Technical Specifications

For construction contracts greater than $20,000

Renovate Surge Spaces in Natural Science Building – Phase 1 Project
SU-042126

Dated March 24, 2026

Proposal Due Date
April 23, 2026

SUNY Purchase College
735 Anderson Hill Road
Purchase, New York 10577-1402
Elizabeth Pleva, Director of Procurement & Accounts Payable

TABLE OF CONTENTS

INITIAL DOCUMENTS AND FORMS

000001 PROJECT TITLE PAGE
000007 SEALS PAGE
000010 TABLE OF CONTENTS

DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS – by College

DIVISION 01 - GENERAL REQUIREMENTS – by College, except as indicated below

018117 LOW EMITTING MATERIAL REQUIREMENTS
018119 CONSTRUCTION INDOOR AIR QUALITY MANAGEMENT

DIVISION 02 - EXISTING CONDITIONS

024119 SELECTIVE STRUCTURE DEMOLITION AND REMOVALS
028100 HAZARDOUS WASTE AND CONTAMINATED MATERIALS REMOVAL
028213 ASBESTOS ABATEMENT
028313 WORKING WITH LEAD-CONTAINING MATERIALS
028513 EXHAUST DUCT REMEDIATION
028613 ACID WASTE PLUMBING SYSTEM REMEDIATION
028700 UNIVERSAL WASTE AND FLUORESCENT LAMPS

DIVISION 03 – CONCRETE

035416 HYDRAULIC CEMENT UNDERLAYMENT

DIVISION 04 - MASONRY – not used

DIVISION 05 - METALS

055000 METAL FABRICATIONS

DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES

061053 MISCELLANEOUS ROUGH CARPENTRY
064020 INTERIOR ARCHITECTURAL WOODWORK

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

078413 PENETRATION FIRESTOPPING
078446 FIRE-RESISTIVE JOINT SYSTEMS
079200 JOINT SEALANTS

DIVISION 08 - OPENINGS

080671 DOOR HARDWARE SCHEDULE
081113 HOLLOW METAL DOORS AND FRAMES
087100 DOOR HARDWARE
088000 GLAZING

DIVISION 09 - FINISHES

092216 NON-STRUCTURAL METAL FRAMING
092900 GYPSUM BOARD
096500 RESILIENT FLOORING AND ACCESSORIES
099100 PAINTING

DIVISION 10 - SPECIALTIES

101000 VISUAL DISPLAY SURFACES
105200 FIRE-PROTECTION SPECIALTIES

DIVISION 11 - EQUIPMENT

115300 LABORATORY EQUIPMENT
115313 LABORATORY FUME HOODS
115343 SERVICE FITTINGS AND ACCESSORIES

DIVISION 12 - FURNISHINGS

122413 ROLLER WINDOW SHADES
123552 COMMON WORK RESULTS FOR LABORATORY FURNITURE AND CASEWORK
123553 LABORATORY CASEWORK
123652 LABORATORY TOP REPAIR
123653 LABORATORY COUNTERTOPS

DIVISION 13 - SPECIAL CONSTRUCTION – not used

DIVISION 14 - CONVEYING EQUIPMENT – not used

DIVISIONS 15 – 19 – not used

DIVISION 20 – MECHANICAL SUPPORT

200000 COMMON MECHANICAL/ELECTRICAL REQUIREMENTS

DIVISION 21 – not used

DIVISION 22 – PLUMBING

220517 SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING
220518 ESCUTCHEONS FOR PLUMBING PIPING
220523.12 BALL VALVES FOR PLUMBING PIPING
220523.13 BUTTERFLY VALVES FOR PLUMBING PIPING
220523.14 CHECK VALVES FOR PLUMBING PIPING
220529 HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT
220548 VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT
220553 IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT
220593 TESTING, ADJUSTING AND BALANCING FOR PLUMBING
220716 PLUMBING EQUIPMENT INSULATION
220719 PLUMBING PIPING INSULATION
220800 COMMISSIONING OF PLUMBING
221113 FACILITY WATER DISTRIBUTION PIPING
221116 DOMESTIC WATER PIPING
221119 DOMESTIC WATER PIPING SPECIALTIES
224500 EMERGENCY PLUMBING FIXTURES
226113 COMPRESSED-AIR PIPING FOR LABORATORY FACILITIES
226119 COMPRESSED-AIR EQUIPMENT FOR LABORATORY FACILITIES
226600 CHEMICAL WASTE SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES
226713 PROCESSED WATER PIPING FOR LABORATORY FACILITIES
226719 PROCESSED WATER EQUIPMENT FOR LABORATORY FACILITIES

DIVISION 23 – HEATING VENTILATING AND AIR CONDITIONING (HVAC)

230500 COMMON WORK RESULTS FOR HVAC
230513 COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT
230529 HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT
230553 IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT
230593 TESTING, ADJUSTING, AND BALANCING FOR HVAC
230700 HVAC INSULATION
233113 AIR DISTRIBUTION SYSTEMS-METAL DUCTS
233400 HVAC FANS AND VENTILATORS
238239.13 CABINET UNIT HEATERS

DIVISIONS 24 – 25 – not used

DIVISION 26 – ELECTRICAL

260500 COMMON WORK RESULTS FOR ELECTRICAL
260519 LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
260526 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
260529 HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS
260533 RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS
260548 VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS
260553 IDENTIFICATION FOR ELECTRICAL SYSTEMS
260573 OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY
260923 LIGHTING CONTROL DEVICES
260943 NETWORK LIGHTING CONTROLS
262416 PANELBOARDS
262726 WIRING DEVICES
262813 FUSES
262816 ENCLOSED SWITCHES AND CIRCUIT BREAKERS
262913 ENCLOSED CONTROLLERS
265100 INTERIOR LIGHTING

DIVISION 27 – COMMUNICATIONS – not used

DIVISION 28 - ELECTRONIC SAFETY AND SECURITY

283105 FIRE ALARM CABLES AND PATHWAYS
283111 DIGITAL, ADDRESSABLE FIRE ALARM SYSTEM

DIVISIONS 29 – 30 – not used

DIVISION 31 – 49 – not used

LIST OF DRAWINGS

GENERAL

GS0.00 COVER
GS0.01 DRAWING LIST, ARCHITECTURAL LEGEND, SYMBOLS, & ABBREVIATIONS
GS1.00 SITE PLAN LOGISTICS

HAZMAT

HM1.01S FIRST FLOOR HAZARDOUS MATERIALS REMOVAL PLAN
HM1.02S SECOND FLOOR HAZARDOUS MATERIALS REMOVAL PLAN
HM1.03S THIRD FLOOR HAZARDOUS MATERIALS REMOVAL PLAN

ARCHITECTURAL DEMOLITION
DS1.00 DEMO KEY PLANS
DS1.01 DEMO REFLECTED CEILING KEY PLANS

ARCHITECTURAL PLANS
AS1.00 KEY PLANS
AS1.01 REFLECTED CEILING KEY PLANS

ARCHITECTURAL ELEVATIONS
AS2.00 EXTERIOR ELEVATION AND DETAILS

ARCHITECTURAL ENLARGED PLANS
AS4.00 DRAWING GENERAL NOTES, CASEWORK TYPES AND SCHEDULES
AS4.01 ENLARGED PLANS AND ELEVATIONS - STOCKROOM AND CHEMICAL STORAGE
AS4.02 ENLARGED PLANS AND ELEVATIONS - STOCKROOM DRY STORAGE
AS4.03 ENLARGED PLANS AND ELEVATIONS - ANIMAL HOLDING ROOMS
AS4.04 ENLARGED PLANS AND ELEVATIONS - ENV GEOLOGY CLASSROOM, PREP AND FIELD GEAR
AS4.05 ENLARGED PLANS AND ELEVATIONS - ENV / PHYSICS CLASSROOM, LAPIDARY AND RESEARCH
AS4.06 ENLARGED PLANS AND ELEVATIONS - ENV RESEARCH AND SUPPORT ROOM
AS4.07 ENLARGED PLANS AND ELEVATIONS - NEW MEDIA AND OFFICES
AS4.08 ENLARGED PLANS AND ELEVATIONS - MICROBIOLOGY CLASS LAB AND RESEARCH LABS
AS4.09 ENLARGED PLANS AND ELEVATIONS - GEN BIO CLASS LAB AND PREP ROOMS

ARCHITECTURAL DETAILS
AS4.10 LAB EQUIPMENT LIST
AS4.11 TYPICAL LAB CASEWORK AND TABLE DETAILS
AS4.12 BIOLOGY LAB TABLE DETAILS
AS4.13 INTERIOR DETAILS
AS8.00 PARTITION TYPES AND PATCHING DETAILS
AS8.01 FINISH SCHEDULE, DOOR SCHEDULE, DOOR TYPES, AND DOOR DETAILS
AS8.02 FINISH PLANS
AS8.03 CEILING DETAILS

MECHANICAL
MS0.01 HVAC - NOTES & ABBREVIATIONS
MS0.02 HVAC - LEGENDS & SYMBOLS
MS1.01 HVAC - DEMO FIRST FLOOR SURGE

MS1.02 HVAC - DEMO SECOND FLOOR SURGE
MS1.03 HVAC - DEMO THIRD FLOOR SURGE
MS2.01 HVAC DUCTWORK - FIRST FLOOR SURGE
MS2.02 HVAC DUCTWORK - SECOND FLOOR SURGE
MS2.03 HVAC DUCTWORK - THIRD FLOOR SURGE
MS6.01 HVAC - SCHEDULES
MS7.01 HVAC - DETAILS

ELECTRICAL
ES0.01 ELECTRICAL - LEGEND
ES0.02 ELECTRICAL - LIGHTING CONTROLS
ES1.01 ELECTRICAL - DEMO FIRST FLOOR SURGE
ES1.02 ELECTRICAL - DEMO SECOND FLOOR SURGE
ES1.03 ELECTRICAL - DEMO THIRD FLOOR SURGE
ES2.01 ELECTRICAL - DISTRIBUTION FIRST FLOOR SURGE
ES2.02 ELECTRICAL - DISTRIBUTION SECOND FLOOR SURGE
ES2.03 ELECTRICAL - DISTRIBUTION THIRD FLOOR SURGE
ES3.01 ELECTRICAL - LIGHTING FIRST FLOOR SURGE
ES3.02 ELECTRICAL - LIGHTING SECOND FLOOR SURGE
ES3.03 ELECTRICAL - LIGHTING THIRD FLOOR SURGE
ES4.01 ELECTRICAL - POWER FIRST FLOOR SURGE
ES4.02 ELECTRICAL - POWER SECOND FLOOR SURGE
ES4.03 ELECTRICAL - POWER THIRD FLOOR SURGE
ES5.01 ELECTRICAL - NORMAL RISER DIAGRAM
ES5.02 ELECTRICAL - EMERGENCY RISER DIAGRAM
ES6.01 ELECTRICAL - SCHEDULES
ES6.02 ELECTRICAL - SCHEDULES
ES7.01 ELECTRICAL - DETAILS
ES7.02 ELECTRICAL - DETAILS

FIRE ALARM
FAS0.01 FIRE ALARM - SYMBOLS & ABBREVIATIONS
FAS0.02 FIRE ALARM - NOTES
FAS1.01 FIRE ALARM - DEMO FIRST FLOOR SURGE
FAS1.02 FIRE ALARM - DEMO SECOND FLOOR SURGE
FAS1.03 FIRE ALARM - DEMO THIRD FLOOR SURGE
FAS2.01 FIRE ALARM - FIRST FLOOR SURGE
FAS2.02 FIRE ALARM - SECOND FLOOR SURGE
FAS2.03 FIRE ALARM - THIRD FLOOR SURGE
FAS5.01 FIRE ALARM - RISER DIAGRAM
FAS5.02 FIRE ALARM - SEQUENCE OF OPERATIONS
FAS6.01 FIRE ALARM - DETAILS

PLUMBING

P0.01 GENERAL NOTES, SYMBOLS & ABBREVIATIONS
P1.00 FIRST FLOOR PLUMBING PLAN
P1.01 SECOND FLOOR PLUMBING PLAN
P1.02 THIRD FLOOR PLUMBING PLAN
P2.00 PARTIAL PLUMBING PLANS
P2.01 PARTIAL PLUMBING PLANS
P2.02 PARTIAL PLUMBING PLANS
P2.03 PARTIAL PLUMBING PLANS
P3.00 PLUMBING SUPPLY RISER
P3.01 PLUMBING RISERS
P6.00 PLUMBING SCHEDULES
P6.02 PLUMBING DETAILS

APPENDIX

Existing Hazardous Material Information

END OF TABLE OF CONTENTS

SECTION 018117 – LOW EMITTING MATERIAL REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for low emitting material requirements, including volatile organic compound (VOC) content limits in adhesives and sealants, paints and coatings, and flooring used for the project.

1.2 DEFINITIONS

A. CDPH Standard Method v1.1: California Department of Public Health (CDPH) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers, for the emissions testing and requirements of products and materials.

B. Composite Wood and Agrifiber: Products made of wood particles and/or plant material pressed and bonded with adhesive or resin such as particleboard, medium density fiberboard (MDF), plywood, wheatboard, strawboard, panel substrates, and door cores.

C. Volatile Organic Compounds (VOC) Emissions Test: Refer to CDPH Standard Method v1.1 definition.

1.3 SUBMITTALS

A. General: Submit additional low-emitting materials submittals required by other Sections.

B. Required Low-Emitting Materials Documentation Submittals:

1. Product Data for adhesives and sealants used inside weatherproofing system, indicating VOC content and laboratory test reports showing compliance with requirements for low-emitting materials.
2. Product Data for paints and coatings used inside weatherproofing system, indicating VOC content and laboratory test reports showing compliance with requirements for low-emitting materials.
3. Laboratory test reports for flooring, indicating compliance with requirements for low-emitting materials.
4. Laboratory test reports for products containing composite wood or agrifiber products or wood glues, indicating compliance with requirements for low-emitting materials – No Urea Formaldehyde.
5. Laboratory test reports for ceilings, walls, and thermal insulation, indicating compliance with requirements for low-emitting materials.

PART 2 - PRODUCTS

2.1 LOW-EMITTING MATERIALS

A. Paints and Coatings: For field applications that are inside weatherproofing system, paints and coatings shall comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 50 g/L.
3. Dry-Fog Coatings: 150 g/L.
4. Primers, Sealers, and Undercoaters: 100 g/L.
5. Rust-Preventive Coatings: 100 g/L.
6. Zinc-Rich Industrial Maintenance Primers: 100 g/L.
7. Pretreatment Wash Primers: 420 g/L.
8. Clear Wood Finishes, Varnishes: 275 g/L.
9. Clear Wood Finishes, Lacquers: 275 g/L.
10. Floor Coatings: 50 g/L.
11. Shellacs, Clear: 730 g/L.
12. Shellacs, Pigmented: 550 g/L.
13. Stains: 100 g/L.

B. Paints and Coatings: For field applications that are inside weatherproofing system, paints and coatings shall comply with requirements of California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Adhesives and Sealants: For field applications that are inside weatherproofing system, adhesives and sealants shall comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:

1. Wood Glues: 30 g/L.
2. Metal-to-Metal Adhesives: 30 g/L.
3. Adhesives for Porous Materials (except Wood): 50 g/L.
4. Subfloor Adhesives: 50 g/L.
5. Plastic Foam Adhesives: 50 g/L.
6. Carpet Adhesives: 50 g/L.
7. Carpet Pad Adhesives: 50 g/L.
8. VCT and Asphalt Tile Adhesives: 50 g/L.
9. Cove Base Adhesives: 50 g/L.
10. Gypsum Board and Panel Adhesives: 50 g/L.
11. Rubber Floor Adhesives: 60 g/L.
12. Ceramic Tile Adhesives: 65 g/L.
13. Multipurpose Construction Adhesives: 70 g/L.
14. Fiberglass Adhesives: 80 g/L.
15. Contact Adhesive: 80 g/L.
16. Structural Glazing Adhesives: 100 g/L.
17. Wood Flooring Adhesive: 100 g/L.
18. Structural Wood Member Adhesive: 140 g/L.

19. Single-Ply Roof Membrane Adhesive: 250 g/L.
20. Special-Purpose Contact Adhesive (Used to Bond Melamine-Covered Board, Metal, Unsupported Vinyl, Rubber, or Wood Veneer 1/16 Inch (1.6 mm) or Less in Thickness to Any Surface): 250 g/L.
21. Top and Trim Adhesive: 250 g/L.
22. Plastic Cement Welding Compounds: 250 g/L.
23. ABS Welding Compounds: 325 g/L.
24. CPVC Welding Compounds: 490 g/L.
25. PVC Welding Compounds: 510 g/L.
26. Adhesive Primer for Plastic: 550 g/L.
27. Sheet-Applied Rubber Lining Adhesive: 850 g/L.
28. Aerosol Adhesive, General-Purpose Mist Spray: 65 percent by weight.
29. Aerosol Adhesive, General-Purpose Web Spray: 55 percent by weight.
30. Special-Purpose Aerosol Adhesive (All Types): 70 percent by weight.
31. Other Adhesives: 250 g/L.
32. Architectural Sealants: 250 g/L.
33. Nonmembrane Roof Sealants: 300 g/L.
34. Single-Ply Roof Membrane Sealants: 450 g/L.
35. Other Sealants: 420 g/L.
36. Sealant Primers for Nonporous Substrates: 250 g/L.
37. Sealant Primers for Porous Substrates: 775 g/L.
38. Modified Bituminous Sealant Primers: 500 g/L.
39. Other Sealant Primers: 750 g/L.

D. Adhesives and Sealants: For field applications that are inside weatherproofing system, adhesives and sealants shall comply with requirements of California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

E. Flooring: Flooring shall comply with requirements of California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

F. Composite Wood, Agrifiber Products, and Adhesives: Shall be made using ultra-low-emitting formaldehyde resins as defined in California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products" or shall be made with no added formaldehyde.

G. Ceilings, Walls, and Thermal Insulation: Shall comply with requirements of California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

PART 3 - EXECUTION – not used

END OF SECTION 018117

SECTION 018119 – CONSTRUCTION INDOOR AIR QUALITY MANAGEMENT

PART 1 - GENERAL

1.1 SUMMARY

A. The Work on this Project shall minimize the detrimental impacts on Indoor Air Quality (IAQ) resulting from construction activities. Factors that contaminate indoor air, such as dust entering HVAC systems and ductwork, improper storage of materials on-site, poor housekeeping, shall be minimized.

B. This Section includes requirements for the development of a Construction Indoor Air Quality Management Plan (referred to as “the Plan” in this Section). Develop the Plan for approval by the Owner and Architect. The Plan shall be implemented throughout the duration of the project construction and shall be documented as outlined in the Submittal Requirements below.

1.2 REFERENCES

A. Sheet Metal and Air Conditioner National Contractors Association (SMACNA) “IAQ Guidelines for Occupied Buildings under Construction”, Second Edition, 2007, ANSI/SMACNA 008-2008 (Chapter 3): www.smacna.org

B. ANSI/ASHRAE 52.2-2007, “Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size”: www.ashrae.org

1.3 DEFINITIONS

A. Volatile Organic Compounds (VOC’s): Chemical compounds common in and emitted by many building products, including solvents in paints, coatings, adhesives and sealants, wood preservatives; composite wood binder, and foam insulations. Not all VOC’s are harmful, but many of those contained within building products contribute to the formation of smog and irritate (at best) building occupants by their smell and/or health impact.

B. Materials that act as “sinks” for VOC contamination: Absorptive materials, typically dry and soft (such as textiles, carpeting, acoustical ceiling tiles and gypsum board) that readily absorb VOC’s emitted by “source” materials and release them over a prolonged period of time.

C. Materials that act as “sources” for VOC contamination: Products with high VOC contents that emit VOC’s either rapidly during application and curing (typically "wet" products, such as paints, sealants, adhesives, caulks and sealers) or over a prolonged period (typically “dry” products such flooring coverings with plasticizers and engineered wood with formaldehyde)..

1.4 CONSTRUCTION IAQ MANAGEMENT PLAN

A. Prepare and submit a Construction IAQ Management Plan to the Architect and Owner for approval. The Construction IAQ Management Plan shall meet the following criteria:

1. Construction activities shall be planned to meet or exceed the minimum requirements of the Sheet Metal and Air Conditioning National Contractors' Association (SMACNA) "IAQ Guidelines for Occupied Buildings under Construction", Second Edition, 2007.

2. Absorptive materials shall be protected from moisture damage when stored on-site and after installation.

3. If air handlers are to be used during construction, filtration with a Minimum Efficiency Reporting Value (MERV) of 8 must be at each return air grill, as determined by ASHRAE 52.2-2007.

4. Filtration media shall be replaced immediately prior to occupancy. Filtration media shall have a Minimum Efficiency Reporting Value (MERV) of 13 as determined by ASHRAE 52.2-2007.

5. A "Sequence of Finish Installation Plan" shall be developed, highlighting measures to reduce the absorption of VOCs by materials that act as "sinks".

B. The Construction IAQ Management Plan shall include the following:

1. SMACNA Guidelines: Chapter 3 of the referenced "IAQ Guidelines for Occupied Buildings under Construction", outline IAQ measures in five categories as listed below. The Construction IAQ Management Plan shall be organized in accordance with the SMACNA format and shall address measures to be implemented in each of the five categories (including subsections). All subsections shall be listed in the Plan; items that are not applicable for this project should be listed as such.

<u>HVAC Protection</u>
- Return Side
- Central Filtration
- Supply Side
- Duct Cleaning

<u>Source Control</u>
- Product Substitution
- Modifying Equipment Operation
- Changing Work Practices
- Local Exhaust
- Air Cleaning
- Cover or Seal

<u>Pathway Interruption</u>
- Depressurize Work Area
- Pressurize Occupied Space
- Erect Barriers to Contain Construction Areas
- Relocate Pollutant Sources
- Temporarily Seal the Building

<u>Housekeeping</u>

Scheduling

- Protect of Materials from Moisture Damage: As part of the "Housekeeping" section of the Construction IAQ Management Plan, measures to prevent installed materials or material stored on-site from moisture damage shall be described. This section should also describe measures to be taken if moisture damage does occur to absorptive materials during the course of construction.
- Replacement of Filtration Media: Under the "HVAC Protection" section of the Construction IAQ Management Plan, a description of the filtration media in all ventilation equipment shall be provided. The description shall include replacement criteria for filtration media during construction, and confirmation of filtration media replacement for all equipment immediately prior to occupancy.
- Sequence of Finish Installation for Materials: Where feasible, absorptive materials shall be installed after the installation of materials or finishes which have high short-term emissions of VOC's, formaldehyde, particulates, or other air-borne compounds. Absorptive materials include, but are not limited to: carpets; acoustical ceiling panels; fabric wall coverings; insulations (exposed to the airstream); upholstered furnishings; and other woven, fibrous or porous materials. Materials with high short-term emissions include, but are not limited to: adhesives, sealants and glazing compounds (specifically those with petrochemical vehicles or carriers); paints, wood preservatives and finishes; control and/or expansion joint fillers; hard finishes requiring adhesive installation; gypsum board (with associated finish processes and products); and composite or engineered wood products with formaldehyde binders.
- Concrete Curing: Schedule installation of coverings of installed concrete to ensure proper curing of concrete.

2. Develop a separate sequencing plan that identifies feasible opportunities to meet the above-stated goals for the project.

3. Include provisions in the Construction IAQ Management Plan for addressing conditions in the field that do not adhere to the Plan, including provisions to implement a stop work order, or to rectify non-compliant conditions.

4. Include provisions in the Construction IAQ Management Plan for addressing construction activities in occupied buildings and avoidance of building occupancy in areas where construction related pollutants are present.

5. Include an outline of the scope and schedule of the IAQ Management process during construction - including submittal review, inspection and enforcement, schedule of expected written work products including checklists and worksheets, and activity schedule.

C. Upon approval of the Plan by the Owner and Architect, it shall be implemented through the duration of the construction process.

