-2023

To: Jody Miller
Planning Design & Construction

From: Rudy Zachary
Environmental Health & Safety

MU EHS has completed a Hazardous Building Material Survey of building materials within identified rooms of the Lottes Health Sciences Library. The survey was conducted to determine the presence of Hazardous Building Materials that will be impacted by the planned renovations to each floor.

This survey was conducted by Rudy Zachary (Missouri Asbestos Inspector #14679, expires 11/01/2023). This survey was also conducted to satisfy the requirements of 40CFR 61, subpart M, which stipulates that all buildings be "thoroughly inspected" for Asbestos before the commencement of renovation or demolition activities.

Gray sealant on HVAC Duct Sections above suspended ceiling tiles is positive for Asbestos. The White Spray-on Coating present on the Sink within room HSL210 also tested positive for Asbestos.

Project Scope

The project scope calls for the remodeling of all floors within the library which will include, partial demolition of identified wall sections, replacement of existing carpet, repair and repainting of wall sections, modifications to existing electrical/data along with potential HVAC and Plumbing modifications.

Field Observations

Wall sections identified for demolition on all three floors are of Drywall construction, representative samples of; Drywall and Joint Compound present were collected from wall sections throughout the project space, analysis results of the materials indicate that they are negative for Asbestos. Plaster present on the damaged wall section of the 3rd floor is negative for Asbestos. Tan adhesive behind acoustical panels on wall sections within room HSL201 is negative for Asbestos.

Flooring thought the project area is mostly carpet squares installed directly onto the concrete subfloor in most rooms, some rooms have 12" white floor tiles beneath carpet squares that is adhered with black mastic to the subfloor, samples of both the tiles and associated mastic tested negative for Asbestos. White 12" tiles present within Janitorial closets and small storage areas along with black mastic also tested negative for Asbestos. Flooring within restrooms identified for demolition are 1" square Ceramic tiles, if during removal any additional adhesives or mastic is detected beneath the tiles it is recommended that the material be tested for Asbestos prior to any disposal.

Ceilings within office areas identified for modifications are non-asbestos containing 24"X24" tiles suspended in a metal grid from the deck above. Ceilings within Restrooms are of drywall construction. HVAC Duct sections above suspended ceiling tiles are mostly bare metal with some sections having a fiberglass wrap present. Inspection of duct sections revealed gray sealant on most seams and connections. Analysis results of the gray caulking / sealant identifies the material as being positive for Asbestos. If any other caulking or sealants other than the already identified gray sealant is detected on duct sections or diffusers it is recommended that the material be tested prior to any disturbance or disposal. Electrical lines are contained within metal conduit above suspended ceiling sections, lines are currently energized no samples were collected.

Plumbing lines above suspended ceiling tiles are insulated with Fiberglass along straight sections and PVC covered Elbows. No Hard Mud or Air Cell insulation was detected on plumbing lines within project areas. Drain lines for sinks are stainless steel with copper supply lines. If during renovation any insulation other than Fiberglass is detected on Plumbing lines, it is recommended that the material be tested for Asbestos prior to any disturbance or disposal. Insulation within mechanical rooms is also mostly Fiberglass with some lines having Neoprene Insulation present on lines. No Hard Mud insulation or Air Cell insulation was detected on plumbing lines within the project area.

Universal Hazardous Waste

The following items have been identified as Universal Hazardous waste.

- One thousand three hundred and sixty-nine (1,369 ea.) Fluorescent Light Bulbs
- Seven hundred and thirty-five (735 ea.) Ballasts
- Seventy-three (73ea.) LED Light bulbs
- Three (3 ea.) Fire rated doors
- Sixteen (16 ea.) Automatic door closers
- Forty-three (43 ea.) Emergency Strobe lights
- Thirty-seven (37 ea.) Exit signs.

Sample Information

Sample Number	Description	Analysis Results
230216-01- Drywall	Drywall Seam Sample Room HSL207	Negative for Asbestos
230216-01-Joint Compound	Drywall Seam Sample Room HSL207	Negative for Asbestos
230216-02	24"x24" Ceiling Tile Debris Sample Room HSL207	Negative for Asbestos
230216-03	Tan Pipe Thread Sealant Debris beneath Sink Room HSL210	Negative for Asbestos
230216-04	12" White Floor Tile Room LHSL210	Negative for Asbestos
230216-05	Black Mastic beneath 12" Floor Tile Room LHSL210	Negative for Asbestos
230216-06	Gray Cove Base Sample Room HSL209	Negative for Asbestos
230216-07	Brown/Tan Cove Base Adhesive Room HSL209	Negative for Asbestos
230216-08-Drywall	Drywall Sample Room HSL209	Negative for Asbestos
230216-08-Joint Compound	Drywall Sample Room HSL209	Negative for Asbestos
230216-09	12" White Floor Tile Sample Room HSL216	Negative for Asbestos
230216-10	Black Mastic beneath 12" Floor Tiles Room HSL216	Negative for Asbestos
230216-11	Drywall Sample Room HSL226	Negative for Asbestos
230216-12	12" White Floor Tile Debris Room HSL201	Negative for Asbestos
230216-13	Black Mastic beneath 12" Floor Tile Room HSL201	Negative for Asbestos
230216-14	Tan Adhesive behind Acoustical Wall Panels Room HSL201	Negative for Asbestos
230216-15-Drywall	Drywall Sample Room HSL201	Negative for Asbestos
230216-15-Joint Compound	Drywall Sample Room HSL201	Negative for Asbestos
230216-16-Drywall	Drywall Seam Sample Room HSL200	Negative for Asbestos
230216-16-Joint Compound	Drywall Seam Sample Room HSL200	Negative for Asbestos
230216-17	Gray Sealant on HVAC Duct Sections Room HSL200	**Positive for Asbestos** • 3% Chrysotile