1.5 SUBMITTALS

A. Submit the following records and documents:

1. The Construction IAQ Management Plan.
2. Product Data: Product cut-sheets for all filtration media used during construction and installed immediately prior to occupancy, with MERV values highlighted. Cut sheets shall be submitted with the Contactor's or Subcontractor's 'approved' stamp as confirmation that the products are the products installed on the project.
3. Construction Photographs: Submit a minimum of 18 photographs comprising of at least six photographs taken on three different occasions during construction. The photographs shall document the implementation of each of the measures followed in the Construction IAQ Management Plan throughout the course of the project construction. Examples include photographs of ductwork sealing and protection, temporary ventilation measures, and conditions of on-site materials storage (to prevent moisture damage). Photographs shall be submitted with brief descriptions of the Construction IAQ Management Plan measure documented or be referenced to project meeting minutes or similar project documents which reference to the Construction IAQ Management Plan measure documented.
4. All meeting minutes, checklists, worksheets, notifications and deficiency or resolution logs related to the project IAQ issues.
5. Listing of all temporary usage of building mechanical systems and schedule of filter replacement and change outs.
6. Documentation of duct testing and cleaning.

1.5 COORDINATION

A. During the pre-construction meeting, discuss and agree to a process for communication and notification between the Owner, Consultant, Contractor(s) plus other parties to prevent and effectively resolve problems related to construction-related air pollutant control.

B. The Fund's representative shall supervise and enforce the IAQ Management Process During Construction.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 IMPLEMENTATION AND COORDINATION

A. Implement the Construction IAQ Management Plan and coordinate the Plan with all affected trades. Designate one individual as the Construction IAQ Representative, who will be responsible for communicating the progress of the Plan with the Owner and Consultant on a regular basis, and for assembling the required documentation.

B. Implement measures to remediate poor or failed compliance with the Construction IAQ Management Plan, as outlined in the Construction IAQ Management Plan and document corrective actions.

END OF SECTION 018119

SECTION 024119 - SELECTIVE STRUCTURE DEMOLITION AND REMOVAL

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Demolition and removal of selected portions of a building or structure.
2. Salvage of selected building components and elements.
3. Repair procedures for selective demolition operations.

B. Related Sections include the following:

1. Division 01 General Requirements for temporary construction and environmental-protection measures for selective demolition operations.
2. Division 01 General Requirements for cutting and patching procedures for selective demolition operations.

1.2 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Detach items from existing construction and deliver them to Owner ready for reuse.

C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.

D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.3 MATERIALS OWNERSHIP

A. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, demolished materials shall become Contractor's property and shall be removed from Project site.

1.4 SUBMITTALS

A. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

B. Proposed Dust-Control, Noise-Control and Other Special Measures: Submit statement or drawing that indicates the measures proposed for use, proposed locations, and proposed time frame for their operation. Identify options if proposed measures are later determined to be inadequate.

C. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
2. Interruption of utility services.
3. Coordination for shutoff, capping, and continuation of utility services.

D. Inventory: After selective demolition is complete, submit a list of items that have been removed and salvaged.

E. Predemolition Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by selective demolition operations. Submit before Work begins.

1.5 QUALITY ASSURANCE

A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.

B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

C. Standards: Comply with ANSI A10.6 and NFPA 241.

D. Predemolition Conference: Conduct conference at Project site to comply with requirements in Division 01 General Requirements.

1.6 PROJECT CONDITIONS

A. Owner will occupy portions of site and buildings immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted. Provide not less than 2 weeks' notice to Owner of activities that will affect Owner's operations.

B. Owner may elect to salvage certain items from areas of construction other than those indicated on Drawings as “salvage” prior to selective demolition operations. Give 2 weeks notice to Owner prior to commencing any selective demolition processes to allow for Owner salvage operations.

C. Maintain access to existing walkways, roadways, and other adjacent occupied or used facilities.

1. Do not close or obstruct walkways, roadways, or other occupied or used facilities without written permission from authorities having jurisdiction.

D. Owner assumes no responsibility for condition of areas to be selectively demolished.

E. Hazardous Materials: Hazardous materials remediation work will be completed prior to commencement of selective demolition in the areas where hazardous materials are present. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner.

1. Hazardous materials reports are included in the Project Manual for information purposes only.

F. Storage or sale of removed items or materials on-site will not be permitted.

G. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

PART 2 - PRODUCTS

2.1 REPAIR MATERIALS

A. Use repair materials identical to existing materials.

1. If identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
2. Use materials whose installed performance equals or surpasses that of existing materials.

B. Comply with material and installation requirements specified in individual Specification Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped.

B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.

D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

E. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2 UTILITY SERVICES

A. Existing Utilities: Maintain services indicated to remain and protect them against damage during selective demolition operations.

B. Do not interrupt existing utilities serving occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and to authorities having jurisdiction.

1. Provide at least 2 weeks' notice to Owner if shutdown of service is required during changeover.

C. Utility Requirements: Locate, identify, disconnect, and seal or cap off indicated utilities serving areas to be selectively demolished.

1. Arrange to shut off indicated utilities with utility companies.
2. If utility services are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary utilities that bypass area of selective demolition and that maintain continuity of service to other parts of building.
3. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.
4. Do not start selective demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.3 PREPARATION

A. Dangerous Materials: Drain, purge, or otherwise remove, collect, and dispose of chemicals, gases, explosives, acids, flammables, or other dangerous materials before proceeding with selective demolition operations.

B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.
2. Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction.

C. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent site improvements, structures 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. Provide special protection measures as required by Owner.

D. Temporary Enclosures: Provide temporary enclosures for protection of existing building and construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

E. Temporary Partitions: Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise.

3.4 POLLUTION CONTROLS

A. Dust Control: Use water mist, temporary enclosures, and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations.

1. Do not use water when it may damage existing construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution or where water will increase existing moisture content in masonry and concrete to remain.

B. Disposal: Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

1. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

C. Cleaning: 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.

3.5 SELECTIVE DEMOLITION

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, to minimize disturbance of adjacent surfaces. 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..
5. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
6. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
7. Dispose of demolished items and materials promptly.
8. Return elements of construction and surfaces that are to remain to condition existing before selective demolition operations began.

B. Removed and Salvaged Items: Comply with the following:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

C. Removed and Reinstalled Items: Comply with the following:

1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

D. Salvage items indicated on the Drawings as “salvage”.

E. Existing Facilities: Comply with Owner’s requirements for using and protecting elevators, stairs, walkways, building entries, and other building facilities during selective demolition operations.

F. 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.

G. Concrete: Demolish in small sections. Cut concrete to a depth of at least 3/4 inch (19 mm) at junctures with construction to remain, using power-driven saw. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then

remove remainder of concrete indicated for selective demolition. Neatly trim openings to dimensions indicated.

H. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.

1. At existing masonry to remain, cut protruding and excess mortar flush to masonry surfaces.

I. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.

J. Air-Conditioning Equipment: Remove equipment without releasing refrigerants.

K. Finishes: Remove fasteners, furring and other components to leave substrate ready to receive new work.

3.6 PATCHING AND REPAIRS

A. General: Promptly repair damage to adjacent construction caused by selective demolition operations.

B. Patching: Comply with “Cutting and Patching" article in Division 01 Section "General Requirements”.

C. Repairs: Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.

1. Completely fill holes and depressions in existing masonry walls that are to remain with an approved masonry patching material applied according to manufacturer's written recommendations.

D. Finishes: Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.

E. Floors and Walls: Where walls or partitions that are demolished extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

1. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.
2. Where patching occurs in a painted surface, apply primer and intermediate paint coats over patch and apply final paint coat over entire unbroken surface containing patch. Provide additional coats until patch blends with adjacent surfaces.
3. Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.

F. Ceilings: Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.

B. Burning: Do not burn demolished materials.

C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

END OF SECTION 024119

SECTION 028100 – HAZARDOUS WASTE AND CONTAMINATED MATERIALS REMOVAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Contractor shall be held to have read all Bidding Documents, Contract Drawings, and Division 1 specification sections, and in the execution of the work they will be bound by all of the conditions and requirements herein.

B. *Hazardous Waste/Contaminated Materials Inventory Report for the Rehabilitation of Natural Science Building, SUCF Project #291029-00, State University of New York at Purchase, Purchase, New York, dated February 2021* prepared by Watts Architecture & Engineering, is included separately and is for reference only.

C. *Laboratory Contaminated Materials Investigation and Sampling Report for the Rehabilitation of Natural Science Building, SUCF Project #291029-02, State University of New York College Purchase, Purchase, New York, dated February 2021, Revised October 2024, prepared by Watts Architecture & Engineering, is included separately and is for reference* only.

D. *Mercury Vapor Monitoring Report* dated January 2, 2026 (and future supplemental update that is to forthcoming) prepared for SUNY Purchase conducted by Quality Environmental Solutions & Technologies, Inc.

1.2 DESCRIPTION OF THE WORK

A. The work shall consist of the removal, inspection, characterization, packaging, labeling, transportation, and disposal or recycling (if permitted) of all contaminated materials, hazardous wastes, and Universal Waste from the locations indicated in the specifications and drawings or as directed by the Consultant on behalf of SUNY Purchase. All identified hazardous and regulated materials scheduled for removal and disposal will be included in this section unless a specific item is otherwise identified for disposal/recycling elsewhere in the bid manual.

B. Disposal of all removed materials and associated waste streams must be at permitted TSDF's in compliance with all regulatory requirements. In addition, the Contractor is responsible for any additional sampling and analysis requirements specified by the receiving disposal or recycling facilities. State University of New York at Purchase College Environmental Health & Safety (EHS) and the Project Monitor (as defined under SUCF Program Directive 1D-9) personnel must be consulted during any activities that involve sampling, analysis, and characterization of waste streams.

C. Contractor shall be responsible for confirming the existence and availability of all utilities and providing all makeup utility services required for the completion of this remediation/abatement work.

D. The Contractor shall note that other environmental concerns have been identified. These concerns are not addressed under this specification.

E. The Contractor shall be responsible for the proper handling, packaging, transport and disposal of these materials including:
   1. Mercury contaminated casework, flooring, and spilled elemental mercury as a hazardous waste.
   2. Mercury vapors contained within fluorescent light bulbs or tubes, metal halide, or high-intensity discharge (HID) lamps [Universal Waste];
   3. Mercury containing thermostats, thermometers, and gauges [Universal Waste];
   4. Lead acid and other batteries [Universal Waste];
   5. Light fixture ballasts containing lead are to be recycled, the electronic ballasts with non-liquid filled capacitors may contain lead with an amount that will fail TCLP toxicity limits for lead if disposed of as a solid waste; and
   6. Ozone depleting substances (chloroflourocarbons [CFCs] and hydrochlorofluorocarbons [HCFCs] refrigerants) associated with various refrigeration and air-conditioning units and equipment.
   7. Lubricants associated with oil reservoirs found affiliated with various mechanical equipment including motors, pumps, and compressors.

F. Extensive mercury vapor testing within the laboratory spaces has been conducted. Readings were taken from within the laboratories, preparation rooms, and research labs and included ambient air readings and specific location readings collected from around, within, and beneath the casework. The results of the initial investigation and testing is detailed within *Laboratory Contaminated Materials Investigation and Sampling Report for the Rehabilitation of Natural Science Building, SUCF Project #291029-02, State University of New York College Purchase, Purchase, New York, dated February 2021, Revised October 2024, prepared by Watts Architecture & Engineering*. In summary, locations at which mercury vapor contamination was detected during the initial investigation includes:
   1. Room 0005: Under West Lab Table (N.I.C.)
   2. Room 0019: Under East Lab Table (N.I.C.)
   3. Room 0022B: Ambient Room Reading (N.I.C.), Under West Wall Shelving (N.I.C.), Under Grate at Door (N.I.C.)
   4. Room 2019-2024: South Wall Lab Table Drawer (N.I.C.)
   5. **Room 2044**: Under Middle Lab Table **(In Contract)**, Under South Lab Table **(In Contract)**, Under West Sinks **(In Contract)**, Under East Sinks **(In Contract)**
   6. Room 2048: Under Center Lab Table (N.I.C.)
   7. Room 3011: Under North Lab Table Island (N.I.C.), Under Middle Lab Table Island (N.I.C.)
   8. **Room 3016**: Under South Lab Table Drawers and Cabinets **(In Contract)**
   9. Room 3017: Under North Cabinet (N.I.C.)
   10. Room 3018: Under North Lab Table Island (N.I.C.), Under South Lab Table Island (N.I.C.)
   11. Room 3020: Under West Lab Tables (N.I.C.)
   12. Room 3022: Under Lab Table (In Contract)
   13. Room 3028: South Lab Table Island Drawer (N.I.C.), Under South Lab Table Island (N.I.C.), Under South Wall Lab Table (N.I.C.), Under Northwest Lab Table Island (N.I.C.), Under Northeast Lab Table Island (N.I.C.)

14. Room 3030: Northwest Cupboard (N.I.C.), Under North Fume Hood (N.I.C.)
15. **Room 3032**: Under North Lab Table Island **(In Contract)**, Under West Lab Table Island **(In Contract)**, Under East Lab Table Island **(In Contract)**

A recent secondary investigation was conducted on behalf of SUNY Purchase that investigated select laboratory casework project locations throughout the project area and identified the following location at which mercury vapor contamination was detected:

1. Chemical Stock Room Fume Hood Sink Base Cabinet

In addition, this recent secondary investigation also identified three other sinks where mercury vapor contamination was located. See that report for additional information.

SUNY Purchase will have a complete supplementary mercury vapor inspection conducted either prior to or during the initial stage of construction. This supplemental inspection will identify which laboratory casework areas have mercury vapor contamination and which areas do not. The Contractor shall properly remediate all areas that show mercury vapor contamination and properly dispose of the elemental mercury and mercury-contaminated items per the Contract Unit Bid Costs for these items. The Contract Drawings show these applicable areas where mercury vapor contamination is to be determined. See Division 01 section for Unit Costs Bid Form and additional information.

The source of the mercury vapor is generally assumed to be a result of historical mercury spillage from thermometer breakage. All associated mercury contaminated items and elemental mercury that is cleaned shall be handled, treated, and properly disposed of by the Contractor as a hazardous for mercury toxicity and U-List Waste due to the presence of elemental mercury (D009/U151). EPA considers disposing of elemental mercury and spill residues (from broken mercury thermometers) as a U151 hazardous waste that requires retorting. Disposal of the removed deposits, cleaning equipment, and personal protective equipment shall be classified based on the waste characterization laboratory analysis results completed by the Contractor as required by the destination facility, but at no time can lose the mercury D009/U151 Hazardous Waste codes. The Contractor shall process all associated items following high mercury concentration disposal guidelines. Elemental mercury or high mercury concentrations (above 260 mg/kg total mercury) will require the waste be transported for mercury recovery “RMERC” in a thermal processing unit. These units are commonly referred to as “retorters” and the recovery process as “retorting”. See Specification Section 02 86 13 - Acid Waste Plumbing System Remediation for more details regarding the proper PPE, waste handling practices, necessary mercury vapor monitoring equipment (Jerome Mercury Vapor Analyzer, or equivalent), cleanup procedures, and disposal requirements associated with mercury.

G. The Contractor should be aware that some of the items identified in the hazardous waste/contaminated materials inventory may have been removed by SUNY Purchase College EHS personnel. These items include the fire extinguishers, electronic waste, all salvageable lab equipment, and most abandoned/discarded chemical containers.

H. The following materials have been developed to assist the Contractor in the performance of the work:
   1. Remediation drawings and notes have been developed to show the approximate configuration of each of the floors and rooms within Natural Science Building so the Contractor may confirm the inspection and completion of work in each area.

I. The Contractor shall manage all surplus materials and waste generated in the performance of the contract in accordance with applicable Federal, State, and local laws and regulations. The Contractor is encouraged to reuse, salvage or recycle materials to the maximum extent possible.

J. The Contractor shall engage a single firm to perform the work of this section. The firm shall have the following qualifications:
   1. Performance of at least three (3) projects in the previous ten (10) years that are similar to the work required for this project, including coordination with simultaneous asbestos abatement and general demolition work.
   2. It has developed and employed a Work Plan, Spill Contingency Plan, and Site-Specific Health and Safety Plan similar to that required for this project.
   3. It has established a Quality Control Program that includes hazard communications and chemical hygiene plans; employee background checks and medical testing; and, waste determination procedures and guidelines, and proper waste manifest tracking.
   4. It has a Project Manager available for this project with at least three years of experience performing similar work; all required training certifications; fluent in the English language and capable of communicating with all the staff; and is experienced in visual inspection, handling, cleaning, storage and field characterization of hazardous materials and contaminated materials similar to those anticipated on this project.
   5. For all employees involved with the hazardous waste related work, completion of 40-hour OSHA HAZWOPER training, annual 8-hour OSHA HAZWOPER refresher training, and proof of annual medical physicals and respirator fit tests.
   6. Must be able certify in writing that these qualifications are met for the firm and persons involved with the hazardous waste and contaminated materials work, and if requested, can submit documentation and resumes to demonstrate their capabilities, experience, and include a list of completed projects with project contact names, addresses, and phone numbers.

K. The Contractor shall be aware of all conditions of the Project and is responsible for verifying quantities and locations of all Work to be performed. Failure to do so shall not relieve the Contractor of its obligation to furnish all labor and materials necessary to perform the Work.

L. All Work shall be performed in strict accordance with the Project Documents and all governing codes, rules, regulations, and guidelines. Where conflicts occur between the Project Documents and applicable codes, rules, regulations, and guidelines, the more stringent shall apply.

M. Working hours shall be as required and approved by the Consultant. The Contractor shall coordinate all Work with the Consultant and Owner regarding scheduling.

1.3 RELATED SECTIONS

A. Asbestos Abatement (Specification 02 8213)

B. Lead Remediation (Specification 02 8313)

C. Exhaust Duct Remediation (Specification 02 8513)

D. Acid Waste Plumbing System Remediation (Specification 02 8613)

E. Universal Waste and Fluorescent Lamps (Specification 02 8700)

1.4 SUBMITTALS

A. The Contractor shall certify in writing that they have prepared and will maintain a valid Site-Specific Health and Safety Plan to support the hazardous waste and contaminated materials work of this section. The Contractor shall certify in writing that they have a valid OSHA Respiratory Protection Program. Submission of the Site-Specific Health and Safety Plan and OSHA Respiratory Protection Program is not necessary, unless specifically requested by the General Contractor, SUNY Purchase College, and/or SUCF (as part of the overall Natural Science Building renovation project). As part of this work the Contractor will designate and maintain a full-time on-site Health and Safety Officer and off-site Corporate Health and Safety Coordinator for the duration of the associated tasks.

B. The Contractor shall certify in writing that they and their personnel meet the qualifications as described under Section 1.2.J. Submission of all documentation to prove that the qualifications are met is not necessary, unless specifically requested by the General Contractor, SUNY Purchase College, and/or SUCF (as part of the overall Natural Science Building renovation project).

C. The Contractor shall be required to submit a Work Plan explaining the personal protective equipment, work methods, procedures, safety, site storage, transportation, and final treatment/disposal/recycling that will be utilized for all work covered under this section. The Work Plan under this section can be a stand-alone document that only covers the work under this section, or if applicable and the work will occur alongside other hazardous waste related work, an overarching Work Plan document may be prepared for the project, provided all necessary and appropriate information is included. Submission shall be made at least 14 days prior to the anticipated start of work for review by the Architect and Environmental Design Consultant prior to the commencement of activities. The plan shall include:
   - List of the anticipated on-site supervisor(s) and workers scheduled to perform this work. Provide the following for each individual:
     - Certificates of successful completion of the OSHA 40-hour HAZWOPER course for handling hazardous materials along with proof of current 8-hour annual refresher (if applicable) and the OSHA 10-hour Construction Safety training (if applicable).

  - Proper documentation or certificates for workers which have successfully completed the required employee training for Universal Waste or appropriate type of training to the type of wastes being managed by those workers as applicable (i.e.: for Universal Waste such as fluorescent bulbs, see United States 40 CFR § 273.16 and § 273.36, and New York 6 CRR-NY IV B 374-3; for ozone depleting refrigerant technicians see training for stationary refrigeration and air conditioning under Section 608 of the Clean Air Act per 40 CFR § 82.161 Technician Certification; etc.)
  - Certification of medical examinations completed within the past 12 months. Only include the health providers written opinion that the employee is certified to complete the work covered under this section, do not include any medical information protected by the HIPAA Privacy Rule.
  - Certificates of successful respiratory fit test in accordance with OSHA's Respiratory Protection Standard (1910.134) completed within the past 12 months for each type of respirator that will be worn in order to complete the work covered under this section.
- Contact information for the full-time on-site Health and Safety Officer and off-site Corporate Health and Safety Coordinator.
- Anticipated schedule of start and finish times and dates for this work.
- The method of recycling or treatment/disposal that will be used for each waste stream. Include specific detail on transportation, transfer and other handling from the time waste leaves campus until its arrival at its ultimate destination. Include the name and address of the facilities where all waste materials are to be sent. Include contact person, facility address and telephone number. Plan must include a copy of each disposal/treatment facilities current operation permit that indicates both the type of materials allowed and not allowed for disposal/treatment/recycling.
  - Name, address, and USEPA and NYSDEC permits or licenses (as appropriate), of all proposed recyclers, if applicable. No substitution will be allowed without approval from the Consultant and EHS.
  - Name, address, phone number, responsible contact, and license/permit information (NYS and/or USEPA/USDOT Waste Transporter ID number) from all identified transporters. No substitution will be allowed without approval from the Consultant and EHS.
  - Name, address, and USEPA and NYSDEC permits or licenses (as appropriate), of recipient landfill and incinerators, if applicable. No substitution will be allowed without approval from the Consultant and EHS.
  - Following final removal, and disposal/recycling or destruction, provide the Consultant and EHS with waste transport and disposal/recycling documents (e.g., manifests), as well as certificates of destruction as appropriate.
- Safety Data Sheets (SDSs) for any chemical materials to be used to facilitate this work.
- The Work Plan must include contingency procedures for handling waste spills and releases and the emergency procedures to be followed by Contractor personnel. Contractor shall maintain minor spill cleanup equipment and supplies

including absorbent pads, wipes, mini-booms, or other necessary specific equipment to handle spills for materials covered under this section. All temporary waste storage must be within a containment area constructed by the Contractor that meets EPA Container Storage Regulation 40 CFR 264.175 or equivalent for hazardous wastes. Preparedness and prevention features and contingency planning and emergency procedures shall be developed per 6 NYCRR 373-3.3 and 373-3.4, respectively.

- A description of appropriate security measures that shall be provided for the protection of hazardous and solid waste while stored on-site.
- Provide a description of the methods, procedures and materials to be used in performing the work and handling all wastes covered under this section. Describe the methods to contain hazardous waste from existing locations and the maintenance required to ensure the safe temporary storage of the waste.
- Provide a description of any samples to be taken and the parameters to be analyzed. Identify the laboratory providing the analytical services and provide a copy of their NYSDOH ELAP certification. Note that all sampling conducted by the Contractor shall be done in coordination with and in the presence of SUCF (as part of the overall Natural Science Building renovation project), SUNY Purchase, and/or their Environmental Representative.

1.5 CODES AND REGULATIONS

A. The following is a list of many of the relevant Federal and State laws, regulations, codes and guidelines that the Contractor shall follow and be familiar with. This list is by no means exhaustive and the Contractor shall be required to meet and comply with all applicable, relevant, and appropriate Federal, State and Local laws and codes.
   1. 40 CFR Part 761, Toxic Substances Control Act (TSCA).
   2. Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), US-EPA (1980).
   3. USEPA 40 CFR 170, Preparation of Hazardous Materials for Transportation.
   4. USEPA 40 CFR Parts 260-272, Resource Conservation and Recovery Act (RCRA).
   5 40 CFR Part 273, Universal Waste Rule.
   6. USEPA 40 CFR 761 (PCBs).
   7. USDOT 49 CFR Parts 100-180, Hazardous Materials Regulations.
   8. 6 NYCRR Part 361, Solid Waste & Material Recovery Facilities.
   9. 6 NYCRR Part 362, Solid Waste Combustion, Transfer and Processing Facilities.
   10. 6 NYCRR Part 363, Solid Waste Landfills.
   11. 6 NYCRR Part 364, Waste Transporters.
   12. 6 NYCRR Part 365, Biohazard Waste Management Facilities.
   13. 6 NYCRR Part 370, Hazardous Waste Management System.
   14. 6 NYCRR Part 371, Identification and Listing of Hazardous Waste.
   15. 6 NYCRR Part 372, Hazardous Waste Manifest System and Related Standards for Generators, Transporters and Facilities.
   16. 6 NYCRR Parts 373-1 through 373-4, TSDF Facilities and Standards.
   17. 6 NYCRR Subpart 374-3, Standards for Universal Wastes.
   18. 6 NYCRR Part 376, Land Disposal and Treatment Standards.

19. OSHA 29CFR 1910, Occupational Safety and Health Standards.
20. OSHA 29CFR 1926, Safety and Health Regulations for Construction.
21. Universal Waste Rule as described in the Federal Register.

B. The Contractor is required to secure and maintain all required regulatory permits necessary to perform all aspects of the work. The Contractor shall containerize and store waste in accordance with all applicable regulations. The Contractor and Waste Haulers will be responsible for all required placards and labeling.

1.6 COMPLIANCE

A. Compliance with any obligation based upon Federal, State, or local environmental, public health, or safety laws, rules, regulations, or requirements shall be coordinated with the Consultant.

1.7 WASTE RECORD SYSTEM

A. The Contractor shall establish a record system that accounts for all waste. The Contractor must be able to document custody of all removed materials from the time they are identified and removed from the work area until they are recycled or disposed of at an approved facility.

B. The State University of New York at Purchase College shall be the generator of the waste and shall supply its EPA I.D. number and address for use in filling out the uniform hazardous waste manifests. The Contractor shall be responsible for the preparation of the manifest (information and tracking form) to be signed by SUNY Purchase College EHS personnel. The Contractor shall allow 5 business days for SUNY Purchase College EHS personnel to review and sign the completed manifests. The treatment and disposal facility shall submit returned original of all hazardous waste manifests to SUNY Purchase College personnel. Mailing address for SUNY Purchase College EHS is identified as:

SUNY Purchase College, State University of New York
Environmental Health & Safety
Attn: Louis Wirtz
735 Anderson Hill Road
Purchase, NY 10577
(914) 251-6022
louis.wirtz@purchase.edu

C. Final manifests and shipping documents must be returned to SUNY Purchase College EHS whose address is listed on each manifest within 30 days of the removal of contaminated materials from the site by the waste hauler or as required under the applicable regulations. A duplicate copy of all completed forms shall be provided by the Contractor to the Construction Manager.

1.8 DEFINITIONS

A. Hazardous Waste - shall be any material that possesses at least one of four characteristics (ignitability, reactivity, corrosivity, or toxicity) or is a F, P, K or U listed waste as regulated under both the Federal Resource Conservation and Recovery Act (RCRA) and with applicable State regulations or a material that appears on Federal or State lists.

B. Hazardous Waste Landfill – a landfill permitted under RCRA Subtitle C and engineered to contain hazardous wastes. Incoming wastes are manifested by the generating facility and may be subject to treatment standards.

C. Chemical Waste Landfill – a landfill permitted under the Toxic Substances Control Act (TSCA) that accepts hazardous substances.

D. TSDF – Permitted/licensed treatment, storage or disposal facility.

E. Waste Management – Shall mean the collection, packaging, transportation, transfer, processing, recovery, storage, reclamation, treatment, handling and disposal of waste whether performed directly by the Contractor or his Sub Contractor.

F. Ballast – a device, typically located in the lamp fixture (luminaire), used to operate fluorescent and HID lamps. Fluorescent and HID lamp ballasts contain a small capacitor that may contain high concentrations of PCBs. Some ballasts manufactured between 1979 and 1991 contain the PCB replacement DEHP.

G. High Intensity Discharge (HID) Lamps – a generic term that refers to mercury vapor, metal halide and high and low-pressure sodium light sources. HID lamps contain mercury.

PART 2 – PRODUCTS

2.1 GENERAL

A. Contractor shall be responsible for identifying the appropriate shipping containers. Some examples include 35 or 55 gallon metal or fiber drums, with lids that can be secured and sealed for ballasts; RC-4, RC U-Bent and RC-HID lamp recycling cartons; lab packs or overpacks for containerized liquids (paints, thinners, cleaning fluids, etc). Drums or containers must meet the required OSHA, EPA (40 CFR Parts 260-272 and 300), and DOT Regulations (49 CFR Parts 171-178).

B. Contractor shall provide the appropriate waste labels identifying contents as regulated TSCA, Universal Waste, and RCRA hazardous wastes as defined by USEPA, NYSDEC and all other applicable Federal and State regulations.

C. Contractor shall provide refrigerant recovery tanks and cylinders to hold and temporarily store compressed refrigerant gasses (ozone depleting substances as defined by the Clean Air Act – CFC, HFC, HCFC or virgin refrigerants).

PART 3 - EXECUTION

3.1 GENERAL

A. Procedures and methods contained herein are to provide guidance to protect from the contamination of the environment and exposure to workers, while handling contaminated materials, hazardous wastes, and Universal Waste, and their respective components during disassembly for disposal/recycling/destruction.

B. Removal and disposal/recycling of all mercury fluorescent and HID lights, electronic ballasts, mercury gauges, and batteries will follow all Universal Waste Rule requirements.

C. On-site recovery and recycling of refrigerants must be conducted in compliance with the Clean Air Act (CAA) and by authorized and certified personnel as defined in Section 608 of the CAA.

D. Removal and recycling/disposal of lubricants and other petroleum-based products from mechanical equipment, elevators, escalators, etc., will be conducted in a manner to prevent releases to the environment.

3.2 PERSONAL PROTECTIVE EQUIPMENT

A. Personal protective equipment (PPE) shall consist of (at a minimum) safety goggles or other protective eye-ware, work shoes with non-slip soles and steel toes, chemical resistant gloves that cover the hand (e.g., neoprene or nitrile gloves), an apron that covers the front of the worker's body from shoulder to calves or disposable tyvek coverall, and respiratory protection, where required. For respiratory protection, the Contractor shall be responsible for identifying the proper respiratory protection for his employees during the duration of the work.

B. Personal protective equipment contaminated by handling operations should be disposed of as contaminated waste.

C. Hammering or sudden impact methods for removing ballasts from the light fixture shall not be employed as such methods may cause leakage in an otherwise non-leaking ballast.

D. Care must be exercised when collecting other items – light bulbs, refrigerants, fuels, and lubricants, so not to release or spill these products into the environment.

E. Throwing and tossing of ballasts into disposal drums shall not be conducted, as such activities may cause leakage in otherwise non-leaking ballast.

F. All removal and disposal activities shall be monitored by the Owner's Project Monitor (as defined under SUCF Program Directive 1D-9) for compliance. See below for Project Monitor description and duties.

3.3 WORK PROCEDURES

A. Contractor shall use the hazardous waste generator number obtained by the SUNY Purchase College from Region II, USEPA. Non-hazardous materials shall be transported using non-hazardous waste manifests or appropriate bills of lading.

B. During the mercury cleaning work and light bulb removal, the following procedures (or equivalent alternate but protective measures) are to be followed:
   1. Carefully remove tubes from fixtures and repackage them in appropriate cartons for transportation for recycling and/or disposal. Intact fluorescent lamps shall be protected and packaged in a box and labeled "Universal Waste-Lamps".
   2. Designate an area where the bulbs can be placed for storage.
   3. In the event a bulb breaks and at all times during mercury cleaning operations, utilize a mercury capture vacuum to remove all debris generated. Wipe the area after vacuuming using Mercon™ spill control products – MerconWipes™, MerconSpray™, MerconKit™ or equivalent products from another manufacturer.
   4. Any fluorescent or HID lamps that are broken during removal are considered hazardous waste due to mercury and are assigned a D009 waste code. Broken lamps must be placed into a sealed vapor tight containers or 55-gallon steel drums and disposed of as RCRA hazardous waste.

C. Carefully remove light ballasts, and segregate for disposal in the following manner:
   1. Any magnetic ballasts with liquid filled capacitors are assumed to contain either poly chlorinated biphenyls (PCBs) or di-2-ethylhexyl phthalate (DEHP). PCBs were used in the manufacture of ballasts until 1979. All ballasts with liquid filled capacitors <u>not</u> labeled with a "No-PCBs" sticker shall be assumed to contain PCBs. Both leaking and non-leaking ballasts that <u>are not</u> specifically labeled as "No-PCBs" shall be segregated and drummed for disposal as a hazardous and TSCA waste. Disposal of PCB ballasts will be by:
      a. Landfilling at a properly permitted TSCA landfill facility that accepts these materials.
      b. Incineration at a properly permitted TSCA facility. Leaking ballasts must be incinerated.
   2. DEHP was used as a substitute for PCBs in ballasts from 1979 to 1991. DEHP in its raw form is a listed hazardous waste under RCRA, classified as a U028 characteristic hazardous waste. The DEHP within a liquid filled capacitor within a lighting ballast has been used and is spent, and therefore, it is no longer considered a hazardous waste (40CFR 261.33). However, Superfund regulations list DEHP as a hazardous substance and a possible cause for litigation should the materials be released from a permitted landfill facility. Therefore, the same precautions should be followed when handling and disposing DEHP ballasts as with PCB ballasts to limit potential cleanup liability. All ballasts with liquid filled capacitors that have a "No-PCBs" sticker will be assumed to contain DEHP. Disposal of used ballasts containing DEHP will be by:
      a. Landfilling at a properly permitted TSCA/hazardous waste landfill facility.
      b. Incineration at a properly permitted TSCA facility.
   3. Contractor should note that if any large capacitors are identified during hazardous waste and contaminated material removal operations they must be treated as PCB containing unless capacitor identification or testing prove otherwise. Large PCB capacitors must be incinerated per USEPA regulations.

4. Any electronic ballast that are identified during this work shall be recycled. All non-liquid filled capacitors associated with the light ballasts are assumed to fail TCLP toxicity limits for lead and thus, shall be properly recycled and not disposed of as a solid waste.

D. All refrigerants must be removed and recycled by a licensed contractor from the various window and roof-top air conditioning units, refrigerators, freezers, and drinking fountains. Technicians who perform CFC/refrigerant removal must be licensed for recovery/recycling with the EPA. In addition, all equipment used in the recycling/recovery process must have a current EPA registration. Reclaimed refrigerants must be sent to an EPA-certified refrigerant reclaimer and must provide: name and address of transporter and refrigerant reclaimer; amount of refrigerant recovered and shipped; and, date of shipment and date of receipt by reclaimer.

E. Drums containing hazardous waste must be stored in accordance with RCRA guidelines for the specific generator size classification type (e.g., Very Small Quantity Generator, Small Quantity Generator, or Large Quantity Generator). SUNY Purchase College is classified as a large quantity generator (LQG). All removed materials shall be stored in the appropriate containers. A secure storage site shall be designated, labeled in accordance with the applicable rules and regulations, and be maintained by the Contractor. The waste storage area shall be inspected daily by the Contractor and the inspection shall be noted on a Waste Inspection Form developed by the Contractor.

F. The Contractor shall coordinate all shipments and arrivals at the TSDF to meet project schedule requirements. The Contractor shall complete any required shipping papers, manifests, placarding, and weighing or load measurements and provide originals to EHS and copies of all documentation to the owner's representative.

G. The Contractor shall ensure that the trucks used to transport any materials during the project protect against contamination to the environment. This will be accomplished by using enclosed trucks, or by properly covering and, if applicable, lining the trucks with compatible material. The Contractor shall verify that any trucks used to transport liquids or solid materials are not leaking.

H. The Contractor shall provide written weekly reports documenting the progress made, summarizing the upcoming work, and identifying any coordination issues with other groups. The weekly reports are to be submitted no later than 3:00 pm the Monday following the week that just ended.

3.4 PROJECT MONITORING/MANAGEMENT

A. SUNY Purchase shall retain the services of an environmental consulting firm to provide a Project Monitor (Monitor) for environmental oversight services from during the remediation of hazardous materials, per SUCF Program Directive: 1D-9 Monitoring Removal of Asbestos and Hazardous Materials during Construction (Last Revised Date: May 2019). The Monitor will perform third-party oversight and monitoring of the removal and disposal of hazardous materials (asbestos, hazardous

waste, universal waste, etc.) and other applicable construction waste owned by the Campus as the generator of the waste. SUCF Directive 1D-9 indicates that the Monitor will assume a duty to act in good faith and with care on behalf of the Campus and the Fund. The Monitor must be familiar with all state and federal regulations, rules and recommendations and Campus policies and procedures for the disposal of hazardous materials (asbestos, hazardous waste, universal waste, and other applicable construction waste).

B. Per SUCF Directive 1D-9, the prerequisites of the Monitor shall include the following:
   1. a minimum of five years' experience in monitoring projects similar to the construction work of this project and be familiar with all applicable state and federal regulations pertaining to hazardous materials waste.
   2. a working knowledge of 6 NYCRR Parts 370 – 374 and 376 (NYSDEC's regulations on hazardous and universal waste.)
   3. a working knowledge of other applicable Federal, State, and Local regulations, laws, and ordinances associated with the hazardous materials scope of work.
   4. Monitor will not perform any asbestos abatement work on the project and has not retained or been retained by any contractor for work on the project.
   5. possess the tools, and working knowledge of their use, required for visual inspection, air monitoring, and other job duties.

C. Per SUCF Directive 1D-9, the duties of the Monitor shall include the following:
   1. Observing construction waste generating work (including preparation, pre-cleaning, removal, containerizing, and labeling, and demobilization) and monitoring compliance contract documents and pertinent rules and regulations as currently amended, including, but not limited to, NYSDOL ICR 56, EPA, NYS, OSHA, NYSDEC, and other applicable governing bodies.
   2. Monitoring and tracking all waste being generated from the project during construction, including hazardous and universal wastes;
   3. Creating and maintaining an inventory of all waste containers on-site, with daily documented inspections of the containers;
   4. Monitoring the actual use of the waste containers, validating that what is on the label of the waste container is what is going into the container;
   5. Validating that the waste containers are appropriately labeled according to NYSDEC, US EPA and other applicable rules and regulations, and kept sealed, stored properly, and protected from the weather when not actively in use;
   6. Validating that the waste containers are in a secure location, such that no one has unauthorized access to the waste containers;
   7. Preparing a "Site Observation Report" (format approved by the Fund and Campus) for each day visited and provide a representative photographic survey of construction waste management activities and practices;
   8. Assisting the Campus by preparing, reviewing, and recommending all paperwork, manifests, etc. for signature by their authorized representative;
   9. Work directly with the Generator's authorized representative responsible for signing waste profiles, and if authorized by the Generator, sign on behalf of as an

agent for the Generator. It is recommended that the Generator's authorized representative sign all waste manifests and the Monitor can implement the processing of the manifests with the Contractor at the time of waste disposal shipping.

10. Monitoring cleaning of the work areas and the handling, transport, and disposal of waste, including adherence to time limitations in applicable rules and regulations and obtaining copies of relevant paperwork.
11. Documenting when any waste leaves the project site (get copy of manifest, confirm/record transport company, driver, waste quantity and type (format approved by the Fund and Campus)).
12. Confirming (by visiting, if required or deemed necessary by the Fund or Campus) actual storage, recycling/incineration and disposal locations.
13. Reviewing and validating information on waste transporter permits, manifests, waste profiles, disposal site acceptance documents, and other documents requested by the Fund or Campus.
14. For phased demolition and abatement, at the end of each phase of the work (do not wait to the end of the project), reviewing and validating that the required closeout paperwork for the asbestos and hazardous materials abatement is complete for the phase;
15. Coordinating any hazardous waste disposal pickups with the Campus Hazardous Waste Specialist (Specialist) and the Campus Project Manager;
16. Allowing the Specialist to review any waste manifest at least 5 business days in advance of any waste pickup;
17. Giving the Specialist advance notice of at least 5 business days any hazardous waste pickups, such that the Specialist, if they choose, can be on-site to sign the manifest and obtain the appropriate copies for the Campus records. Conversely, the Generator's authorized representative can provide a signed waste manifest(s) to the Monitor who will implement the processing of the manifest(s) with the Contractor at the time of waste disposal shipping and retain pertinent copies;
18. Attending construction meetings and other meetings as requested, being prepared to discuss observations and project status.
19. Being available to identify variance from best practices during the work involving asbestos abatement, hazardous materials, hazardous waste, or universal waste.

D. The Contractor shall cooperate fully with the Monitor during the course of work. Failure to cooperate fully may lead to the issuance of a stop work order. Any liquidated damages incurred as a result of any stop work order issued shall be the responsibility of the Contractor.

E. The Monitor will oversee work practices and ensure compliance to all applicable regulations, standards, and the Contract Documents.

F. The Monitor will perform visual inspections during and after the remediation work to ensure that all contaminated material has been properly removed in accordance with the contract documents.

3.5 WASTE DISPOSAL

A. All elemental mercury, waste with elemental mercury mixed in, and items containing >260 ppm of mercury shall be segregated, handled, and treated as high level mercury waste and retorted per 40 CFR, 268 – land disposal restrictions. All mercury-contaminated items containing <260 ppm of mercury shall be segregated, handled, treated, and disposed of as low level mercury waste.

B. Fluorescent fixtures are to be repackaged for recycling or disposed at an appropriate facility. Certificates of destruction are to be provided for lamps destroyed or recycled. Waste manifests are to be provided for lamps that are landfilled.

B. Leaking PCB or DEHP ballasts are to be destroyed by high-temperature incineration at an approved RCRA facility permitted to handle TSCA wastes. All ballasts are to be properly manifested. Certificates of destruction and waste transport/shipment records must be provided upon completion.

C. Non-leaking PCB or DEHP ballasts are to be properly incinerated or disposed of within a RCRA facility permitted to handle TSCA wastes. All ballasts are to be properly manifested. Certificates of disposal or destruction and waste transport/shipment records must be provided upon completion.

D. Batteries and mercury containing gauges/levels/thermostats shall be disposed of under the Universal Waste Rule.

E. All other wastes are to be disposed of in accordance with all applicable Federal, State and Local regulation

END OF SECTION 028100

SECTION 028213 – ASBESTOS ABATEMENT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including but not limited to General and Supplementary Conditions, and other Specification Sections, apply to this Section.

B. *Pre-Renovation Regulated Building Materials Survey for the SUNY Purchase College Rehabilitation of Natural Science Building, 735 Anderson Hill Road Purchase, New York SUCF Project #291029-00.* Prepared by Watts dated October 2021, Revised February 2025.

1.2 SUMMARY

A. This project includes the removal of asbestos-containing materials (ACM) from the Natural Science Building at SUNY Purchase, 735 Anderson Hill Road Purchase, New York.

1.3 SCOPE OF WORK

A. The asbestos abatement scope of work for this project is depicted on contract drawings HM1.01, HM1.02, sand HM1.03.

1.4 CODES AND REGULATIONS

A. General Applicability of Codes and Regulations and Standards: Except to the extent that more explicit or more stringent requirements are written directly into the Contract Documents, all applicable codes, regulations and standards 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.

B. 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 and Owner's Representative harmless for failure to comply with any applicable work, hauling, disposal, safety, health or other regulation on the part of himself, his employees or his subcontractors.

C. Federal requirements that govern asbestos abatement work or hauling and disposal of asbestos waste materials include but are not limited to the following:

1. OSHA: U.S. Department of Labor, Occupational Safety and Health Administration (OSHA), including but not limited to:

   a. Occupational Exposure to Asbestos, Tremolite, Anthophyllite, and Actinolite; Final Rules: Title 29, Part 1926, Section 1101 of the Code of Federal Regulations

   b. Respiratory Protection: Title 29, Part 1910, Section 134 of the Code of Federal Regulations

   c. Access to Employee Exposure and Medical Records: Title 29, Part 1910, Section 2 of the Code of Federal Regulations

   d. Hazard Communication: Title 29, Part 1910, Section 1200 of the Code of Federal Regulations

   e. Specifications for Accident Prevention Signs and Tags: Title 29, Part 1910, Section 145 of the Code of Federal Regulations

2. DOT: U.S. Department of Transportation, including but not limited to:

   a. Hazardous Substances: Title 49, Part 171 and 172 of the Code of Federal Regulations

3. EPA: U.S. Environmental Protection Agency (EPA), including but not limited to:

   a. Training Requirements of (AHERA) Regulations - Asbestos-Containing Material in Schools Final Rule & Notice: Title 40, Part 763, Subpart E, amended Appendix C of the Code of Federal Regulations dated April 4, 1994

   b. National Emission Standard for Hazardous Air Pollutants (NESHAP) National Emission Standard for Asbestos: Title 40, Part 61, Subpart A, and revised Subpart M (Revised Subpart B) of the Code of Federal Regulations dated November 20, 1990

D. State requirements that govern asbestos abatement work or hauling and disposal of asbestos waste materials include but are not limited to the following:

1. New York State Department of Labor (NYSDOL):

   a. Part 56 of Title 12 of the Official Compilation of Codes, Rules and Regulations of the State of New York (12 NYCRR Part 56) - Industrial Code Rule 56 (Code Rule)

2. New York State Department of Environmental Conservation (DEC) Regulations regarding waste collector registration:

   a. Title 6, Part 364 of the New York State Official compilation of Codes, Rules and Regulations. An annual "Industrial Waste Hauler Permit" specifically for asbestos-containing materials is required for transportation of asbestos-containing waste to the disposal site.

   b. New York State Department of Health (NYS DOH):

Title 10, Part 73: Asbestos Safety Program Requirements

E. Local Requirements: Abide by all local requirements that govern asbestos abatement work or hauling and disposal of asbestos waste materials.

1.5 STANDARDS

A. General Applicability of Standards: Except to the extent that more explicit or more stringent requirements are written directly into the Contract Documents, all applicable standards 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.

B. Contractor Responsibility: The Contractor shall assume full responsibility and liability for the compliance with all standards pertaining to work practices, hauling, disposal, and protection of workers, visitors to the site and persons occupying areas adjacent to the site. The Contractor shall hold the Owner and Owner's Representative harmless for failure to comply with any applicable standard on the part of himself, his employees or his subcontractors.

C. Standards: These standards apply to asbestos abatement work or hauling and disposal of asbestos waste materials and include but are not limited to the following:

1. American National Standards Institute (ANSI)
   1430 Broadway
   New York, NY 10018
   (212) 354-3300

2. Practices for Respiratory Protection Publication Z88.2-80

3. American Society for Testing and Materials (ASTM)
   1916 Race Street
   Philadelphia, PA 19103
   (215) 299-5400

4. Safety and Health Requirements Relating to Occupational Exposure to Asbestos E 849-82

1.6 SUBMITTALS

NOTE: Submittals will not be considered acceptable for review unless they are submitted as a complete package including all specified information. All information shall be submitted in the order listed in this specification section. An electronic copy of the submittals must be provided. Include title pages to identify the information included in the distinct sections. If any of the specified information is not included, contractor shall include a page acknowledging the specified information, and an explanation as to why the information is not included. Pre-work submittals shall be submitted at least ten (10) business days prior to the commencement of work.

A. At least ten (10) business days before the start of the project, legible copies of the following items must be submitted to the Owner or the Owner's Representative:

1. NYSDOL Contractor's License (DOH-432).
2. A statement signed by an authorized representative of the company stating that a Respiratory Protection Program that meets the requirements of OSHA Title 29, Part 1910, Section 134 will be in effect and followed during the project.
3. Project Notifications: As required by Federal and State regulatory agencies together with proof of transmittal (i.e. certified mail return receipt).
4. Provide a statement signed by an authorized representative of the company stating that the Building Occupants/Other Trades notification required by ICR 56 will be or has been posted at least 10 days prior to the start of the project. Provide a copy of the proposed Building Occupant Notification that will be posted at the job site.
5. A Negative Exposure Assessment (NEA) prepared in accordance with OSHA 1926.1101(f)(2), if one will be utilized. If a NEA will not be utilized, provide a statement signed by an authorized representative of the company stating that a negative exposure assessment will not be used.
6. Information regarding the type(s) of respiratory protection planned for use for each type of abatement activity.
7. Site-specific variance(s) proposed for use on the project, if applicable. Note: Any variance petition initiated by the contractor must be submitted to the Owner and/or Owner's Representative for review and approval prior to submission to NYSDOL.
8. Information (i.e. product data sheet) on the surfactant to be used. Note: Product must be specified for use on asbestos abatement projects.
9. Waste Hauler's Permit.
10. Landfill permit.
11. Name, address and phone number of air sampling firm and laboratory to be used on the project for OSHA personal samples. Include the accreditation of the analytical laboratory (ELAP certificates) of the air monitoring firm.
12. Site-Specific Work Plan that includes the following:
    a. A schedule for the completion of the work.
    b. Work procedures.
    c. Types of equipment to be used.
    d. Anticipated location for water and electrical hookups.
    e. Anticipated location of decontamination enclosures.
    f. Anticipated location(s) of negative air exhaust.
    g. Estimated crew size, shift times and durations.

h. Emergency procedures for fire and medical emergencies and for failure of containment barriers.