Sample Information

Sample Number	Description	Analysis Results
230216-18-Drywall	Drywall Seam Sample Room HSL200	Negative for Asbestos
230216-18-Joint Compound	Drywall Seam Sample Room HSL200	Negative for Asbestos
230216-19	Wall Plaster Sample from Display Case HSL300	Negative for Asbestos
230216-20-Drywall	Drywall Sample Exterior Wall Room HSL326	Negative for Asbestos
230216-20-Joint Compound	Drywall Sample Exterior Wall Room HSL326	Negative for Asbestos
230216-21	White Filler beneath Carpet Squares Room HSL200	Negative for Asbestos
230216-22	Black Adhesive beneath Carpet Squares Room HSL126	Negative for Asbestos
230216-23-Drywall	Drywall Sample Room HSL100P	Negative for Asbestos
230216-23-Joint Compound	Drywall Sample Room HSL100P	Negative for Asbestos
230216-24	Debris from Damaged Wall Section 3rd floor Room HSL300	Negative for Asbestos
230216-25-Drywall	Drywall Sample Room HSL119	Negative for Asbestos
230216-25-Joint Compound	Drywall Sample Room HSL119	Negative for Asbestos
230216-26	24"x24" Ceiling Tile Debris Room HSL119	Negative for Asbestos
230216-27	White Spray-on Coating on Sink Room HSL210	**Positive for Asbestos** • 5% Chrysotile

UNIVERSITY *of* MISSOURI

ENVIRONMENTAL HEALTH AND SAFETY

APPENDIX B

ASBESTOS SURVEY
CP230151
LOTTES HEALTH SCIENCES LIBRARY
ROOF REPLACEMENT
4/3/23

TO: Jody Miller
Planning, Design, and Construction

FROM: Pete Kohler
Environmental Health and Safety

MU Environmental Health and Safety has completed an asbestos survey of the roofing material for barrel vaults on Lottes Health Sciences Library (Bldg. C37-144).

The asbestos inspection was conducted to satisfy the requirements of 40CFR 61, subpart M, which stipulates that all buildings be "thoroughly inspected" for asbestos before the commencement of renovation or demolition activities. The asbestos inspection was conducted by Pete Kohler (MO Asbestos Inspector #10883, expires 11/05/2023). The survey was conducted on March 29, 2023 and the report was completed April 3, 2023.

As a result of sampling and analysis, no asbestos was identified in the scope of the project.

FIELD OBSERVATIONS

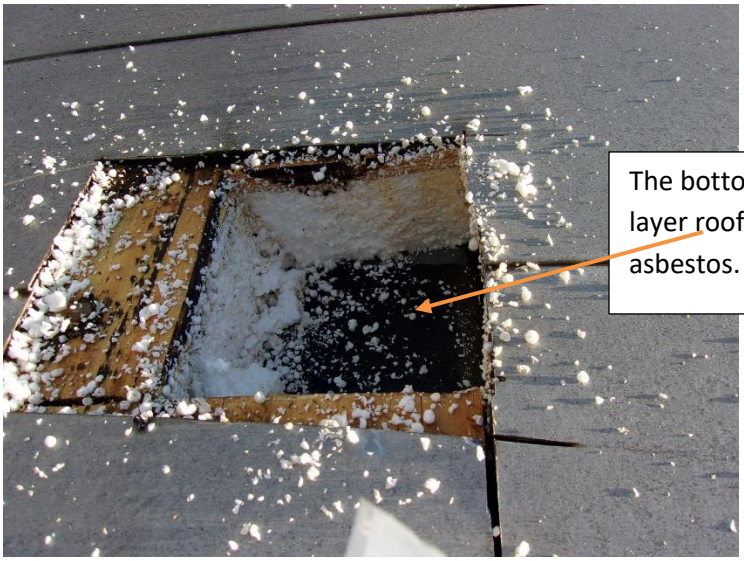
The roofs that will be replaced are curved metal structures that include a package of insulation material. University of Missouri roofers cut and then repaired the spot from which we collected samples.

The top of the roof is curved metal. Beneath the metal, we found a layer of roofing felt, on top of ½" plywood, over EPS foam, followed by another layer of roofing felt, which is the vapor barrier on the bottom deck of curved metal.

The plywood and the EPS are not suspect material. The two layers of felts were sampled and analyzed. Neither was found to contain asbestos.

Several varieties of caulk were found at different spots and performing different jobs. The window glazing compound itself is a silicone caulk. I collected several samples of caulk and had them analyzed. None of the caulk was found to contain asbestos.

SAMPLE ID	LOCATION/DESCRIPTION	ANALYSIS
230329-01	Lottes Health Sciences Library Roof, north barrel vault, gray/white caulk (window glazing compound)	100% non-fibrous
230329-02	HSL roof, beneath metal roof, top layer, roofing felt	75% cellulose, 25% non-fibrous
230329-03	HSL roof, bottom layer (vapor barrier) roofing felt	60% cellulose, 40% non-fibrous
230329-04a	HSL roof, gray caulk	100% non-fibrous
230329-04b	HSL roof, gray caulk	100% non-fibrous
230329-04c	HSL roof, gray caulk	100% non-fibrous



ASBESTOS SUMMARY:

No asbestos-containing material was identified within the scope of the project.