Marked-up drawings must be provided with the work plan to clearly indicate proposed work plan and work area layout (i.e. locations of decontamination units, negative air exhaust areas, locations of restricted areas to be established, estimated duration of abatement activities per work area, worker/waste pathways, dumpster locations, utility connections, etc.).

B. During the project, legible copies of the following items must be submitted to the Owner or Owner's Representative:

1. NYSDOL Asbestos Handling Certifications (DOH 442) for all persons employed on the project. (Likeness on photographs must be clear) *****
2. Proof of current (within the last 12 months) physical examination for all persons to be employed on the project. *****
3. Proof of current (within the last 12 months) respirator fit test for all persons to be employed on the project. *****
4. Project Log Book Entries.
5. Daily Sign-in Log.
6. Work Area Entry/Exit Log.
7. Any and all changes to the Contract should any occur.
8. Personal sampling results within 24 hours of sampling.

***** If this information is not provided at the time each worker arrives on site, they will be prohibited from working until the information is provided and reviewed.

C. During the project, legible copies of the following items must be maintained at the job site, and available for review:

1. The company's standard operating procedures manual.
2. The company's respiratory protection program.
3. Safety Data Sheets for all substances to be used on the project.

D. Upon completion of the project, legible copies of the following items must be submitted to the Owner or Owner's Representative:

1. Personal air sampling records including chain-of-custody forms and laboratory results. These records must also include the accreditation of the analytical laboratory (ELAP certificates).
2. Waste manifest(s), shipment records and landfill receipts signed by the landfill operator within 30 days after the waste leaves the site. A percentage of the final payment will be withheld until the waste shipment record is received by the Owner or Owner's Representative.
3. Project log book.

1.7 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the referenced regulations and standards.

B. Pre-work Conference: Before the work of this section is scheduled to commence, a conference will be held at the site for the purpose of reviewing the Contract Documents, discussing requirements for the work and site-specific procedures, reviewing the Contractor's approved Site-Specific Work Plan, and abatement procedures. The asbestos abatement contractor shall attend.

1.8 SPECIAL CONDITIONS

A. Locations and quantities of all materials to be removed by the abatement contractor must be field verified. Information given on contract drawings and specification sections is for general orientation and information only.

B. The Contractor shall have at least one English-speaking supervisor on the job site at all times while the project is in progress. The supervisor must be able to communicate fluently with all employees.

PART 2 – PRODUCTS AND RESPIRATORS

2.1 PRODUCTS

A. WETTING MATERIALS: For wetting prior to disturbance of asbestos-containing materials, use amended water:

1. Amended Water: Water to which a surfactant has been added. Use a mixture of surfactant and water which results in wetting of the asbestos-containing material and retardation of fiber release during disturbance of the material equal to or greater than that provided by the use of one ounce of a surfactant consisting of 50% polyoxyethylene ester and 50% polyoxyethylene ether mixed with five gallons of water.

B. POLYETHYLENE SHEET: Fire retardant polyethylene film in the largest sheet size possible to minimize seams, 6-mil thick as indicated, clear, frosted or black as indicated.

C. DUCT TAPE: Provide duct tape in 2" or 3" widths as indicated, with an adhesive which is formulated to stick aggressively to sheet polyethylene.

D. SPRAY CEMENT: Provide spray adhesive in aerosol cans which is specifically formulated to stick tenaciously to sheet polyethylene.

E. DISPOSAL BAGS: Provide 6-mil thick leak-tight polyethylene bags labeled as described in the standards referenced in Part 1 of this section.

F. GARDEN SPRAYER: Provide a hand pump type pressure-can garden sprayer fabricated out of either metal or plastic, equipped with a metal wand at the end of a hose that can deliver a stream or spray of liquid under pressure.

2.2 RESPIRATORS

A. Select respirators from those approved by the National Institute for Occupational Safety and Health (NIOSH), Department of Health and Human Services.

B. Respirators shall be fit-tested to personnel by an industrial hygienist or other competent person. Fit-tested respirators shall be permanently marked to identify the individual fitted, and use shall be limited to that individual.

C. In accordance with 29 CFR 1926.1101(h)(3)(iv), at a minimum, all employees will be required to use full face, powered air purifying HEPA-filtered respirators when they are in a regulated area where OSHA Class I work is being performed until a negative exposure assessment is obtained in accordance with 1926.1101 (f)(2)(iii).

D. No respirators shall be issued to personnel without such personnel participating in a respirator training program.

E. High Efficiency Particulate Air (HEPA) respirator filters shall be approved by NIOSH and have the NIOSH P100 designation. The respirator filters shall also conform to the OSHA requirements in 29 CFR 1910.134 and 29 CFR 1926.1101.

F. A storage area for respirators shall be provided by the Contractor on the clean room side of any established decontamination chamber where they will be kept in a clean environment.

G. The Contractor shall provide and make available a sufficient quantity of respirator filters so that filter changes can be made as necessary during the work day. Filters will be removed and discarded during the decontamination process. Filters cannot be reused. Filters must be changed if breathing becomes difficult.

H. Filters shall not be used any longer than one eight (8) hour work day.

I. Respirator filters shall be stored at the project site in the clean room of each work area personnel decontamination unit.

J. Where not in violation of NIOSH and OSHA requirements the Contractor shall provide at least the following minimum respiratory protection to the maximum use concentrations indicated below:

OSHA/NIOSH Approved Respiratory Protection	Maximum use Concentrations (fibers/cm^3) (f/cc)
Half Face Mask Air Purifying, HEPA Filtered	1.0
Full Face Piece Air Purifying, HEPA Filtered, Qualitative Fit Test	5.0
Powered Air Purifying (PAPR), Full Face Piece, HEPA Filtered	10.0
Supplied Air - Continuous Flow, Full Face Piece, HEPA Filtered	10.0
Supplied Air - Full Face Piece, Pressure Demand	100.0
Supplied Air - Full Face Piece, Pressure Demand with Auxiliary SCBA Pressure Demand or Continuous Flow	100.0

* A qualitative fit-tested tight fitting negative pressure air-purifying respirator can only be used in an atmosphere less than or equal to 10 times the PEL. In order to achieve the full protection factor, quantitative fit testing must be performed.

PART 3 – EXECUTION

3.1 ASBESTOS-CONTAINING MATERIAL HANDLING AND REMOVAL PROCEDURES

A. Perform work under this contract in accordance with the standards referenced in Part 1 of this Section. The provisions of any site-specific variance to New York State Department of Labor (NYSDOL) Industrial Code Rule 56 (ICR 56) obtained for this project may not be implemented until approval is given by the Owner or Owner's Representative.

B. Work resulting in disturbance of asbestos-containing materials shall be performed by a licensed asbestos abatement contractor employing certified workers in accordance with all applicable standards referenced herein.

3.2 CLEAN-UP PROCEDURES

A. Comply with the standards referenced in Part 1 of this Section.

3.3 AIR SAMPLING AND ANALYSIS

A. The Owner shall be responsible for hiring an independent third-party firm to perform any/all required area air sampling and analysis in accordance with ICR 56 and AHERA.

B. The Contractor is required to ensure cooperation of its personnel with the Air Sampling Technician (AST) for general air sampling, and clearance testing of each work area after completion of asbestos work prior to removal of containment barriers.

C. Air samples shall be analyzed using Phase Contrast Microscopy (PCM) and/or Transmission Electron Microscopy (TEM) in accordance with applicable NYSDOL Industrial Code Rule 56 and AHERA requirements.

D. Standard turn-around time for laboratory analysis of area air samples shall not exceed twenty-four (24) hours. The Owner may request an expedited turn-around time for some or all air samples. Copies of all area air monitoring results shall be maintained by the Project Monitor/Air Sampling Technician and included with the project monitoring closeout report.

E. For clearance air sampling: PCM air samples, taken utilizing an aggressive sampling technique must show airborne concentrations of total fibers below 0.01 fibers per cubic centimeter (f/cc). TEM results must show less than (<) an average of 70 structures per square millimeter, and/or be deemed satisfactory in accordance with the Z-test methodology as prescribed by AHERA.

F. If the clearance criteria are not met, then the abatement/decontamination is incomplete. The cleaning procedures shall be repeated and retesting conducted until such time clearance criteria are successfully achieved. The Contractor shall bear the cost of any additional re-testing required due to failure to achieve final clearance criteria.

3.4 PERSONAL AIR SAMPLING

A. The Contractor shall conduct daily personal monitoring that is representative of the exposure of each employee who is assigned to work within a regulated area who is performing OSHA Class I or II work, unless the employer has obtained a negative exposure assessment for the entire operation in accordance with OSHA 1926.1101 (f)(2)(iii). Periodic personal monitoring shall be performed in accordance with 1926.1101(f)(3). If the provisions of 1926.1101(f)(4)(i) are met and monitoring is discontinued, the Contractor shall resume the periodic personal monitoring whenever there has been a change in process, control equipment, personnel or work practices that may result in new or additional exposures above the permissible exposure limits or when the Contractor has any reason to suspect that a change may result in new or additional exposures above the permissible exposure limits. This resumption of personal monitoring is required regardless of whether a "negative exposure assessment" was previously produced for the specific work area.

B. All personal samples shall be analyzed within 48 hours upon being collected at the site. The analysis of personal air samples shall be conducted by an ELAP approved laboratory, subject to approval of the Owner or the Owner’s Representative.

C. The Contractor shall notify affected employees of the personal monitoring results that represent that employee's exposure as soon as possible following receipt of monitoring results. The Contractor shall notify affected employees of the results of monitoring representing the employee's exposure in writing either individually or by posting at a centrally located place that is accessible to affected employees.

3.5 PROJECT MONITORING

A. The Owner shall retain the services of a New York State Department of Labor licensed and certified Project Monitor to provide periodic, as needed site inspections, documentation review, and general consulting services. ICR 56 requires a Project Monitor perform a visual inspection at the completion of the asbestos abatement work to verify the completeness of the abatement and the cleanup. The Contractor shall cooperate fully with the Project Monitor(s) during the course of work. Failure to cooperate fully may lead to the issuance of a Stop Work Order. Any liquidated damages incurred as a result of any stop work order issued shall be the responsibility of the Contractor.

3.6 DISPOSAL OF ASBESTOS-CONTAINING MATERIAL AND RELATED DEBRIS

A. Transport the asbestos-containing waste and related debris to the approved disposal site. Comply with the standards referenced in Part 1 of this Section. All asbestos waste removed from the project site shall be transported directly to the disposal site without any additional waste being added to the container during transport.

B. The Contractor's Hauler and Disposal Site shall be approved by the Owner.

C. The Contractor shall give twenty-four (24) hour notification prior to removing any waste from the site. Waste shall be removed from the site only during normal working hours unless otherwise specified. Unless otherwise specified, no waste may be taken from the site unless the Contractor and Environmental Consultant are present, and the Environmental Consultant authorizes the release of the waste.

D. The Contractor and the Environmental Consultant shall inspect the material in the transport container prior to the waste transporter taking possession of the waste.

E. All waste generated as part of the asbestos project shall be removed from the site within ten (10) calendar days after successful completion of all asbestos abatement work.

3.7 RESTORATION

A. Remove temporary decontamination facilities and restore area designated for these facilities to its original condition or better.

END OF SECTION 028213

SECTION 028313 – WORKING WITH LEAD-CONTAINING MATERIALS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 specification sections, apply to this section.

B. ON MARCH 31, 2008 EPA ISSUED A RULE REQUIRING THE USE OF LEAD-SAFE PRACTICES AND OTHER ACTIONS AIMED AT PREVENTING LEAD POISONING. UNDER THE RULE, CALLED THE EPA'S LEAD-BASED PAINT RENOVATION, REPAIR AND PAINTING PROGRAM (LEAD-BASED PAINT RRP), BEGINNING IN APRIL 2010, CONTRACTORS PERFORMING RENOVATION, REPAIR AND PAINTING PROJECTS THAT DISTURB LEAD-BASED PAINT IN HOMES, CHILD CARE FACILITIES AND PRE-SCHOOLS BUILT BEFORE 1978 MUST BE CERTIFIED AND MUST FOLLOW SPECIFIC WORK PRACTICES TO PREVENT LEAD CONTAMINATION.

C. Child occupied facilities are defined by EPA as: Building or portion of building constructed prior to 1978, visited regularly by the same child, under the age of 6 years, on at least two days within any week (Sunday through Saturday period), provided that each day's visit lasts at least three hours and the combined weekly visits last 6 hours, and the combined annual visits last at least 60 hours. Child-occupied facilities may be located in public or commercial buildings or target housing.

1.2 RELATED CONTRACTORS

A. General Contractor will advise all other contractors, subcontractors and trades of the presence of Lead-Based Paint (LBP) and Lead-Containing Materials (LCM) and coordinate all work accordingly.

1.3 DESCRIPTION OF WORK

A. This section specifies the procedures for disturbance and/or removal of lead-based paint/coatings, lead-containing materials, and disposal of removed materials from the Depew Union Free School District (Depew UFSD) located in Depew, New York as part of Phase II of the Depew UFSD's 2016 Capital Improvements Project.

Phase II of the Depew UFSD's 2016 Capital Improvements Project includes work at the following locations:

1. Depew Bus Garage – 5261 South Transit Road, Depew, New York
2. Cayuga Heights Elementary – 1780 Como Park Blvd., Depew, New York
3. Depew Middle School – 5201 South Transit Road, Depew, New York

4. Depew High School – 5201 South Transit Road, Depew, New York

Refer to the contract documents for additional information regarding the scope of work.

1.4 SCOPE OF WORK

Testing of representative surfaces has been performed for the presence of lead-based paint/coatings at the buildings included within Phase II of the Depew UFSD's 2016 Capital Improvements Project. All contractors are responsible for making themselves and their employees aware of the presence, location, and quantity of existing LBP/LCM, and to warn their employees of the potential dangers of disturbing lead based paint. The requirements referenced in this specification shall apply to all disturbances of LBP/LCM.

A. All work under this contract shall be performed in strict conformance with applicable federal, state and local rules, laws and regulations.

B. The specifications are to be used in conjunction with the contract drawings for this project. A copy of each shall be maintained at the job site at all times.

C. Contractors shall verify all project conditions and material quantities prior to bidding the project. Material quantities listed in any documents provided by the Owner are approximations only and are NOT TO BE considered accurate for bidding purposes.

D. The contractor shall furnish all labor, materials, services, employee training, permits, insurance, and equipment for the disturbance and/or removal of LBP, LCM, and/or components covered with LBP.

E. General Notes:

1. All Lead removal and subsequent clean up activities shall be performed in accordance with these specifications and all applicable standards, codes and regulations as indicated in section 1.8.
2. Waste Disposal Requirements meeting EPA criteria shall be determined by sampling of a composite of the waste material for analysis by TCLP.
3. The contractor shall be responsible for performing TCLP sampling for waste stream classification, unless otherwise directed by the owner. The owner shall be responsible for retaining a third party environmental consultant to perform clearance inspections/sampling prior to re-occupancy in accordance with the NYS Education Department mandate of October 3, 1999.

F. The following materials have been identified to be covered with lead-based paint/coating at Depew Middle School:

- Metal pipes
- Metal walls
- Cork tack strips/tack boards (green)

- Structural steel I-beams

The following materials have been identified to be covered with lead-based paint/coating at Depew High School:

- Glazed block walls
- Glazed block window sills
- Structural steel I-beams
- Chalk boards (green)
- Cork tack strips (green)

Note: Results of testing for LBP at Cayuga Heights Elementary, as well as at the Bus Garage, did not identify building components covered with LBP/coatings.

Note: Furnishing of this information is not intended to relieve contractors of their responsibilities under OSHA to determine the lead-containing materials that their employees and subcontractors may be exposed to, and to warn their employees of the potential dangers of the disturbance of lead-containing materials.

G. For additional information regarding identified lead-containing materials, refer to prior test data/reports, which are available upon request.

1. Where any lead-containing materials are to be impacted by renovation plans, such activity shall generally take place as follows:

a. Contractor shall place poly drop cloths on the floor under and around the affected component to collect any dust/chips/debris that may fall during removal operations. Contractor shall install barrier tape around area of removal to restrict access by unauthorized persons. The Contractor shall properly dispose of all removed material and contaminated poly sheeting following waste stream classification.

1.5 QUALITY ASSURANCE

A. Use latest edition, including all addenda, revisions and supplements for all regulatory agencies codes, etc., including but not limited to:

1. Environmental Protection Agency (EPA).
2. Occupational Safety and Health Administration.
3. State of New York codes and laws.
4. All local codes.
5. US-DOT 49 CFR.
6. Guidelines for the Evaluation and Control of Lead-based Paint Hazards in Housing (US Department of Housing and Urban Development).

1.6 QUALIFICATIONS

A. The following qualifications must be met by all prospective bidders:

1. All contractor personnel who will participate in activities that may generate airborne concentrations of lead shall have, at a minimum, such training as specified in OSHA 29 CFR 1926.62 (d). Prior to starting the activities that may generate airborne concentrations of lead, provide workers with blood lead testing in accordance with OSHA 29 CFR 1926.62(d).

1.7 REGULATIONS

A. All work under this contract shall be done in strict accordance with all applicable federal, state, and local regulations, standards, and codes governing lead disturbance and/or removal and any other trade work done in conjunction with this work.

B. The most recent edition of any relevant regulation, standard, document, or code shall be applicable to the work. Where conflict among the requirements or with these specifications exists, the most stringent requirements are applicable.

C. Copies of all standards, regulations, codes, and other applicable documents and subsequent amendments thereto, listed in this section and including this specification, shall be available at the work site.

1.8 SPECIFIC REQUIREMENTS

A. New York State Education Department (NYSED)

1. NYSED regulations governing lead abatement include, but are not limited to:

a. Sections 101, 207, 409-d, 409-e, 3602 and 3641 of the Education Law
b. Chapters 56 and 58 of the Laws of 1998.
c. Section 155.1 of the Regulations of the Commissioner of Education amended, October 7, 1999.

B. Occupational Safety and Health Administration (OSHA)

1. OSHA regulations governing lead disturbance include, but are not limited to:

a. Title 29 Section 1910.134, respiratory protection.
b. Title 29 CFR Section 1910.20, access to employee exposure and medical records.
c. Title 29 CFR Section 1910.1200, hazard communication.
d. Title 29 CFR Section 1910.95, noise regulation.
e. Title 29 CFR Part 1926.62, Lead Exposure in Construction; Interim Final Rule.

C. Environmental Protection Agency (EPA)

1. EPA regulations governing hazardous waste disposal include but not limited to:
2.
    a. 40 CFR Part 260, Definitions.
    b. 40 CFR Part 261, Section 3001: Identification and Listing of Hazardous Waste.
    c. 40 CFR Part 262, Section 3002: Standards Applicable to Generators of Hazardous Waste.
    d. 40 CFR Part 263, Section 3003: Standards Applicable to Transporters of Hazardous Waste.
    e. 40 CFR Part 264, Section 3004: Final Standards Applicable to Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities.
    f. 40 CFR Part 267, Temporary Standards for Land Disposal Facilities.
    g. 40 CFR Part 268, Land Disposal Restrictions.
    h. 40 CFR Part 270, 271 & 124, Section 3005: Permits for Treatment, Storage and Disposal of Hazardous Wastes.
    i. 40 CFR Part 745.

D. American National Standards Institute (ANSI)

1. ANSI standards governing lead abatement include, but are not limited to:

    a. Fundamentals governing the design and operation of local exhaust systems, Publication 29.2-79.
    b. Practices for respiratory protection, Publication Z88.2-80.

E. Mine Safety and Health Administration (MSHA)

1. Certification of respirators as per 30 CFR Part 11.

F. National Institute for Occupational Safety and Health (NIOSH)

1. NIOSH regulations governing lead abatement include, but are not limited to:

    a. Approval of respirators as per 30 CFR PART 11.

G. New York State Requirements

1. State regulations governing Hazardous Waste Disposal include, but are not limited to:

    a. 6 NYCRR Part 371, Identification and Listing of Hazardous Wastes, December 25, 1988.

b. 6 NYCRR Part 373-2, Final Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities, December 25, 1988.

c. 6 NYCRR Part 360, Solid Waste Management Facilities, Revised March 27, 1990.

H. Department of Transportation

1. 49 CFR Parts 171-179.

I. Department of Housing and Urban Development

1. Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing. June 1995.

J. Licenses

1. Maintain current licenses as required by applicable federal state or local jurisdictions for the removal, transportation, disposal, or other regulated activity relative to the work of this Contract.

K. New and Amended Regulations

1. Any and all new or amended federal, state, or local regulations becoming effective during this project and not listed are to be considered as part of this specification. Where copies of standards are needed for proper performance of the work, the Contractor is required to obtain such copies directly from the publication source. Although certain copies of standards needed for enforcement of the requirements may be required submittals, the owner's representative reserves the right to require the Contractor to submit additional copies of these standards as necessary for enforcement of the requirements.

1.9 DEFINITIONS

A. Action Level: Employee exposure, without regard to respiratory protection, to an airborne concentration of lead of thirty (30) micrograms per cubic meter of air, as an 8-hour time weighted average, measured in the breathing zone as defined by 29 CFR 1926.62.

B. Hazardous Waste: Material, including contaminated material, which after testing by the Toxicity Characteristic Leaching Procedure (TCLP), the leachate contains any element in excess of the following:

Arsenic	5mg/l		Barium	100mg/l
Cadmium	1mg/l	Chromium	5mg/l	
Lead	5mg/l	Mercury	0.2mg/l	
Selenium	1mg/l	Silver	5mg/l	

C. Lead-Based Paint: Paint under laboratory analysis that contains 0.5%, by weight or greater elemental lead. Paint analyzed by XRF that contains equal to or greater than 1.0 mg/cm^2.

D. Lead Work Area: That area where lead disturbance operations are performed which is isolated by physical boundaries that assist in the prevention of uncontrolled release of lead dust or debris.

E. Permissible Exposure Limit: Employee exposure, without regard to respiratory protection, to an airborne concentration of lead of fifty (50) micrograms per cubic meter of air, as an 8-hour time weighted average, measured in the breathing zone as defined by 29 CFR 1926.62.

F. Regulated Area: Area(s) where lead work is conducted as defined by 29 CFR 1926.62.

1.10 SUBMITTALS

NOTE: Submittals will not be considered acceptable for review unless they are submitted as a complete package including all specified information. All information shall be submitted in the order listed in this section. Include title pages to identify the information included in the distinct sections. If any of the specified information is not included, contractor shall include a page acknowledging the specified information, and an explanation as to why the information is not included. Pre-work submittals shall be submitted at least ten (10) business days prior to the commencement of work.

A. Pre-Construction: At least ten (10) business days prior to the commencement of activities that may generate airborne concentrations of lead, the Contractor shall provide all required submittals in accordance with the Contract Documents and provisions herein.

The Contractor shall not proceed with disturbance and/or removal method, materials and/or equipment prior to receipt of approval. Any disturbance and/or removal method, material and/or equipment used which are not in compliance with “approved” or “approved as noted” shall be at no cost to the Owner.

The Contractor shall provide copies of the following:

1. Lead-Containing Material Removal Work Plan: The work plan shall include, but not be limited to: the location, size, and details of lead dust control work areas, work procedures, types of equipment, and crew size.
2. OSHA Compliance Program in accordance with OSHA 29 CFR 1926.62(e)(2).
3. Transporter Permits: DEC permit and permit(s) as required by county(s) through which the lead contaminated waste and recycled material is transported to TSDF and/or recycling facility.
4. Disposal Site/Landfill Permit from applicable regulatory agency.

B. The following submittals, documentation, and postings shall be maintained onsite by the Contractor during abatement activities (Subject to owner/owner's representative request and approval):

1. Copies of training/certification records as required by the EPA's RRP rule.
2. Copies of written respiratory program.
3. Proof of current (within last 12 months) physical exam for use of a respirator and provide copy of qualitative fit test for all personnel.
4. Personal air monitoring records and test results as required by OSHA.
5. Safety Data Sheets for products being used on the project.

C. Following the completion of abatement activities, the Contractor shall submit the following Project Close-Out Documentation:

1. Contractor Supervisor's daily activity logs during all phases of the work including preparation, disturbance and/or removal and final cleaning.
2. Personnel paperwork for each Employee actually utilized on project including:

    a. Copy of valid respirator fit test issued within the twelve-month period preceding the conclusion of abatement.
    b. Proof of current (within last 12 months) physical examination indicating ability to safely don respiratory protection and respirator fit tests for all persons required to wear respirators

3. Personal Sampling Records and test results for the project.
4. Waste and recycled materials manifest(s) from TSDF and recycling facility representatives listing dates of delivery, quantity of material, confirmation of receipt in proper, undamaged containers and signature(s) by authorized designated representative(s) including signature of Owner or Owner's Representative.

PART 2 – PRODUCTS AND PROCEDURES

2.1 PRODUCTS

A. Polyethylene Sheeting

1. Polyethylene sheeting shall be at least 6 mil thickness, in widths selected to minimize joints.
2. Polyethylene sheeting utilized for worker decontamination enclosure shall be opaque white.
3. All polyethylene sheeting shall be fire retardant material.

B. Attachment Materials for Polyethylene: Method of attaching polyethylene sheeting shall be agreed upon in advance by the Contractor and Owner or Owner's Representatives and selected to minimize damage to equipment and surfaces. Method of attachment may include any combination of duct tape or other waterproof tape, furring strips, spray glue, staples, nails, screws, or other

effective procedures capable of sealing adjacent sheets of polyethylene and capable of sealing polyethylene to dissimilar finished or unfinished surfaces under both wet and dry conditions (including the use of amended water).

C. Disposal Bags: As required, 6 mil polyethylene, pre-printed with labels as required by this specification shall contain the following information:

DANGER
CONTAINS LEAD DUST
AVOID CREATING DUST
OWNER

D. Disposal Drums: metal or fiberboard with locking ring tops, warning labels as required by OSHA, EPA and DOT.

E. Stick-On Labels: per OSHA Requirements.

F. Surfactant (Wetting Agent): 50/50 mixture of Polyoxyethylene Ether and Polyoxyethylene Ester, or equivalent, mixed in a proportion of 1 fluid ounce to 5 gallons of water or as specified by manufacturer. (An equivalent surfactant shall be understood to mean a material with a surface tension of 29 dynes/cm as tested in its properly mixed concentration, using ASTM Method D1331-56 "Surface and Interfacial Tension of Solutions of Surface Active Agents"). Where work area temperature may cause freezing of the amended water solution, the addition of Ethylene Glycol in amounts sufficient to prevent freezing is permitted.

G. Encapsulating Agent: provide an encapsulant specifically designed for application to lead based paint. All materials used shall have a flame spread of less than 25 when dry (when tested in accordance with ASTM-84).

Note: Contractor shall obtain Owner/Owner's Representatives Owner's permission prior to using spray adhesives on building surfaces.

2.2 GENERAL EQUIPMENT

A. A sufficient supply of disposable mops, rags, and sponges for work area cleaning shall be available.

B. A sufficient supply of scaffolding, ladders, lifts, and hand tools, (e.g., scrapers, wire cutters, brushes, utility knives, wire saws, tarps etc.) shall be provided as needed.

C. Low pressure or airless sprayers.

D. Rubber dustpans and rubber squeegees.

E. Brushes utilized for removing loose lead based paint shall have nylon or fiber bristles, not metal.

F. HEPA filtered vacuum cleaners with attachments.

2.3 PERSONNEL PROTECTION

A. Regulatory requirements - Section 1.8

B. Personnel protection procedures - Sections 2.4, 2.5, 2.6, & 2.7

2.4 RESPIRATORY PROTECTION EQUIPMENT

A. Respirators shall be provided to ensure that the workers are not exposed to lead in air concentrations above the PEL of 50 micrograms/cubic meter. Respirators must be worn in accordance with tasks described in 29 CFR part 1926.62, Lead Exposure in Construction; Interim Final Rule. The rules set forth in 29 CFR 1910.134 and 29 CFR 1926.62 shall govern selection, training and use of respiratory protection.

2.5 PROTECTIVE CLOTHING

A. A sufficient supply of disposable or cloth protective coveralls with full sleeves and full legs shall be supplied by the contractor to all employees, as required by 29 CFR 1926.62(g).

B. Additional safety equipment (e.g., hard hats meeting the requirements of ANSI Standard Z89.1-1981, eye protection meeting the requirements of ANSI Standard Z87.1-1979, safety shoes meeting the requirements of ANSI Standard Z41.1-1967, disposable PVC gloves or other work gloves), as necessary, shall be provided to all workers and authorized visitors.

2.6 TRAINING

A. All employees shall have completed, at a minimum, training in accordance with 29 CFR 1926.62.

2.7 MEDICAL SURVEILLANCE

A. Medical surveillance must be provided by the contractor to any employee or agent working on this project in accordance with 29CFR Part 1926 (Lead Exposure in Construction). No worker or supervisor will be allowed to work on this project while blood lead levels are over 30 micrograms / deciliter.

2.8 PERSONAL AIR MONITORING

A. Contractor will be responsible for personal air monitoring of workers, and results given to the Owners Representative for review within 24 hours of sampling.

2.9 ENVIRONMENTAL TESTING

A. The Owner shall be responsible for engaging the services of a third party environmental consultant to conduct any/all necessary clearance wipe sampling. Clearance wipe sampling is required by NYSED for areas where LBP disturbances take place prior to re-occupancy by school district personnel or students. Testing services will be performed under a separate third party contract with the Owner's Representative. According to HUD standards, clearance wipe samples are considered satisfactory when the results are less than 40 micrograms per square foot on floors, 250 micrograms per square foot on interior window sills, and 400 micrograms per square foot on the window troughs.

PART 3 – EXECUTION

3.1 GENERAL

Conduct all lead-based paint disturbance and related work in accordance with the provisions of all applicable standards, codes and regulations.

A. Cordon off entire work area with danger tape or fences to prevent entry of unprotected persons. Always provide a means of ingress/egress for building occupants.

B. Establish emergency and fire exits from the work area as part of the written emergency action plan.

3.2 PREPARATION - WORK AREAS

A. Cordon off work area with contractor fencing or warning tape.

B. A curtain consisting of three interlocking sheets, constructed of 6-mil poly sheeting shall be constructed at entrance to work area. A drop cloth (single layer of 6-mil poly sheeting) shall be placed under and/or around the component that is being removed or disturbed.

C. Access to the work area shall be through a restricted entrance area only.

D. Signs: Caution signs, per 29 CFR 1926.62(m), shall be posted at all locations and approaches to a location where airborne concentrations of lead dust may exceed ambient background levels. Signs shall be conspicuously posted that allow a person to read the sign and take the necessary protective measures to avoid potential exposure.

E. Utilities: The Owner will provide electrical and water utilities. The Contractor shall provide a sufficient supply of power cords and ground fault circuit interrupters. The contractor shall be responsible for making connections to the electric and water supply. Only certified electricians and plumbers shall conduct electrical and plumbing work.

F. Exits: Emergency and fire exits from the work area shall be maintained or alternate exits shall be established according to all applicable codes.

G. Contractors shall utilize engineering controls such as negative pressure ventilation equipment, wet methods, chemical peels and HEPA vacuums and equipment to minimize airborne dust levels.

H. At a minimum, the following work practices shall be followed for removing intact building/mechanical components (doors, doors frames, corkboards, trim, radiators, pipes etc.)

1. Contractor shall install barrier tape and warning signs to restrict access by unauthorized personnel.
2. A drop cloth of 6-mil plastic sheeting shall be placed under and around the component to be removed.
3. Collect any paint chips, dust, or debris that results from removing the building component.
4. All horizontal surfaces in the areas where the components have been removed shall be cleaned, prior to wipe samples being collected.

I. At a minimum, the following work practices shall be followed for removing or disturbing window components.

1. A drop cloth (single layer 6-mil plastic sheeting) shall be placed under the window that is being removed.
2. Barrier tape and warning signs will be placed at the entrance to each area where the work is occurring.
3. A curtain constructed of 6-mil plastic sheeting shall be constructed around the window(s) being removed and or scraped or the doorway to the room where the work will occur shall be sealed with a curtained doorway consisting of three interlocking layers of 6 mil plastic sheeting.
4. Any loose, peeling or flaking paint shall be immediately containerized to prevent it from being spread throughout the building.
5. All horizontal surfaces in the areas where the components have been removed shall be cleaned, prior to wipe samples being collected.

J. At a minimum, the following work practices shall be followed for demolishing or disturbing glazed/ceramic tile, plaster, concrete, block or brick walls and ceilings.

1. A drop cloth (single layer of 6-mil plastic sheeting) will be placed under and around the walls and/or ceiling that is being removed.
2. Barrier tape and warning signs will be placed at the entrance to each area where the work is occurring.
3. A curtain constructed of 6-mil plastic sheeting shall be constructed around the
window(s) being removed and or scraped or the doorway to the room where the work will occur shall be sealed with a curtained doorway consisting of three interlocking layers of 6 mil plastic sheeting.

4. All horizontal surfaces in the areas where the components have been removed shall be cleaned, prior to wipe samples being collected.

K. At a minimum, the following work practices shall be followed for the removal/stripping of paint from structural steel.

1. Barrier tape and warning signs shall be placed around the work area to restrict access by unauthorized personnel.
2. In areas where paint will be removed from the structural steel, 6-mil plastic sheeting shall be installed to protect horizontal surfaces within the restricted work area, as well as adjacent areas, as appropriate.
3. HEPA-filtered negative pressure ventilation equipment shall be installed and operated within the work area(s) to help control airborne dust levels for the work area.
4. All surfaces in the work area(s) where the paint/components have been removed shall be cleaned, prior to inspection by the third party environmental consultant.

3.3 ADVERSE WEATHER CONDITIONS

A. Work shall not take place during periods when precipitation is likely unless provisions are made to keep rainwater from mixing with lead contaminated dust and debris. Any accumulations of water in the work area shall be cleaned immediately and disposed of in accordance with all applicable state and federal regulations.

B. Exterior work shall not take place during periods when high wind is likely to cause dispersal of dust and debris. Halt work procedures if wind is greater than or equal to 15 MPH.

3.4 FINAL CLEAN-UP

A. Remove visible accumulations of materials and debris. HEPA vacuum all surfaces within the work area and within worker/equipment decontamination enclosure system, wet clean, then HEPA vacuum again. Sealed drums, bags, and all equipment used in the work area shall be included in the clean up and shall be removed from work area.

B. Frequency for Cleaning of Dust. Accumulations of dust shall be cleaned off all surfaces on a daily basis using HEPA vacuum and/or wet cleaning methods. Removal work shall stop in time to thoroughly clean work area at the end of each shift.

C. Contractor shall clean all surfaces with wet method wiping and HEPA-filtered vacuum equipment; this will include the cleaning of Contractor's equipment, after cleaning the work area.

D. A visual inspection shall be performed by the Owner's Environmental Consultant under conditions of adequate lighting provided by the contractor. The work area shall be free of visible debris.

3.5 QUALITY ASSURANCE

A. The owner's representative and/or environmental consultant shall inspect work areas subject to this specification. The contractor will bring into compliance any unsatisfactory conditions as noted within 24 hours of such notice. The contract will be complete only when all conditions of this specification have been met to the satisfaction of the project Owner, and Owner's Representative.

3.6 ON-SITE STORAGE OF DEBRIS

A. All on site storage of hazardous waste/materials shall conform to the applicable regulations of all Federal, State and local agencies having jurisdiction in such matters, in addition to the other provisions of this document.

B. All debris shall be stored in a secured, locked staging area.

C. Debris shall not be stored in any building at the site.

D. Non-hazardous debris (construction demolition) shall be stored in dumpsters and removed on a weekly basis or more often, unless otherwise specified in writing by the Owner or Owner's representative.

E. The placement of all dumpsters, trailers, or other storage shall be done with the Owner or Owner's representative's approval. Waste trailer/dumpster locations may be remote from the work area.

F. Conditions caused by the storage of such materials affecting the health and safety of the public including but not limited to fire, dust or vermin, shall be grounds to require the Contractor to remove, relocate, or take other control measures to correct the condition at the Contractor's expense.

3.7 DISPOSAL OF NON-HAZARDOUS WASTE

A. All disposal of waste shall conform to the regulations of all Federal, State and local agencies having jurisdiction.

B. The contractor shall submit to the owner proof of proper disposal consisting of dump tickets from an approved landfill. Proof of proper disposal must be submitted prior to project close-out.

C. Non-hazardous waste shall be disposed of by the contractor at the contractor's expense.

D. Testing of lead-based paint debris, not inclusive of construction and demolition debris as defined by EPA, will be tested by TCLP for waste characterization by the contractor, unless otherwise directed by the owner.

3.8 HAZARDOUS WASTE – LEAD

A. Hazardous Wastes/Lead Waste - Liquid:

1. No water or solvents shall be discharged into any waterway, sewer or on the ground.
2. All liquid waste shall be disposed of by the contractor at the contractor's expense. The contractor shall be responsible for the temporary storage and disposal of all liquid waste. Testing of waste for characterization shall be conducted by the contractor, unless otherwise directed by the owner.
3. The contractor shall submit to the owner proof of proper disposal consisting of, waste hauler license and permit, trailer numbers for all vehicles and trailers used for transport, signed waste manifest and bills of lading for all shipments and from approved and licensed TSD facility. Proof of proper disposal must be submitted on an ongoing basis, within 20 days if disposal site is located within NYS, 45 days if outside NYS, and prior to or at the same time as applications for payment. The contractor will not be paid until proof of proper disposal is submitted.

B. Hazardous Wastes/Lead Waste - Solids:

1. The contractor shall supply a suitable container(s) for the storage of lead waste.
2. The contractor shall be responsible for lining waste containers with two layers of 6-mil polyethylene sheeting. The contractor will keep the waste containers locked and secured at all times. The contractor shall be responsible for packaging and labeling of all lead waste.
3. The contractor shall test the waste by TCLP for waste stream classification, unless otherwise directed by the owner. All hazardous waste shall be disposed of at the contractor's expense, and disposal shall be as required by federal, state and local laws and/or regulations the waste characteristics as per the TCLP analysis.
4. The contractor shall submit to the owner proof of proper disposal consisting of, waste hauler license and permit, trailer numbers for all vehicles and trailers used for transport, signed waste manifest and bills of lading for all shipments from approved and licensed TSD facility. Proof of proper disposal must be submitted on an ongoing basis, within 20 days if disposal site is located within NYS, 45 days if outside NYS, and prior to or at the same time as applications for payment. Contractor will not be paid until proof of proper disposal is submitted.

3.9 CONTAINER LABELING REQUIREMENTS

A. These requirements shall be enforced whenever hazardous materials or hazardous wastes shall be transported from or to the job site.

B. Hazardous Wastes:

1. Closure Date: All containers shall be marked within 48 hours of being filled and sealed.
2. Labels: Such labels shall be either stenciled/painted on container or on preprinted "bumper sticker" materials. Date may be filled in neatly by hand with either weather/wear resistant paint stick or other indelible marker.
3. Shipping Address: All containers shall be marked with the proper shipping address of the consignee and the shipper's address.
4. DOT Classification: Where required by Federal regulations, DOT, containers shall carry a proper DOT classification diamond (4" x 4") and proper UN#. Where required by law, any trucks used to transport materials shall be properly placarded as to hazard classification.

END OF SECTION 028313

SECTION 028513 – EXHAUST DUCT REMEDIATION

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.

B. Representative bulk testing from the interior of the fume hood exhaust duct system has been performed to determine the proper handling and disposal requirements for any deposits found within the exhaust ducts. The results of the investigation and testing are detailed within *Laboratory Contaminated Materials Investigation and Sampling Report for the Rehabilitation of Natural Science Building, SUCF Project #291029-02, State University of New York College Purchase, Purchase, New York, dated February 2021, Revised October 2024, prepared by Watts Architecture & Engineering.* Elevated total concentrations of cadmium, chromium, lead, and mercury were detected in the dust/debris located within the fume hood exhaust duct system at significant concentrations which exceed the RCRA toxicity limits when applying the twenty times rule. As a result of limited bulk dust available for sampling at the sampling points within the fume hood exhaust duct system, TCLP disposal characteristics sampling was not performed due to insufficient amounts accessible at the time of sampling. Given the likely inconsistency of the chemical makeup of the dust present within the duct system, it must be assumed that contamination is present throughout. Given the elevated total concentrations that have been identified, all exhaust ducts shall be assumed to contain contaminated deposits that are hazardous for cadmium (D006), chromium (D007), lead (D008), and mercury (D009). All fume hood exhaust and associated ductwork and mechanical parts that are impacted by this project will require careful disassembly, removal, staging and cleaning prior to their disposal as construction and demolition waste or be sent off for recycling once cleaned. Disposal of the removed deposits, cleaning equipment, and personal protective equipment shall be classified based on the waste characterization laboratory results conducted by the Contractor upon completion of the work for the recovered exhaust duct system wastes, but the waste shall retain the following waste codes: D006, D007, D008, and D009, for the toxicity of cadmium, chromium, lead, and mercury given the identified total quantities. Any future sample collection shall be observed by the Owner or Owners Representative.

C. *Hazardous Waste/Contaminated Materials Inventory Report for the Rehabilitation of Natural Science Building, SUCF Project #291029-00, State University of New York at Purchase, Purchase, New York, dated February 2021* prepared by Watts Architecture & Engineering, is included separately and is for reference only.

D. *Mercury Vapor Monitoring Report* dated January 2, 2026 (and future supplemental update that is to forthcoming) prepared for SUNY Purchase conducted by Quality Environmental Solutions & Technologies, Inc.

E. Pre-Renovation Regulated Building Materials Survey for the SUNY Purchase College, Rehabilitation of Natural Science Building Project, SUCF Project #291029-02, *dated October 2021,* prepared by Watts Architecture and Engineering, is included separately and is for reference only. Any disturbance of ACM must follow all applicable rules and regulations. See Specification 028213 Asbestos Abatement for additional information.

1.2 DESCRIPTION OF THE WORK

A. The work shall consist of the proper removal, packaging, labeling, transportation, and disposal of all contaminated deposits found within the fume hood exhaust ducts from areas where exhaust ducts will be removed within the project limits. Contractor shall be responsible for any supplemental testing of the removed deposits and collected cleaning solutions to determine their proper disposal requirements. Contractor's bid shall assume that the deposits are RCRA hazardous waste due to the toxicity of the elevated presence of cadmium, chromium, lead, and mercury.

B. The dismantlement, inspection, and cleaning of fume hoods, ducts, and mechanical parts impacted by this project shall include all fume hood exhaust system components within the project limits of demolition.
   1. All exhaust ducts will be handled as if they are contaminated. As a result, the exhaust ducts will require physical removal, careful disassembly and cleaning to complete the removal and collection of any deposits found within the interior of the exhaust duct network. The condition found within the interior of the ducts may vary by proximity to the nearest fume hood; location within the building or on the roof; commonly executed chemical processes contributing to particulate deposition; alignment and configuration of the duct; size and shape of duct; and, a variety of other factors. Internal conditions may vary from clean and containing no appreciable deposits to areas where the deposits are thick and must be scraped or scrubbed off for collection.
   2. Once the deposits are removed and the ducts are cleaned, the metal ducts may be transported off-site for disposal in a NYSDEC regulated solid waste landfill as construction and demolition (C&D) debris or salvaged and sent off-site for recycling. Contractor shall note that some fume hood units and ducting will be reused on this project and shall be properly cleaned to remove hazardous and/or contaminated deposits. Contractor shall be responsible for confirming disposal of the metal ducts as C&D material or the ability to recycle these materials under the NYSDEC regulations.
   3. Access to the ducts may require asbestos abatement of the fume hoods and countertops, removal of wall sections, possible saw cutting, and any other action to remove all exhaust ducting within the project limits. The contract drawings indicate the room locations where the exhaust ducts originate. The asbestos abatement design drawings indicate what asbestos containing building materials are located in the area of demolition.
   4. The disposal of all waste streams (e.g., removed deposits, cleaning fluids, cleaning equipment, and personnel safety equipment) must be at licensed and permitted treatment, storage and disposal facilities in compliance with all regulatory requirements. In addition, the Contractor is responsible for all

additional sampling and analysis requirements specified by the receiving disposal or recycling facilities, and the development of approved waste profile(s) for acceptance into that facility.

5. Contractor shall be responsible for confirming the existence and availability of power, lighting needed to perform his work and providing all makeup utility services required for the completion of this work. Contractor is responsible for all fall hazard safety protection associated with removal. Contractor shall be responsible for temporary utilities that may be required for cleaning stations. Contractor shall also coordinate the shutdown of all utility systems within the building as necessary to perform the work with appropriate SUNY Purchase College personnel.

C. This section identifies the types of wastes that the Contractor will be required to develop precautions and procedures to be followed to protect against the contamination of the building and protect workers, occupants and the public:

1. Contractor should anticipate various inorganics (metals) and organic compounds are likely present within the exhaust duct deposits and interior coatings.

D. The following reference materials have been developed to assist the Contractor in the performance of the work:
1. Architectural and mechanical demolition drawings.
2. Hazardous material drawings.

E. The Contractor shall note that other environmental concerns have been identified. These concerns will not be addressed under this specification but will be described in their own specification.

F. The Contractor shall develop all applicable waste manifests, shipping papers, waste profiles, land ban forms and any other documentation and coordinate with the Consultant and SUNY Purchase College Environmental Health and Safety (EHS) personnel for review and signature.

G. The work area includes all areas within the project limits where the above referenced materials slated for removal and subsequent disposal are located.

H. The Contractor shall manage all surplus materials and waste generated in the performance of the contract in accordance with applicable Federal, State, and local laws and regulations.

I. The Contractor shall engage a single firm to perform the work of this section. The firm shall have the following qualifications:
1. Performance of at least three (3) projects in the previous ten (10) years that are similar to the work required for this project, including coordination with simultaneous asbestos abatement and general demolition work.
2. It has developed and employed a Work Plan, Spill Contingency Plan, and Site-Specific Health and Safety Plan similar to that required for this project.
3. It has established a Quality Control Program that includes hazard communications and chemical hygiene plans; employee background checks and

medical testing; and, waste determination procedures and guidelines, and proper waste manifest tracking.

4. It has a Project Manager available for this project with at least three years of experience performing similar work; all required training certifications; fluent in the English language and capable of communicating with all the staff; and is experienced in visual inspection, handling, cleaning, storage and field characterization of hazardous materials and contaminated materials similar to those anticipated on this project.
5. For all employees involved with the hazardous waste related work, completion of 40-hour OSHA HAZWOPER training, annual 8-hour OSHA HAZWOPER refresher training, and proof of annual medical physicals and respirator fit tests.
6. Must be able certify in writing that these qualifications are met for the firm and persons involved with the hazardous waste and contaminated materials work, and if requested, can submit documentation and resumes to demonstrate their capabilities, experience, and include a list of completed projects with project contact names, addresses, and phone numbers.

J. The Contractor shall be aware of all conditions of the Project and is responsible for verifying quantities and locations of all Work to be performed. Failure to do so shall not relieve the Contractor of its obligation to furnish all labor and materials necessary to perform the Work.

K. All Work shall be performed in strict accordance with the Project Documents and all governing codes, rules, regulations and guidelines. Where conflicts occur between the Project Documents and applicable codes, rules, regulations and guidelines, the more stringent shall apply.

1.3 RELATED SECTIONS

A. Hazardous Waste and Contaminated Materials Removal (Specification 02 8100)

B. Asbestos Abatement (Specification 02 8213)

C. Lead Remediation (Specification 02 8313)

D. PCB Caulk Remediation (Specification 02 8400)

E. Acid Waste Plumbing System Remediation (Specification 02 8613)

F. Universal Waste and Fluorescent Lamps (Specification 02 8700)

1.4 SUBMITTALS

A. The Contractor shall certify in writing that they have prepared and will maintain a valid Site-Specific Health and Safety Plan to support the hazardous waste and contaminated materials work of this section. The Contractor shall certify in writing that they have a valid OSHA Respiratory Protection Program. Submission of the Site-Specific Health and Safety Plan and OSHA Respiratory Protection Program is not necessary, unless specifically requested by the General Contractor, SUNY

Purchase College, and/or SUCF (as part of the overall Natural Science Building renovation project). As part of this work the Contractor will designate and maintain a full-time on-site Health and Safety Officer and off-site Corporate Health and Safety Coordinator for the duration of the associated tasks.

B. The Contractor shall certify in writing that they and their personnel meet the qualifications as described under Section 1.2.I. Submission of all documentation to prove that the qualifications are met is not necessary, unless specifically requested by the General Contractor, SUNY Purchase College, and/or SUCF (as part of the overall Natural Science Building renovation project).

C. The Contractor shall be required to submit a Work Plan explaining the personal protective equipment, work methods, procedures, safety, site storage, transportation, and final treatment/disposal/recycling that will be utilized for all work covered under this section. The Work Plan under this section can be a stand-alone document that only covers the work under this section, or if applicable and the work will occur alongside other hazardous waste related work, an overarching Work Plan document may be prepared for the project, provided all necessary and appropriate information is included. Submission shall be made at least 14 days prior to the anticipated start of work for review by the Architect and Environmental Design Consultant prior to the commencement of activities. The plan shall include:
   - List of the anticipated on-site supervisor(s) and workers scheduled to perform this work. Provide the following for each individual:
     - Certificates of successful completion of the OSHA 40-hour HAZWOPER course for handling hazardous materials along with proof of current 8-hour annual refresher (if applicable) and the OSHA 10-hour Construction Safety training (if applicable).
     - Proper documentation or certificates for workers which have successfully completed the required employee training for Universal Waste or appropriate type of training to the type of wastes being managed by those workers as applicable (i.e.: for Universal Waste such as fluorescent bulbs, see United States 40 CFR § 273.16 and § 273.36, and New York 6 CRR-NY IV B 374-3; for ozone depleting refrigerant technicians see training for stationary refrigeration and air conditioning under Section 608 of the Clean Air Act per 40 CFR § 82.161 Technician Certification; etc.)
     - Certification of medical examinations completed within the past 12 months. Only include the health providers written opinion that the employee is certified to complete the work covered under this section, do not include any medical information protected by the HIPAA Privacy Rule.
     - Certificates of successful respiratory fit test in accordance with OSHA's Respiratory Protection Standard (1910.134) completed within the past 12 months for each type of respirator that will be worn in order to complete the work covered under this section.
   - Contact information for the full-time on-site Health and Safety Officer and off-site Corporate Health and Safety Coordinator.
   - Anticipated schedule of start and finish times and dates for this work.

- The method of recycling or treatment/disposal that will be used for each waste stream. Include specific detail on transportation, transfer and other handling from the time waste leaves campus until its arrival at its ultimate destination. Include the name and address of the facilities where all waste materials are to be sent. Include contact person, facility address and telephone number. Plan must include a copy of each disposal/treatment facilities current operation permit that indicates both the type of materials allowed and not allowed for disposal/treatment/recycling.
  - Name, address, and USEPA and NYSDEC permits or licenses (as appropriate), of all proposed recyclers, if applicable. No substitution will be allowed without approval from the Consultant and EHS.
  - Name, address, phone number, responsible contact, and license/permit information (NYS and/or USEPA/USDOT Waste Transporter ID number) from all identified transporters. No substitution will be allowed without approval from the Consultant and EHS.
  - Name, address, and USEPA and NYSDEC permits or licenses (as appropriate), of recipient landfill and incinerators, if applicable. No substitution will be allowed without approval from the Consultant and EHS.
  - Following final removal, and disposal/recycling or destruction, provide the Consultant and EHS with waste transport and disposal/recycling documents (e.g., manifests), as well as certificates of destruction as appropriate.
- Safety Data Sheets (SDSs) for any chemical materials to be used to facilitate this work.
- The Work Plan must include contingency procedures for handling waste spills and releases and the emergency procedures to be followed by Contractor personnel. Contractor shall maintain minor spill cleanup equipment and supplies including absorbent pads, wipes, mini-booms, or other necessary specific equipment to handle spills for materials covered under this section. All temporary waste storage must be within a containment area constructed by the Contractor that meets EPA Container Storage Regulation 40 CFR 264.175 or equivalent for hazardous wastes. Preparedness and prevention features and contingency planning and emergency procedures shall be developed per 6 NYCRR 373-3.3 and 373-3.4, respectively.
- A description of appropriate security measures that shall be provided for the protection of hazardous and solid waste while stored on-site.
- Provide a description of the methods, procedures and materials to be used in performing the work and handling all wastes covered under this section. Describe the methods to contain hazardous waste from existing locations and the maintenance required to ensure the safe temporary storage of the waste.
- Provide a description of any samples to be taken and the parameters to be analyzed. Identify the laboratory providing the analytical services and provide a copy of their NYSDOH ELAP certification. Note that all sampling conducted by the Contractor shall be done in coordination with and in the presence of SUCF (as part of the overall Natural Science Building renovation project), SUNY Purchase, and/or their Environmental Representative.

1.5 CODES AND REGULATIONS

The following is a list of many of the relevant Federal and State laws, regulations, codes and guidelines that the Contractor shall follow and be familiar with. This list is by no means exhaustive, and the Contractor shall be required to meet and comply with all applicable, relevant, and appropriate Federal, State and Local laws and codes.

A. Toxic Substances Control Act (TSCA), US-EPA (1976).

B. Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), US-EPA (1980).

C. USEPA 40 CFR 170, Preparation of Hazardous Materials for Transportation.

D. USEPA 40 CFR Parts 260-272, Resource Conservation and Recovery Act (RCRA).

E. 40 CFR Part 273, Universal Waste Rule.

F. USEPA 40 CFR 761 (PCBs).

G. USDOT 49 CFR Parts 100-180, Hazardous Materials Regulations.

H. 6 NYCRR Part 361, Solid Waste & Material Recovery Facilities.

I. 6 NYCRR Part 362, Solid Waste Combustion, Transfer and Processing Facilities.

J. 6 NYCRR Part 363, Solid Waste Landfills.

K. 6 NYCRR Part 364, Waste Transporters.

L. 6 NYCRR Part 365, Biohazard Waste Management Facilities.

M. 6 NYCRR Part 370, Hazardous Waste Management System.

N. 6 NYCRR Part 371, Identification and Listing of Hazardous Waste.

O. 6 NYCRR Part 372, Hazardous Waste Manifest System and Related Standards for Generators, Transporters and Facilities.

P. 6 NYCRR Parts 373-1 through 373-4, TSDF Facilities and Standards.

Q. 6 NYCRR Subpart 374-3, Standards for Universal Wastes.

R. 6 NYCRR Part 376, Land Disposal and Treatment Standards.

S. OSHA 29CFR 1910, Occupational Safety and Health Standards.

T. OSHA 29CFR 1926, Safety and Health Regulations for Construction.

U. Universal Waste Rule as described in the Federal Register.

The Contractor is required to secure and maintain all required regulatory permits necessary to perform all aspects of the work. The Contractor shall containerize and store waste in accordance with all applicable regulations. The Contractor and Waste Haulers will be responsible for all required placards and labeling.

1.6 COMPLIANCE

A. Compliance with any obligation based upon Federal, State, or local environmental, public health, or safety laws, rules, regulations or requirements shall be coordinated with the Consultant.

1.7 WASTE RECORD SYSTEM

A. The Contractor shall establish a record system that accounts for all waste. The Contractor must be able to document custody of all removed materials from the time they are identified and removed from the work area until they are disposed of at an approved facility.

B. The State University of New York at Purchase College shall be the generator of the waste and shall supply its EPA I.D. number and address for use in filling out the uniform hazardous waste manifests. The Contractor shall be responsible for the preparation of the manifest (information and tracking form) to be signed by SUNY Purchase College EHS personnel. The Contractor shall allow 5 business days for SUNY Purchase College EHS personnel to review and sign the completed manifests. The treatment and disposal facility shall submit returned original of all hazardous waste manifests to SUNY Purchase College EHS personnel. Mailing address for SUNY Purchase College EHS is identified as:

SUNY Purchase College, State University of New York
Environmental Health & Safety
Attn: Louis Wirtz
735 Anderson Hill Road
Purchase, NY 10577
(914) 251-6022
louis.wirtz@purchase.edu

C. Final manifests and shipping documents must be returned to SUNY Purchase College EHS whose address is listed on each manifest within 30 days of the removal of contaminated materials from the site by the waste hauler or as required under the applicable regulations. A duplicate copy of all completed forms shall be provided by the Contractor to the Construction Manager.

1.9 DEFINITIONS

A. Hazardous Waste - shall be any material that possesses at least one of four characteristics (ignitability, reactivity, corrosivity, or toxicity) or is a F, P, K or U listed

waste as regulated under both the Federal Resource Conservation and Recovery Act (RCRA) and with applicable State regulations or a material that appears on Federal or State lists.

B. Hazardous Waste Landfill – a landfill permitted under RCRA Subtitle C and engineered to contain hazardous wastes. Incoming wastes are manifested by the generating facility and may be subject to treatment standards. Only one hazardous waste landfill shall be used for work of this contract.

C. Chemical Waste Landfill – a landfill permitted under the Toxic Substances Control Act (TSCA) that accepts hazardous substances. Only one chemical waste landfill shall be used for the work of this contract.

D. TSDF – Permitted/licensed treatment, storage or disposal facility. Only one TSDF shall be used for work of this contract.

E. Waste Management – Shall mean the collection, packaging, transportation, transfer, processing, recovery, storage, reclamation, treatment, handling and disposal of waste whether performed directly by the Contractor or other firms in his employ. Use a single firm to perform each waste management task, as applicable, i.e., a single hauler for all transportation, etc.

PART 2 – PRODUCTS

2.1 GENERAL

A. Contractor shall be responsible for identifying the appropriate shipping containers. Some examples include 55 gallon metal drums with lids that can be secured and sealed. Drums or containers must meet the required OSHA, EPA (40 CFR Parts 260-272 and 300), and DOT Regulations (49 CFR Parts 171-178, HM 181 DOT requirement).

B. Contractor shall provide the appropriate waste labels identifying contents as regulated RCRA hazardous or solid waste as defined by USEPA, NYSDEC and all other applicable Federal and State regulations.

PART 3 –- EXECUTION

3.1 GENERAL

A. Procedures and methods contained herein are to provide guidance to protect from the contamination of the environment and exposure to workers, occupants, and the public, while handling contaminated materials and hazardous wastes, and their respective components during disassembly for waste disposal/recycling/destruction.

3.2 PERSONAL PROTECTIVE EQUIPMENT

A. Personal protective equipment (PPE) shall consist of (at a minimum) eye protection, work shoes with non-slip soles and steel toes, two layers of chemical resistant gloves

that cover the hand (e.g., neoprene or nitrile gloves), an apron that covers the front of the worker's body from shoulder to calves or disposable chemical resistant coverall, and respiratory protection. For respiratory protection, the Contractor shall provide, at a minimum, air-purifying respirators with combination organic vapor/acid gas/P100 filters to protect workers against organic vapors, gases, solid and liquid aerosols, and asbestos and particulate/dust contaminants that may be found in the building materials and ducts being removed.

B. An organic vapor analyzer (OVA) (or equivalent) and Jerome® mercury vapor analyzer (or equivalent) shall be used during all fume duct disassembly activities. The meters will be used as an industrial hygiene tool to measure the concentration of any volatile and mercury airborne vapors. The Contractor's on-site Health and Safety Officer shall utilize, review and coordinate all changes in personal protective equipment requirements based upon the outcome of the instrument readings and the work tasks being performed.

C. Personal protective equipment (PPE) contaminated by the cleaning operations should be placed in 55-gallon drums and sent off-site for disposal as hazardous or solid waste.

D. All removal and disposal activities shall be monitored by the Owner's Project Monitor (as defined under SUCF Program Directive 1D-9) for compliance. See below for Project Monitor description and duties.

3.3 WORK PROCEDURES

A. Contractor shall use the hazardous waste generator number obtained by SUNY Purchase College from Region II, USEPA. After proper cleaning, non-hazardous materials shall be transported using non-hazardous waste manifests or appropriate bills of lading.

B. During the fume duct removal, the following procedures (or equivalent alternate but equally protective measures) are to be followed:
   1. Designate an area where the containers, equipment and personal protective equipment (both new and used) can be placed for temporary storage.
   2. Carefully remove duct sections, wrap loosely in polyethylene sheeting and move them to a designated location for cleaning. Contractor should minimally designate and construct cleaning stations on each floor. Contractor shall pick up all loose, dislodged deposits/residues lost during the dismantlement operations. Deposits should be vacuumed or sweep up and transferred to the appropriate storage containers for subsequent disposal. Sloppy work practices that cause the release of contaminants as a result of the Contractor's actions shall be cleaned by the Contractor at their own expense.
   3. The cleaning station shall consist of a two-layer (6-mil) polyethylene sheeting on the floor designed to contain the deposits/residues and any spilled wash water. A shallow plastic basin or pan will be used to place the disassembled duct section for subsequent scrapping and scrubbing. In addition, a plastic leak proof basin or pan shall be placed next in series on top of the plastic and will contain Alconox (or equivalent substitute) soap solution. After scraping, each duct section shall be

placed in the soap solution and scrubbed and wiped down. The pan will contain and collect the cleaning solution.
Three five-gallon buckets or other appropriately sized containers shall be placed adjacent to the cleaning station. The first container shall contain wash water to be used to scrub and wash the interior of the duct sections. The second container shall contain wash water to be used to scrub and wash the workers gloves prior to doffing the PPE equipment. The third container will contain clean tap water. This water shall be used to rinse the workers as they exit the work area. All used cleaning equipment shall be containerized for disposal. Wash water from decontamination stations shall be containerized and subsequently tested for disposal. Contractor shall be responsible for cleaning any spillage and environmental contamination that is caused outside the plastic sheeting and contained pan and buckets.

4. Duct sections shall first be cleaned by manually scraping all surfaces with steel putty knifes and/or scrubbing with plastic bristle brushes to remove all visible deposits and residues off the exhaust duct walls and collecting the removed deposits in 55-gallon drums. The visibly cleaned ducts will then be wiped clean with a soap solution. Wiping shall include wet wiping with disposable wash rags and/or brushes using the soap solution in the basin. If visible deposits cannot be cleaned with the soap solution, an alternate non-hazardous citrus based product may be substituted in its place.
5. Contractor must recognize that some materials within the building contain asbestos as identified on the hazardous materials drawings, within the asbestos abatement specification, and as identified in the asbestos survey. Any activities that disturb asbestos-containing materials must be conducted within an asbestos work area that has containment barriers and by properly trained/certified asbestos workers.

C. Upon removal, the Contractor shall place the deposits/residues, wash water and PPE equipment into properly labeled, airtight 55-gallon drums or other suitable containers. In turn these containers shall be transported under proper manifesting procedures to a waste disposal facility.

D. Hazardous waste can be stored for any period less than one year from the initial date of waste generation, prior to disposal or destruction because of large quantity generator (LGQ) status. All other removed materials shall be stored in the appropriate containers and disposed of as soon as time permits. A secure storage site shall be designated, labeled in accordance with the applicable rules and regulations, and be maintained by the Contractor. The waste storage area shall be inspected daily by the Contractor and the inspection shall be noted on a Waste Inspection Form developed by the Contractor.

E. The Contractor shall coordinate all shipments and arrivals at the TSDF to meet project schedule requirements.

F. The Contractor shall ensure that the trucks used to transport any materials during the project protect against contamination to the environment. This will be accomplished by using enclosed trucks. The Contractor shall verify that any trucks used to transport liquids or solid materials are not leaking.

G. The Contractor shall provide written weekly reports documenting the progress made, summarizing the upcoming work, and identifying any coordination issues with other groups. The weekly reports are to be submitted no later than 3:00 pm the Monday following the week that just ended.

3.4 PROJECT MONITORING/MANAGEMENT

A. SUNY Purchase shall retain the services of an environmental consulting firm to provide a Project Monitor (Monitor) for environmental oversight services from during the remediation of hazardous materials, per SUCF Program Directive: 1D-9 Monitoring Removal of Asbestos and Hazardous Materials during Construction (Last Revised Date: May 2019). The Monitor will perform third-party oversight and monitoring of the removal and disposal of hazardous materials (asbestos, hazardous waste, universal waste, etc.) and other applicable construction waste owned by the Campus as the generator of the waste. SUCF Directive 1D-9 indicates that the Monitor will assume a duty to act in good faith and with care on behalf of the Campus and the Fund. The Monitor must be familiar with all state and federal regulations, rules and recommendations and Campus policies and procedures for the disposal of hazardous materials (asbestos, hazardous waste, universal waste, and other applicable construction waste).

B. Per SUCF Directive 1D-9, the prerequisites of the Monitor shall include the following:
   a. a minimum of five years' experience in monitoring projects similar to the construction work of this project and be familiar with all applicable state and federal regulations pertaining to hazardous materials waste.
   b. a working knowledge of 6 NYCRR Parts 370 – 374 and 376 (NYSDEC's regulations on hazardous and universal waste.)
   c. a working knowledge of other applicable Federal, State, and Local regulations, laws, and ordinances associated with the hazardous materials scope of work.
   d. Monitor will not perform any asbestos abatement work on the project and has not retained or been retained by any contractor for work on the project.
   e. possess the tools, and working knowledge of their use, required for visual inspection, air monitoring, and other job duties.

C. Per SUCF Directive 1D-9, the duties of the Monitor shall include the following:
   a. Observing construction waste generating work (including preparation, pre-cleaning, removal, containerizing, and labeling, and demobilization) and monitoring compliance contract documents and pertinent rules and regulations as currently amended, including, but not limited to, NYSDOL ICR 56, EPA, NYS, OSHA, NYSDEC, and other applicable governing bodies.
   b. Monitoring and tracking all waste being generated from the project during construction, including hazardous and universal wastes;
   c. Creating and maintaining an inventory of all waste containers on-site, with daily documented inspections of the containers;

d. Monitoring the actual use of the waste containers, validating that what is on the label of the waste container is what is going into the container;
e. Validating that the waste containers are appropriately labeled according to NYSDEC, US EPA and other applicable rules and regulations, and kept sealed, stored properly, and protected from the weather when not actively in use;
f. Validating that the waste containers are in a secure location, such that no one has unauthorized access to the waste containers;
g. Preparing a "Site Observation Report" (format approved by the Fund and Campus) for each day visited and provide a representative photographic survey of construction waste management activities and practices;
h. Assisting the Campus by preparing, reviewing, and recommending all paperwork, manifests, etc. for signature by their authorized representative;
i. Work directly with the Generator's authorized representative responsible for signing waste profiles, and if authorized by the Generator, sign on behalf of as an agent for the Generator. It is recommended that the Generator's authorized representative sign all waste manifests and the Monitor can implement the processing of the manifests with the Contractor at the time of waste disposal shipping.
j. Monitoring cleaning of the work areas and the handling, transport, and disposal of waste, including adherence to time limitations in applicable rules and regulations and obtaining copies of relevant paperwork.
k. Documenting when any waste leaves the project site (get copy of manifest, confirm/record transport company, driver, waste quantity and type (format approved by the Fund and Campus)).
l. Confirming (by visiting, if required or deemed necessary by the Fund or Campus) actual storage, recycling/incineration and disposal locations.
m. Reviewing and validating information on waste transporter permits, manifests, waste profiles, disposal site acceptance documents, and other documents requested by the Fund or Campus.
n. For phased demolition and abatement, at the end of each phase of the work (do not wait to the end of the project), reviewing and validating that the required closeout paperwork for the asbestos and hazardous materials abatement is complete for the phase;
o. Coordinating any hazardous waste disposal pickups with the Campus Hazardous Waste Specialist (Specialist) and the Campus Project Manager;
p. Allowing the Specialist to review any waste manifest at least 3 business days in advance of any waste pickup;
q. Giving the Specialist advance notice of at least 3 business days any hazardous waste pickups, such that the Specialist, if they choose, can be on-site to sign the manifest and obtain the appropriate copies for the Campus records. Conversely, the Generator's authorized representative can provide a signed waste manifest(s) to the Monitor who will implement the processing of the manifest(s) with the Contractor at the time of waste disposal shipping and retain pertinent copies;

r. Attending construction meetings and other meetings as requested, being prepared to discuss observations and project status.
s. Being available to identify variance from best practices during the work involving asbestos abatement, hazardous materials, hazardous waste, or universal waste.

D. The Contractor shall cooperate fully with the Monitor during the course of work. Failure to cooperate fully may lead to the issuance of a stop work order. Any liquidated damages incurred as a result of any stop work order issued shall be the responsibility of the Contractor.

E. The Monitor will oversee work practices and ensure compliance to all applicable regulations, standards, and the Contract Documents.

F. The Monitor will perform visual inspections during and after the remediation work to ensure that all contaminated material has been properly removed in accordance with the contract documents.

3.5 WASTE DISPOSAL

A. All wash water and cleaning equipment shall be containerized and tested for disposal by the contractor. All test results and waste manifests shall be provided to the Monitor and SUNY Purchase College EHS for review and approval a minimum of 5 business days prior to removing from the job site. All waste shall be manifested according to applicable regulations.

B. All solid deposits removed from the interior of the exhaust ducts shall be containerized and transported for disposal under D006, D007, D008, and D009 Hazardous Waste codes. All waste manifests shall be provided to the Monitor and SUNY Purchase College EHS for review and approval a minimum of 5 business days prior to removing from the job site. All waste shall be manifested according to applicable regulations.

END OF SECTION 028513

SECTION 028613 – ACID WASTE PLUMBING SYSTEM REMEDIATION

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.

B. All contents of the acid waste plumbing system drain traps and plumbing lines shall be assumed by the Contractor to be hazardous waste, at a minimum for lead toxicity (D008), mercury toxicity (D009), and mercury U-List Waste due to the presence of elemental mercury (U151). Testing of the sink drain traps, their contents, and the acid waste plumbing lines has been conducted. The results of the investigation and testing is detailed within *Laboratory Contaminated Materials Investigation and Sampling Report for the Rehabilitation of Natural Science Building, SUCF Project #291029-02, State University of New York College Purchase, Purchase, New York, dated February 2021, Revised October 2024, prepared by Watts Architecture & Engineering.* Laboratory analysis has confirmed the presence of significant quantities of many heavy metals, including levels of lead and mercury that exceed toxicity regulatory criteria, many semivolatile organic compounds, many volatile organic compounds, and the PCB Aroclor 1254. Significant amounts of elemental mercury was observed within the acid waste plumbing system during the sampling event. EPA considers disposing of elemental mercury and spill residues (from broken mercury thermometers) as a U151 hazardous waste that requires retorting. The acid waste plumbing system and its contents shall be properly segregated into the following waste streams:
   1. Disposal of the removed liquids and deposits from the acid waste plumbing system shall be properly segregated and classified based on the laboratory analysis results, but at no time can lose the D008 (lead toxicity), or D009/U151 (high level mercury waste) Hazardous Waste codes.
   2. Disposal of all other acid waste plumbing system components that have not been cleaned shall be classified based on the laboratory analysis results, but at no time can lose the D008 or D009 (low level mercury waste) Hazardous Waste codes.
   3. Disposal of the cleaned acid waste plumbing components and vent lines may be disposed of as C&D, if appropriate and confirmed as appropriate as detailed within this specification.
   4. Disposal of cleaning equipment and personal protective equipment shall comply with EPA contained-in policy as appropriate, where if contamination cannot be removed, PPE must be treated to land disposal restrictions (LDR) treatment standards prior to disposal.

C. RELATED DOCUMENTS

   1. Pre-Renovation Regulated Building Materials Survey for the SUNY Purchase College, Rehabilitation of Natural Science Building Project, SUCF Project

#291029-02, *dated October 2021,* prepared by Watts Architecture and Engineering, is included separately and is for reference only. Any disturbance of ACM must follow all applicable rules and regulations. See Specification 028213 Asbestos Abatement for additional information.

2. *Hazardous Waste/Contaminated Materials Inventory Report for the Rehabilitation of Natural Science Building, SUCF Project #291029-00, State University of New York at Purchase, Purchase, New York, dated February 2021* prepared by Watts Architecture & Engineering, is included separately and is for reference only.
3. *Laboratory Contaminated Materials Investigation and Sampling Report for the Rehabilitation of Natural Science Building, SUCF Project #291029-02, State University of New York College Purchase, Purchase, New York, dated February 2021, Revised October 2024, prepared by Watts Architecture & Engineering, is included separately and is for reference* only.
4. *Mercury Vapor Monitoring Report* dated January 2, 2026 (and future supplemental update that is to forthcoming) prepared for SUNY Purchase conducted by Quality Environmental Solutions & Technologies, Inc.

1.2 DESCRIPTION OF THE WORK

A. The work shall consist of the proper removal, packaging, labeling, transportation, and disposal of all contaminated materials associated with the acid waste plumbing system within the project limits. This includes any contaminated materials that may have spilled out of the system onto the adjacent floors, casework, etc. Also note that the mercury-related work practices, handling, storage, transporation, treatment, and disposal methods described in this specification are also applicable to the mercury remediation associated with the laboratory casework.

1. The Contractor shall remove and dispose of all laboratory sink traps, fume hood sink traps and any other miscellaneous plumbing traps and their contents that are within the project limits. Contractor shall assume that all drain traps and acid waste plumbing lines contain hazardous toxicity characteristic (TC) wastes and/or U-list wastes. Physical removal and segregation shall include collecting the plumbing traps and their contents (any liquids or sediments) identified during disassembly of the plumbing network. All removal operations shall be done carefully to prevent breaking the piping and spreading possible contamination within the building. The Contractor shall assume the contents of the acid waste plumbing system should follow high mercury concentration disposal guidelines. Elemental mercury or high mercury concentrations (above 260 mg/kg total mercury) will require the plumbing traps and their contents be transported for mercury recovery “RMERC” in a thermal processing unit. These units are commonly referred to as “retorters” and the recovery process as “retorting”.
2. Otherwise the plumbing traps shall be handled with the remaining uncleaned acid-waste plumbing system components including the plumbing laterals, unions, vents, etc., that are empty and dry (without identifiable liquids, sediments, or appreciable deposits). These components shall be segregated and handled as toxicity characteristic (TC) wastes for low level mercury contamination (RCRA D009 waste code). All removal operations shall be done <u>carefully by disassembly to prevent breaking the piping</u> and spreading possible contamination within the building.

3. Cleaned acid waste vent pipes shall be properly cleaned and disposed of as C&D, provided there is no residual mercury contamination.
4. Under no circumstance will any of the plumbing system components be sent off for recycling. Disposal or treatment followed by disposal shall be the only alternative and all materials shall be handled as either as a solid or hazardous waste.
5. All acid-waste plumbing demolition shall be conducted by a Contractor with HAZWOPER trained personnel and using proper personal protective equipment and on-site screening instruments as described in the Contractor's Work Plan and Site-Specific Health and Safety Plan.
6. Access to the acid waste plumbing network may require removal of ceiling systems, wall sections, pipe chases, removal of countertops and cabinets, demolition/saw cutting of the concrete floor, asbestos abatement, and other demolition activities to access and remove all acid waste piping found within the project limits. Access to the floor drains and piping may require saw cutting/demolition of areas of the concrete/quarry tile floors. Contractor should refer to the architectural demolition and plumbing demolition drawings for additional detail on location of plumbing removals.
7. The disposal of all waste streams must be conducted at permitted treatment, storage and disposal facilities (TSDFs) in compliance with all regulatory requirements. In addition, the Contractor is responsible for all sampling and laboratory analysis as specified by the receiving disposal facility, however, the Consultant and/or SUNY Purchase College EHS or their representative must be consulted before and informed of any activities that involve sampling, analysis, and characterization of waste streams.
8. Contractor shall be aware that the plumbing systems contains sharps, glass instruments, and other items utilized in a laboratory setting. Contractor shall takes necessary safety precautions when dismantling the plumbing lines.
9. Contractor shall be responsible for confirming the existence and availability of power, lighting needed to perform his work and providing all makeup utility services required for the completion of this work. Contractor shall also coordinate the shut down of all utility systems within the building as necessary to perform the work with SUNY Purchase College personnel.
10. At this time, no known broken plumbing traps are present in the building. Contractor shall confirm the condition of all traps prior to acid waste plumbing system remediation and demolition and notify the Consultant if any broken traps are identified. This inventory must be completed and reported <u>before the start</u> of the remediation work.

B. The Contractor shall note that other environmental concerns have been identified. These concerns will not be addressed under this specification but will be described in their own specification identified below.

C. The Contractor shall develop all applicable waste manifests, shipping papers, profile sheets, land ban forms and any other documentation required by applicable rules and regulation, the transporter, the disposal facility and others involved in the handling and disposal process. Coordinate with the Project Monitor (as defined under SUCF Program Directive 1D-9) for review and SUNY Purchase College EHS personnel for review and Generator signature.

D. The work area includes all areas within the project limits where the above referenced materials slated for removal and subsequent disposal are located.

E. The Contractor shall manage all surplus materials and waste generated in the performance of the contract in accordance with applicable Federal, State, and local laws and regulations.

F. Engage a single firm to perform the work of this section. The firm performing the work for the Contractor shall have the following qualifications:
   1. Performance of at least three (3) projects in the previous ten (10) years that are similar to the work required for this project, including coordination with simultaneous asbestos abatement and general demolition work.
   2. It has developed and employed a Work Plan, Spill Contingency Plan, and Site-Specific Health and Safety Plan similar to that required for this project.
   3. It has established a Quality Control Program that includes hazard communications and chemical hygiene plans; employee background checks and medical testing; and, waste determination procedures and guidelines, and proper waste manifest tracking.
   4. It has a Project Manager available for this project with at least three years of experience performing similar work; all required training certifications; fluent in the English language and capable of communicating with all the staff; and is experienced in visual inspection, handling, cleaning, storage and field characterization of hazardous materials and contaminated materials similar to those anticipated on this project.
   5. For all employees involved with the hazardous waste related work, completion of 40-hour OSHA HAZWOPER training, annual 8-hour OSHA HAZWOPER refresher training, and proof of annual medical physicals and respirator fit tests.
   6. Must be able certify in writing that these qualifications are met for the firm and persons involved with the hazardous waste and contaminated materials work, and if requested, can submit documentation and resumes to demonstrate their capabilities, experience, and include a list of completed projects with project contact names, addresses, and phone numbers.

G. The Contractor shall be aware of all conditions of the Project and is responsible for verifying quantities and locations of all Work to be performed. Failure to do so shall not relieve the Contractor of its obligation to furnish all labor and materials necessary to perform the Work.

H. All Work shall be performed in strict accordance with the Project Documents and all governing codes, rules, regulations and guidelines. Where conflicts occur between the Project Documents and applicable codes, rules, regulations and guidelines, the more stringent shall apply.

1.3 RELATED SECTIONS

A. Hazardous Waste and Contaminated Materials Removal (Specification 02 8100)

B. Asbestos Abatement (Specification 02 8213)

C. Lead Remediation (Specification 02 8313)

D. PCB Caulk Remediation (Specification 02 8400)

E. Exhaust Duct Remediation (Specification 02 8513)

F. Universal Waste and Fluorescent Lamps (Specification 02 8700)

1.4 SUBMITTALS

A. The Contractor shall certify in writing that they have prepared and will maintain a valid Site-Specific Health and Safety Plan to support the hazardous waste and contaminated materials work of this section. The Contractor shall certify in writing that they have a valid OSHA Respiratory Protection Program. Submission of the Site-Specific Health and Safety Plan and OSHA Respiratory Protection Program is not necessary, unless specifically requested by the General Contractor, SUNY Purchase College, and/or SUCF (as part of the overall Natural Science Building renovation project). As part of this work the Contractor will designate and maintain a full-time on-site Health and Safety Officer and off-site Corporate Health and Safety Coordinator for the duration of the associated tasks.

B. The Contractor shall certify in writing that they and their personnel meet the qualifications as described under Section 1.2.F. Submission of all documentation to prove that the qualifications are met is not necessary, unless specifically requested by the General Contractor, SUNY Purchase College, and/or SUCF (as part of the overall Natural Science Building renovation project).

C. The Contractor shall be required to submit a Work Plan explaining the personal protective equipment, work methods, procedures, safety, site storage, transportation, and final treatment/disposal/recycling that will be utilized for all work covered under this section. The Work Plan under this section can be a stand-alone document that only covers the work under this section, or if applicable and the work will occur alongside other hazardous waste related work, an overarching Work Plan document may be prepared for the project, provided all necessary and appropriate information is included. Submission shall be made at least 14 days prior to the anticipated start of work for review by the Architect and Environmental Design Consultant prior to the commencement of activities. The plan shall include:
   - List of the anticipated on-site supervisor(s) and workers scheduled to perform this work. Provide the following for each individual:
     - Certificates of successful completion of the OSHA 40-hour HAZWOPER course for handling hazardous materials along with proof of current 8-hour annual refresher (if applicable) and the OSHA 10-hour Construction Safety training (if applicable).
     - Proper documentation or certificates for workers which have successfully completed the required employee training for Universal Waste or appropriate type of training to the type of wastes being managed by those workers as applicable (i.e.: for Universal Waste such as fluorescent bulbs, see United

States 40 CFR § 273.16 and § 273.36, and New York 6 CRR-NY IV B 374-3; for ozone depleting refrigerant technicians see training for stationary refrigeration and air conditioning under Section 608 of the Clean Air Act per 40 CFR § 82.161 Technician Certification; etc.)

  - Certification of medical examinations completed within the past 12 months. Only include the health providers written opinion that the employee is certified to complete the work covered under this section, do not include any medical information protected by the HIPAA Privacy Rule.
  - Certificates of successful respiratory fit test in accordance with OSHA's Respiratory Protection Standard (1910.134) completed within the past 12 months for each type of respirator that will be worn in order to complete the work covered under this section.
- Contact information for the full-time on-site Health and Safety Officer and off-site Corporate Health and Safety Coordinator.
- Anticipated schedule of start and finish times and dates for this work.
- The method of recycling or treatment/disposal that will be used for each waste stream. Include specific detail on transportation, transfer and other handling from the time waste leaves campus until its arrival at its ultimate destination. Include the name and address of the facilities where all waste materials are to be sent. Include contact person, facility address and telephone number. Plan must include a copy of each disposal/treatment facilities current operation permit that indicates both the type of materials allowed and not allowed for disposal/treatment/recycling.
  - Name, address, and USEPA and NYSDEC permits or licenses (as appropriate), of all proposed recyclers, if applicable. No substitution will be allowed without approval from the Consultant and EHS.
  - Name, address, phone number, responsible contact, and license/permit information (NYS and/or USEPA/USDOT Waste Transporter ID number) from all identified transporters. No substitution will be allowed without approval from the Consultant and EHS.
  - Name, address, and USEPA and NYSDEC permits or licenses (as appropriate), of recipient landfill and incinerators, if applicable. No substitution will be allowed without approval from the Consultant and EHS.
  - Following final removal, and disposal/recycling or destruction, provide the Consultant and EHS with waste transport and disposal/recycling documents (e.g., manifests), as well as certificates of destruction as appropriate.
- Safety Data Sheets (SDSs) for any chemical materials to be used to facilitate this work.
- The Work Plan must include contingency procedures for handling waste spills and releases and the emergency procedures to be followed by Contractor personnel. Contractor shall maintain minor spill cleanup equipment and supplies including absorbent pads, wipes, mini-booms, or other necessary specific equipment to handle spills for materials covered under this section. All temporary waste storage must be within a containment area constructed by the Contractor that meets EPA Container Storage Regulation 40 CFR 264.175 or equivalent for

hazardous wastes. Preparedness and prevention features and contingency planning and emergency procedures shall be developed per 6 NYCRR 373-3.3 and 373-3.4, respectively.

- A description of appropriate security measures that shall be provided for the protection of hazardous and solid waste while stored on-site.
- Provide a description of the methods, procedures and materials to be used in performing the work and handling all wastes covered under this section. Describe the methods to contain hazardous waste from existing locations and the maintenance required to ensure the safe temporary storage of the waste.
- Provide a description of any samples to be taken and the parameters to be analyzed. Identify the laboratory providing the analytical services and provide a copy of their NYSDOH ELAP certification. Note that all sampling conducted by the Contractor shall be done in coordination with and in the presence of SUCF, SUNY Purchase, and/or their Environmental Representative.

1.5 CODES AND REGULATIONS

The following is a list of many of the relevant Federal and State laws, regulations, codes and guidelines that the Contractor shall follow and be familiar with. This list is by no means exhaustive and the Contractor shall be required to meet and comply with all applicable, relevant, and appropriate Federal, State and Local laws and codes.

A. Toxic Substances Control Act (TSCA), US-EPA (1976).

B. Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), US-EPA (1980).

C. USEPA 40 CFR 170, Preparation of Hazardous Materials for Transportation.

D. USEPA 40 CFR Parts 260-272, Resource Conservation and Recovery Act (RCRA).

E. 40 CFR Part 273, Universal Waste Rule.

F. USEPA 40 CFR 761 (PCBs).

G. USDOT 49 CFR Parts 100-180, Hazardous Materials Regulations.

H. 6 NYCRR Part 361, Solid Waste & Material Recovery Facilities.

I. 6 NYCRR Part 362, Solid Waste Combustion, Transfer and Processing Facilities.

J. 6 NYCRR Part 363, Solid Waste Landfills.

K. 6 NYCRR Part 364, Waste Transporters.

L. 6 NYCRR Part 365, Biohazard Waste Management Facilities.

M. 6 NYCRR Part 370, Hazardous Waste Management System.

N. 6 NYCRR Part 371, Identification and Listing of Hazardous Waste.

O. 6 NYCRR Part 372, Hazardous Waste Manifest System and Related Standards for Generators, Transporters and Facilities.

P. 6 NYCRR Parts 373-1 through 373-4, TSDF Facilities and Standards.

Q. 6 NYCRR Subpart 374-3, Standards for Universal Wastes.

R. 6 NYCRR Part 376, Land Disposal and Treatment Standards.

S. OSHA 29CFR 1910, Occupational Safety and Health Standards.

T. OSHA 29CFR 1926, Safety and Health Regulations for Construction.

U. Universal Waste Rule as described in the Federal Register.

V. EPA's Land Disposal Restrictions: Treatment Standards for Mercury-Bearing Hazardous Waste; Notice of Data Availability, 1/29/2003, Docket Number: RCRA-2002-0029

The Contractor is required to secure and maintain all required regulatory permits necessary to perform all aspects of the work. The Contractor shall containerize and store waste in accordance with all applicable regulations. The Contractor and Waste Haulers will be responsible for all required placards and labeling.

1.6 COMPLIANCE

A. Compliance with any obligation based upon Federal, State, or local environmental, public health, or safety laws, rules, regulations or requirements shall be coordinated with the Consultant.

1.7 WASTE RECORD SYSTEM

A. The Contractor shall establish a record system that accounts for all waste. The Contractor must be able to document custody of all removed materials from the time they are identified and removed from the work area until they are disposed of at an approved facility.

B. The Contractor shall develop all applicable waste manifests, shipping papers, profile sheets, and any other documentation and coordinate with the Project Monitor regarding proper signatures required by SUNY Purchase College EHS personnel. Shipping papers must be provided to the Monitor and SUNY Purchase College EHS personnel five (5) business days prior to waste shipment to provide adequate time for review and approval. SUNY Purchase College EHS personnel shall sign all manifests. Mailing address for SUNY Purchase College EHS is identified as:

SUNY Purchase College, State University of New York

Environmental Health & Safety
Attn: Louis Wirtz
735 Anderson Hill Road
Purchase, NY 10577
(914) 251-6022
louis.wirtz@purchase.edu

B. Final manifests and shipping documents must be returned to SUNY Purchase College EHS whose address is listed on each manifest within 30 days of the removal of contaminated materials from the site by the waste hauler or as required under the applicable regulations. A duplicate copy of all completed forms shall be provided by the Contractor to the Consultant.

1.8 DEFINITIONS

A. Hazardous Waste - shall be any material that possesses at least one of four characteristics (ignitability, reactivity, corrosivity, or toxicity) or is a F, P, K or U listed waste as regulated under both the Federal Resource Conservation and Recovery Act (RCRA) and with applicable State regulations or a material that appears on Federal or State lists.

B. Hazardous Waste Landfill – a landfill permitted under RCRA Subtitle C and engineered to contain hazardous wastes. Incoming wastes are manifested by the generating facility and may be subject to treatment standards. Only one hazardous waste landfill shall be used for work of this contract.

C. Solid Waste Landfill – a landfill permitted under RCRA Subtitle D and engineered to contain solid wastes. Only one solid waste landfill shall be used for work of this contract.

D. TSDF – Permitted/licensed treatment, storage or disposal facility. Only one TSDF shall be used for work of this contract.

E. Waste Management – Shall mean the collection, packaging, transportation, transfer, processing, recovery, reclamation, treatment, handling and disposal of waste whether performed directly by the Contractor or his Sub Contractor. Use a single firm to perform each waste management task, as applicable, i.e., a single hauler for all transportation, etc.

PART 2 – PRODUCTS

2.1 GENERAL

A. Contractor shall be responsible for identifying the appropriate shipping containers. Some examples include 55 gallon metal drums with lids that can be secured and sealed, cubic yard boxes, roll-off boxes, etc. Drums and other shipping containers must meet the required OSHA, EPA (40 CFR Parts 260-272 and 300), and DOT Regulations (49 CFR Parts 171-178, HM 181 DOT requirement).

B. Contractor shall provide the appropriate waste labels identifying contents as regulated RCRA hazardous or solid waste as defined by USEPA, NYSDEC and all other applicable Federal and State regulations.

PART 3 - EXECUTION

3.1 GENERAL

A. Procedures and methods contained herein are to provide guidance to protect from the contamination of the environment and exposure to workers, occupants, and the public, while handling contaminated materials and hazardous wastes, and their respective components during disassembly for waste disposal/recycling/destruction.

B. During the project, the Contractor shall use proper and effective work methods to ensure that no employees or occupants of the project work area exceed the OSHA mercury vapor Permissible Exposure Limit of 0.1 mg/m^3. At the completion of the demolition and remediation work, mercury vapor shall not exceed the OSHA Permissible Exposure Limit of 0.1 mg/m^3 in any portion of the project area.

3.2 PERSONAL PROTECTIVE EQUIPMENT

A. Personal protective equipment (PPE) shall consist of (at a minimum) eye protection suitable for splash protection (goggles), work shoes with non-slip soles and steel toes, chemical resistant gloves that cover the hand (e.g., inner and outer nitrile gloves), an apron that covers the front of the worker's body from shoulder to calves or chemical resistant coverall, and available respiratory protection. For respiratory protection, the Contractor shall provide, at a minimum, air-purifying respirators with mercury vapor and P100 filters to protect workers against mercury vapors that may be present during disassembly of the acid-waste plumbing system.

B. A Jerome® mercury vapor analyzer or equivalent survey meter shall be used during all acid waste piping and drain trap disassembly activities. The meter will be used as an industrial hygiene tool to measure the concentration of airborne vapors. The Contractor's on-site Health and Safety Officer shall utilize, review and coordinate all changes in personal protective equipment requirements based upon the outcome of the instrument readings and the work tasks being performed.

C. A Jerome® mercury vapor analyzer or equivalent survey meter shall be used by the Contractor to screen all spaces in the vicinity of the plumbing network including but not limited to floors, fume hoods, countertops being removed, and all surfaces on, behind and under casework, etc., to confirm the absence of mercury contamination. SUNY Purchase College reserves the right to have confirmatory investigations performed.

D. Personal protective equipment (PPE) contaminated by the cleaning operations should be placed in 55 gallon drums and sent off-site for disposal as hazardous or solid waste.

E. Hammering or sudden impact methods that may cause the plumbing to shatter or break shall not be employed as such methods may cause leakage, spills and increased vapor readings. Disassembly of the plumbing system shall be conducted in a careful manner. Sloppy work practices that cause the release of contaminants as a result of the Contractor's actions shall be cleaned by the Contractor at their own expense.

F. All removal and disposal activities shall be monitored by the Owner's Project Monitor (as defined under SUCF Program Directive 1D-9) for compliance. See below for Project Monitor description and duties.

3.3 WORK PROCEDURES

A. Contractor shall use the hazardous waste generator number obtained by SUNY Purchase College EHS from Region II, USEPA. Non-hazardous construction and demolition materials shall be transported using non-hazardous waste manifests or appropriate bills of lading.

B. During the acid waste piping and drain piping removal, the following procedures are to be followed:
   1. Designate an area where the containers, equipment and personal protective equipment (both new and used) can be placed for temporary storage.
   2. Carefully remove the contents of the plumbing sections and fixtures (e.g., traps), and any other acid waste plumbing sections that have liquids or appreciable solid deposits and place the contents into an appropriate containers for transportation to a facility for treatment (retorting) and recovery as a high level mercury waste. All components of the acid waste plumbing system shall either be completely cleaned free of all appreciable deposits and staining prior to confirmatory testing and disposal as C&D, or otherwise be appropriately disposed of as a low level mercury waste, provided there is no elemental mercury and the waste stream is <260 ppm mercury.
   3. In the event that the contents of a trap, an elbow or a section of piping with liquids or loose sediments is damaged and leaks, Contractor shall utilize a mercury capture vacuum, wipes or other equipment to capture the leak and remove all debris generated. If the area is impervious it shall be wiped after vacuuming using Mercon™ spill control products – MerconWipes™, MerconSpray™, MerconKit™ or equivalent products from another manufacturer. Pervious materials shall be removed to a reasonable depth and area dependent on the size of the leak and the readings of the Jerome Mercury vapor analyzer. All captured leaks, spills, contaminated material, and cleanup material shall be placed in a 55-gallon drum or other appropriate and permissible container for transportation to a facility for mercury recovery.
   4. Contractor must recognize that some materials within the building contain asbestos as identified on the hazardous materials drawings, within the asbestos abatement specification, and as identified in the asbestos survey. Any activities that disturb asbestos-containing materials must be conducted within an asbestos work area that has containment barriers and by properly trained/certified asbestos workers.

C. Upon removal of the plumbing components, the Contractor shall place the contents (all liquids, sediments, appreciable deposits, etc.) into appropriate containers as designated by the facility that will receive the high level mercury waste (all elemental mercury and >260 ppm mercury contaminated contents) for treatment and recovery. As previously identified, containers may include 55 gallon metal drums with lids that can be secured, sealed and labeled as mercury containing hazardous waste. The plumbing traps and low lying components are to be segregated from other plumbing assemblies that do not contain visible liquid and do not have appreciable residual deposits. All plumbing laterals and connecting sections that contain visible appreciable residual deposits shall be placed in a separate set of 55-gallon drums and labeled as low level mercury hazardous waste, unless properly cleaned and determined by laboratory characterization to be clean and in consultation with the appropriate disposal facility to the satisfaction of SUNY Purchase College and the Project Monitor (as defined under SUCF Program Directive 1D-9). Cleaned and tested plumbing components and acid waste plumbing vent lines may be disposed of as C&D provided that there is no mercury contamination as evidenced by laboratory testing, rigorous inspection of cleaning effectiveness, or other effective means that ensure no mercury or mercury-contaminated items are being improperly disposed of.

D. Hazardous waste can be stored for up to ninety (90) days from the initial date of waste generation, prior to disposal or destruction for a Large Quantity Generator. All other removed materials shall be stored in the appropriate secure containers and disposed of as soon as time permits. A secure storage site shall be designated, labeled in accordance with the applicable rules and regulations, and be maintained by the Contractor. The waste storage area shall be inspected daily by the Contractor and the inspection shall be noted on a Waste Inspection Form developed by the Contractor.

E. The Contractor shall coordinate all shipments and arrivals at the treatment, storage or disposal facility to meet project schedule requirements.

F. The Contractor shall ensure that the trucks used to transport any materials during the project protect against contamination to the environment. This will be accomplished by using enclosed trucks. The Contractor shall verify that any trucks used to transport liquids or solid materials are not leaking.

G. All shipments will be transported under proper manifesting procedures to a hazardous waste treatment or disposal facility. The Contractor shall forward a certificate of disposal or destruction directly to SUNY Purchase College personnel and a duplicate copy to the Project Monitor (as defined under SUCF Program Directive 1D-9).

H. The Contractor shall provide written weekly reports documenting the progress made, summarizing the upcoming work, and identifying any coordination issues with other groups. The weekly reports are to be submitted no later than 3:00 pm the Monday following the week that just ended.

3.4 PROJECT MONITORING/MANAGEMENT

A. SUNY Purchase shall retain the services of an environmental consulting firm to provide a Project Monitor (Monitor) for environmental oversight services from during the remediation of hazardous materials, per SUCF Program Directive: 1D-9 Monitoring Removal of Asbestos and Hazardous Materials during Construction (Last Revised Date: May 2019). The Monitor will perform third-party oversight and monitoring of the removal and disposal of hazardous materials (asbestos, hazardous waste, universal waste, etc.) and other applicable construction waste owned by the Campus as the generator of the waste. SUCF Directive 1D-9 indicates that the Monitor will assume a duty to act in good faith and with care on behalf of the Campus and the Fund. The Monitor must be familiar with all state and federal regulations, rules and recommendations and Campus policies and procedures for the disposal of hazardous materials (asbestos, hazardous waste, universal waste, and other applicable construction waste).

B. Per SUCF Directive 1D-9, the prerequisites of the Monitor shall include the following:
   1. a minimum of five years' experience in monitoring projects similar to the construction work of this project and be familiar with all applicable state and federal regulations pertaining to hazardous materials waste.
   2. a working knowledge of 6 NYCRR Parts 370 – 374 and 376 (NYSDEC's regulations on hazardous and universal waste.)
   3. a working knowledge of other applicable Federal, State, and Local regulations, laws, and ordinances associated with the hazardous materials scope of work.
   4. Monitor will not perform any asbestos abatement work on the project and has not retained or been retained by any contractor for work on the project.
   5. possess the tools, and working knowledge of their use, required for visual inspection, air monitoring, and other job duties.

C. Per SUCF Directive 1D-9, the duties of the Monitor shall include the following:
   1. Observing construction waste generating work (including preparation, pre-cleaning, removal, containerizing, and labeling, and demobilization) and monitoring compliance contract documents and pertinent rules and regulations as currently amended, including, but not limited to, NYSDOL ICR 56, EPA, NYS, OSHA, NYSDEC, and other applicable governing bodies.
   2. Monitoring and tracking all waste being generated from the project during construction, including hazardous and universal wastes;
   3. Creating and maintaining an inventory of all waste containers on-site, with daily documented inspections of the containers;
   4. Monitoring the actual use of the waste containers, validating that what is on the label of the waste container is what is going into the container;
   5. Validating that the waste containers are appropriately labeled according to NYSDEC, US EPA and other applicable rules and regulations, and kept sealed, stored properly, and protected from the weather when not actively in use;
   6. Validating that the waste containers are in a secure location, such that no one has unauthorized access to the waste containers;

7. Preparing a "Site Observation Report" (format approved by the Fund and Campus) for each day visited and provide a representative photographic survey of construction waste management activities and practices;
8. Assisting the Campus by preparing, reviewing, and recommending all paperwork, manifests, etc. for signature by their authorized representative;
9. Work directly with the Generator's authorized representative responsible for signing waste profiles, and if authorized by the Generator, sign on behalf of as an agent for the Generator. It is recommended that the Generator's authorized representative sign all waste manifests and the Monitor can implement the processing of the manifests with the Contractor at the time of waste disposal shipping.
10. Monitoring cleaning of the work areas and the handling, transport, and disposal of waste, including adherence to time limitations in applicable rules and regulations and obtaining copies of relevant paperwork.
11. Documenting when any waste leaves the project site (get copy of manifest, confirm/record transport company, driver, waste quantity and type (format approved by the Fund and Campus)).
12. Confirming (by visiting, if required or deemed necessary by the Fund or Campus) actual storage, recycling/incineration and disposal locations.
13. Reviewing and validating information on waste transporter permits, manifests, waste profiles, disposal site acceptance documents, and other documents requested by the Fund or Campus.
14. For phased demolition and abatement, at the end of each phase of the work (do not wait to the end of the project), reviewing and validating that the required closeout paperwork for the asbestos and hazardous materials abatement is complete for the phase;
15. Coordinating any hazardous waste disposal pickups with the Campus Hazardous Waste Specialist (Specialist) and the Campus Project Manager;
16. Allowing the Specialist to review any waste manifest at least 5 business days in advance of any waste pickup;
17. Giving the Specialist advance notice of at least 5 business days any hazardous waste pickups, such that the Specialist, if they choose, can be on-site to sign the manifest and obtain the appropriate copies for the Campus records. Conversely, the Generator's authorized representative can provide a signed waste manifest(s) to the Monitor who will implement the processing of the manifest(s) with the Contractor at the time of waste disposal shipping and retain pertinent copies;
18. Attending construction meetings and other meetings as requested, being prepared to discuss observations and project status.
19. Being available to identify variance from best practices during the work involving asbestos abatement, hazardous materials, hazardous waste, or universal waste.

D. The Contractor shall cooperate fully with the Monitor during the course of work. Failure to cooperate fully may lead to the issuance of a stop work order. Any

liquidated damages incurred as a result of any stop work order issued shall be the responsibility of the Contractor.

E. The Monitor will oversee work practices and ensure compliance to all applicable regulations, standards, and the Contract Documents.

F. The Monitor will perform visual inspections during and after the remediation work to ensure that all contaminated material has been properly removed in accordance with the contract documents.

G. In the presence of the Monitor, after removal of all waste covered by this section and other demolition sections, inspect all remaining floors, ledges and other horizontal surfaces with a Jerome Mercury analyzer.

3.5 WASTE DISPOSAL

A. The contents of the acid waste plumbing traps, plumbing trap assemblies, and other plumbing sections with free liquids and sediments will require certificates of destruction for materials that are retorted in a thermal processing unit. These wastes are categorized as D009/U151 High Mercury – Inorganic Subcategory. All waste manifests shall be provided to the Project Monitor (as defined under SUCF Program Directive 1D-9) and SUNY Purchase College for review and approval a minimum of 5 business days prior to removing from the job site. All waste shall be manifested according to applicable regulations.

B. After removal and collection of free phase mercury and mercury-contaminated contents of the acid waste plumbing system, the dry acid waste plumbing laterals and components with appreciable deposits and staining are to be transported for hazardous waste disposal as low level mercury waste. Pre-treatment of the waste stream (e.g., macroencapsulation or microencapsulation) is required for waste that is disposed of in a landfill as determined by applicable regulations. The Contractor should be aware that land disposal regulations (LDR) require that all wastes meet disposal limits or must be pre-treated to meet these standards. All test results and waste manifests shall be provided to the Project Monitor (as defined under SUCF Program Directive 1D-9) and SUNY Purchase College EHS for review and approval a minimum of 5 business days prior to removing from the job site. All waste shall be manifested according to applicable regulations.

C. Clean and mercury-free acid waste plumbing system components and acid waste vent lines may be disposed of as C&D provided effective cleaning methods are completed and/or laboraty testing confirms the appropriate disposal characterization as clean, which must be done in consultation with the appropriate disposal facility to the satisfaction of SUNY Purchase College EHS and the Project Monitor (as defined under SUCF Program Directive 1D-9). All appropriate measures shall be taken to ensure that mercury and mercury-contaminated items are not improperly disposed of.

END OF SECTION 028613

SECTION 028700 – UNIVERSAL WASTE AND FLOURESCENT LAMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Contractor shall be held to have read all Bidding Documents, Contract Drawings, and Division 1 specification sections, and in the execution of the work he will be bound by all of the conditions and requirements herein. Drawings and general provisions of the Contract, including Division 01 Section "State University Construction Fund General Requirements", apply to this Section.

B. *Hazardous Waste/Contaminated Materials Inventory Report for the Rehabilitation of Natural Science Building, SUCF Project #291029-00, State University of New York at Purchase, Purchase, New York, dated February 2021* prepared by Watts Architecture & Engineering, is included separately and is for reference only.

C. *Laboratory Contaminated Materials Investigation and Sampling Report for the Rehabilitation of Natural Science Building, SUCF Project #291029-02, State University of New York College Purchase, Purchase, New York, dated February 2021, Revised October 2024, prepared by Watts Architecture & Engineering, is included separately and is for reference* only.

D. *Mercury Vapor Monitoring Report* dated January 2, 2026 (and future supplemental update that is to forthcoming) prepared for SUNY Purchase conducted by Quality Environmental Solutions & Technologies, Inc.

1.2 DESCRIPTION OF THE WORK

A. This specification covers the removal and disposal of Universal Waste, including fluorescent lamps, high-intensity discharge (HID) lamps, mercury thermostats and switches, and batteries (see Hazardous Waste and Contaminated Materials Removal Specification 028100). Removed mercury thermostats shall be managed under the Universal Waste Rule and recycled. Demolition and removal of materials shall be as required to support the work.

   This Project will include, but not be limited to, the proper removal and disposal of the following materials from the SUNY Purchase College, Rehabilitation of Natural Science Building Project, SUCF Project #291029-02.

B. The Contractor shall note that other environmental concerns have been identified. These concerns are not addressed under this specification but are described in their own specification.

C. The Contractor shall develop all applicable waste manifests, shipping papers, waste profiles, land ban forms and any other documentation and coordinate with the Consultant and SUNY Purchase College Environmental Health and Safety (EHS) personnel for review and signature.

D. The work area includes all areas within the project limits where the above referenced materials slated for removal and subsequent disposal are located.
E. The Contractor shall manage all surplus materials and waste generated in the performance of the contract in accordance with applicable Federal, State, and local laws and regulations.

F. The Contractor shall engage a single firm to perform the work of this section. The firm shall have the following qualifications:
   1. Performance of at least three (3) projects in the previous ten (10) years that are similar to the work required for this project, including coordination with simultaneous asbestos abatement and general demolition work.
   2. It has developed and employed a Work Plan, Spill Contingency Plan, and Site-Specific Health and Safety Plan similar to that required for this project.
   3. It has established a Quality Control Program that includes hazard communications and chemical hygiene plans; employee background checks and medical testing; and, waste determination procedures and guidelines, and proper waste manifest tracking.
   4. It has a Project Manager available for this project with at least three years of experience performing similar work; all required training certifications; fluent in the English language and capable of communicating with all the staff; and is experienced in visual inspection, handling, cleaning, storage and field characterization of hazardous materials and contaminated materials similar to those anticipated on this project.
   5. For all employees involved with the hazardous waste related work, completion of 40-hour OSHA HAZWOPER training, annual 8-hour OSHA HAZWOPER refresher training, and proof of annual medical physicals and respirator fit tests.
   6. Must be able certify in writing that these qualifications are met for the firm and persons involved with the hazardous waste and contaminated materials work, and if requested, can submit documentation and resumes to demonstrate their capabilities, experience, and include a list of completed projects with project contact names, addresses, and phone numbers.

G. The Contractor shall be aware of all conditions of the Project and is responsible for verifying quantities and locations of all Work to be performed. Failure to do so shall not relieve the Contractor of its obligation to furnish all labor and materials necessary to perform the Work.

H. All Work shall be performed in strict accordance with the Project Documents and all governing codes, rules, regulations and guidelines. Where conflicts occur between the Project Documents and applicable codes, rules, regulations and guidelines, the more stringent shall apply.

1.3 RELATED SECTIONS

A. Hazardous Waste and Contaminated Materials Removal (Specification 02 8100)

B. Asbestos Abatement (Specification 02 8213)

C. Lead Remediation (Specification 02 8313)

D. PCB Caulk Remediation (Specification 02 8400)

E. Exhaust Duct Remediation (Specification 02 8513)

F. Acid Waste Plumbing System Remediation (Specification 02 8613)

1.4 SUBMITTALS

A. The Contractor shall certify in writing that they have prepared and will maintain a valid Site-Specific Health and Safety Plan to support the hazardous waste and contaminated materials work of this section. The Contractor shall certify in writing that they have a valid OSHA Respiratory Protection Program. Submission of the Site-Specific Health and Safety Plan and OSHA Respiratory Protection Program is not necessary, unless specifically requested by the General Contractor, SUNY Purchase College, and/or SUCF (as part of the overall Natural Science Building renovation project). As part of this work the Contractor will designate and maintain a full-time on-site Health and Safety Officer and off-site Corporate Health and Safety Coordinator for the duration of the associated tasks.

B. The Contractor shall certify in writing that they and their personnel meet the qualifications as described under Section 1.2.F. Submission of all documentation to prove that the qualifications are met is not necessary, unless specifically requested by the General Contractor, SUNY Purchase College, and/or SUCF (as part of the overall Natural Science Building renovation project).

C. The Contractor shall be required to submit a Work Plan explaining the personal protective equipment, work methods, procedures, safety, site storage, transportation, and final treatment/disposal/recycling that will be utilized for all work covered under this section. The Work Plan under this section can be a stand-alone document that only covers the work under this section, or if applicable and the work will occur alongside other hazardous waste related work, an overarching Work Plan document may be prepared for the project, provided all necessary and appropriate information is included. Submission shall be made at least 14 days prior to the anticipated start of work for review by the Architect and Environmental Design Consultant prior to the commencement of activities. The plan shall include:
   - List of the anticipated on-site supervisor(s) and workers scheduled to perform this work. Provide the following for each individual:
     - Certificates of successful completion of the OSHA 40-hour HAZWOPER course for handling hazardous materials along with proof of current 8-hour annual refresher (if applicable) and the OSHA 10-hour Construction Safety training (if applicable).
     - Proper documentation or certificates for workers which have successfully completed the required employee training for Universal Waste or appropriate type of training to the type of wastes being managed by those workers as applicable (i.e.: for Universal Waste such as fluorescent bulbs, see United

States 40 CFR § 273.16 and § 273.36, and New York 6 CRR-NY IV B 374-3; for ozone depleting refrigerant technicians see training for stationary refrigeration and air conditioning under Section 608 of the Clean Air Act per 40 CFR § 82.161 Technician Certification; etc.)

  - Certification of medical examinations completed within the past 12 months. Only include the health providers written opinion that the employee is certified to complete the work covered under this section, do not include any medical information protected by the HIPAA Privacy Rule.
  - Certificates of successful respiratory fit test in accordance with OSHA's Respiratory Protection Standard (1910.134) completed within the past 12 months for each type of respirator that will be worn in order to complete the work covered under this section.
- Contact information for the full-time on-site Health and Safety Officer and off-site Corporate Health and Safety Coordinator.
- Anticipated schedule of start and finish times and dates for this work.
- The method of recycling or treatment/disposal that will be used for each waste stream. Include specific detail on transportation, transfer and other handling from the time waste leaves campus until its arrival at its ultimate destination. Include the name and address of the facilities where all waste materials are to be sent. Include contact person, facility address and telephone number. Plan must include a copy of each disposal/treatment facilities current operation permit that indicates both the type of materials allowed and not allowed for disposal/treatment/recycling.
  - Name, address, and USEPA and NYSDEC permits or licenses (as appropriate), of all proposed recyclers, if applicable. No substitution will be allowed without approval from the Consultant and EHS.
  - Name, address, phone number, responsible contact, and license/permit information (NYS and/or USEPA/USDOT Waste Transporter ID number) from all identified transporters. No substitution will be allowed without approval from the Consultant and EHS.
  - Name, address, and USEPA and NYSDEC permits or licenses (as appropriate), of recipient landfill and incinerators, if applicable. No substitution will be allowed without approval from the Consultant and EHS.
  - Following final removal, and disposal/recycling or destruction, provide the Consultant and EHS with waste transport and disposal/recycling documents (e.g., manifests), as well as certificates of destruction as appropriate.
- Safety Data Sheets (SDSs) for any chemical materials to be used to facilitate this work.
- The Work Plan must include contingency procedures for handling waste spills and releases and the emergency procedures to be followed by Contractor personnel. Contractor shall maintain minor spill cleanup equipment and supplies including absorbent pads, wipes, mini-booms, or other necessary specific equipment to handle spills for materials covered under this section. All temporary waste storage must be within a containment area constructed by the Contractor that meets EPA Container Storage Regulation 40 CFR 264.175 or equivalent for

hazardous wastes. Preparedness and prevention features and contingency planning and emergency procedures shall be developed per 6 NYCRR 373-3.3 and 373-3.4, respectively.

- A description of appropriate security measures that shall be provided for the protection of hazardous and solid waste while stored on-site.
- Provide a description of the methods, procedures and materials to be used in performing the work and handling all wastes covered under this section. Describe the methods to contain hazardous waste from existing locations and the maintenance required to ensure the safe temporary storage of the waste.
- Provide a description of any samples to be taken and the parameters to be analyzed. Identify the laboratory providing the analytical services and provide a copy of their NYSDOH ELAP certification. Note that all sampling conducted by the Contractor shall be done in coordination with and in the presence of SUCF, SUNY Purchase, and/or their Environmental Representative.

1.5 DEFINITIONS

A. Large Quantity Handler (LQH) of Universal Waste shall be a waste handler who accumulates 5,000 kilograms or more of universal waste (batteries, pesticides, thermostats, or lamps, calculated collectively) at any time. This designation as a large quantity handler of universal waste is retained through the end of the calendar year in which 5,000 kilograms (11,000 pounds) or more total of universal waste is accumulated. The LQH shall notify the EPA, acquire or co-ordinate with a facility regarding an EPA identification number, and provide records for each shipment. The LQH shall ensure all employees are thoroughly familiar with proper waste handling and emergency procedures, relative to their responsibilities during normal facility operations and emergencies.

B. Small Quantity Handler of Universal Waste (SQH) shall be a waste handler who does not accumulate 5,000 kilograms (11,000 pounds) or more of total universal waste (batteries, pesticides, thermostats, or lamps, calculated collectively) at any time.

C. Destination Facility shall be a facility that legitimately and can legally accept universal waste from offsite so that the universal waste can be treated, disposed, or recycled in accordance with the regulatory requirements.

D. Universal Waste Transporter shall be anyone who transports universal waste. In New York, universal waste transporters that transport greater than 500 pounds of universal waste in a single shipment must be a permitted hazardous waste transporter pursuant to Federal and State regulations. Proper notification with the receiving handler agreeing to receive the shipment is required by the Universal Waste Transporter.

E. Universal Waste consists of the following discarded materials, as identified in 6 NYCRR 374-3: Fluorescent light bulbs high-intensity discharge (HID) lamps, mercury thermostats and switches, batteries, and pesticides. Removed or replaced mercury thermostats must be delivered to a designated mercury thermostat collection site as per current NYC DEC regulations. Disposal of mercury thermostats in a solid waste management facility is prohibited. PCB ballasts/capacitors from light fixtures shall not be treated as universal waste, they shall be handled and disposed of as hazardous waste.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Polyethylene Sheet: A single polyethylene film in the largest sheet size possible to minimize seams, 6.0 mil thick, clear, frosted, or black.

B. Duct Tape: Provide duct tape in 3" widths, with an adhesive which is formulated to stick aggressively to sheet polyethylene.

C. Spray Cement: Provide spray adhesive in aerosol cans which is specifically formulated to stick tenaciously to sheet polyethylene.

D. Disposal Bags: Provide 6 mil thick leak-tight polyethylene bags.

E. Labels: As required by the EPA and OSHA for handling, transportation, and disposal of hazardous waste.

F. Drums: Recovery or salvage drums acceptable for disposal of hazardous waste. Prior approval of drums is required. Drums or containers must meet the required OSHA EPA (40 CFR Parts 264265 and 300), and DOT regulations (49 CFR Parts 171-178). Use of damaged drums will not be allowed.

PART 3 –- EXECUTION

3.1 UNIVERSAL WASTE

A. Employee training shall ensure that all employees are thoroughly familiar with proper waste handling and emergency procedures, relative to their responsibilities during normal operations and emergencies and to the type of waste they are handling.

B. Mercury thermostats shall be segregated from other Universal Wastes to allow for required recycling.

C. Once the properly labeled containers holding the universal waste have been filled and sealed, they shall be stored in designated accumulation areas as agreed upon by the Owners Representative and Contractor. They shall not be allowed to store in transportation vehicles, or onsite for more than one year from when the waste has been generated.

D. Documentation when a universal waste in storage was first accumulated shall be provided. This is to be done by dating and labeling the waste with the date of the earliest accumulation that can document the length of time the universal waste has been accumulated.

E. Maintenance of an inventory system on-site that identifies the earliest date that any universal waste in a group of universal waste items or a group of containers of universal waste became a waste was received.

F. Any waste developed from the work that exhibits one or more characteristics of hazardous waste, that are not specifically identified by EPA and DEC as Universal Waste, must be handled accordingly and not as a universal waste. See the Hazardous Waste Disposal Specification for those wastes.

3.2 OFF-SITE SHIPMENT OF UNIVERSAL WASTE

A. Off-Site shipments shall meet the requirements for offsite shipments and is prohibited from sending or taking universal waste to a place other than a designated universal waste handler or a universal waste destination facility.

B. LQH's of universal waste must notify EPA in writing and develop an EPA identification number or co-ordinate with the facility regarding use of their EPA identification number, prior to exceeding 5,000 kilograms of universal waste onsite.

C. SQH's do not need to notify EPA, receive an EPA identification number or keep records of shipments of universal waste.

D. LQH's must keep a record of all universal waste shipments received or sent offsite, and must retain those records for at least three years from the date of receipt or shipment. Records may include invoices, manifests, logs, bills or lading, or other shipping documents.

E. The Contractor shall provide certified copies of all receipts obtained from designated mercury thermostat recycling collection sites within 30 days of thermostat acceptance by collection site.

F. The Contractor shall furnish all certified copies of manifests (interim storage and final disposal) within regulatory requirements. Within 30 days from acceptance of the waste by the disposal facility, the Contractor shall provide the Owner with Certificate of Disposal documents, as a requirement for final payment.

END OF SECTION 028700

SECTION 035416 - HYDRAULIC CEMENT UNDERLAYMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes hydraulic-cement-based underlayment for use below interior floor coverings.

1. Flash patch and level 100% of the existing flooring where interior floor coverings (resilient flooring) are to be installed.
2. Provide sloped underlayment surfacing on existing slabs to pitch to floor drains as required, wherever floor drains are indicated on Drawings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1. Include product data indicating VOC content and compliance with requirements for low-emitting materials.

B. Shop Drawings: Plans indicating substrates, locations, and average depths of underlayment based on survey of substrate conditions.

1.3 INFORMATIONAL SUBMITTALS

A. Manufacturer Certificates: Signed by manufacturers of both underlayment and floor covering system certifying that products are compatible.

B. Qualification Data: For Installer.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Installer who is approved by manufacturer for application of underlayment products required for this Project.

B. Product Compatibility: Manufacturers of both underlayment and floor covering system certify in writing that products are compatible.

C. Mockups: Apply hydraulic-cement-based underlayment mockups to demonstrate surface finish, bonding, texture, tolerances, and standard of workmanship.

1. Apply mockups approximately 25 sq. ft. in area in location indicated or, if not indicated, as directed by Architect.
2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials to comply with manufacturer's written instructions to prevent deterioration from moisture or other detrimental effects.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ambient temperature and humidity, ventilation, and other conditions affecting underlayment performance.

1. Place hydraulic-cement-based underlayments only when ambient temperature and temperature of substrates are between 50 and 80 deg F (10 and 27 deg C).

1.7 COORDINATION

A. Coordinate application of underlayment with requirements of floor covering products, including adhesives, specified in Division 09 Sections, to ensure compatibility of products.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the following:

1. Ardex, Inc.; K-15 Self-Leveling Underlayment Concrete.
2. Dayton Superior Specialty Chemical Corp.; Level Layer I
3. Mapei Corporation; Ultraplan I Plus

2.2 MATERIALS, GENERAL

A. VOC Content: Coatings shall meet the requirements of Section 018117 "Low Emitting Material Requirements".

2.3 HYDRAULIC-CEMENT-BASED UNDERLAYMENTS

A. Underlayment: Hydraulic-cement-based, polymer-modified, self-leveling product that can be applied in minimum uniform thicknesses of 1/8 inch (3 mm) and that can be feathered at edges to match adjacent floor elevations. Product shall also be capable of being poured/pumped monolithically (rather than room-by-room).

1. Cement Binder: ASTM C 150, portland cement, or hydraulic or blended hydraulic cement as defined by ASTM C 219.
2. Compressive Strength: Not less than 4100 psi (28 MPa) at 28 days when tested according to ASTM C 109/C 109M.

3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3 to 6 mm); or coarse sand as recommended by underlayment manufacturer.
   a. Provide aggregate when recommended in writing by underlayment manufacturer for underlayment thickness required

4. Water: Potable and at a temperature of not more than 70 deg F (21 deg C).

B. Primer: Product of underlayment manufacturer recommended in writing for substrate, conditions, and application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for conditions affecting performance.

1. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Prepare and clean substrate according to manufacturer's written instructions.

1. Treat nonmoving substrate cracks according to manufacturer's written instructions to prevent cracks from telegraphing (reflecting) through underlayment.
2. Fill substrate voids to prevent underlayment from leaking.

B. Concrete Substrates: Mechanically remove, according to manufacturer's written instructions, laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants that might impair underlayment bond. Perform moisture tests recommended by manufacturer and as follows.

1. Moisture Testing: Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates do not exceed a maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/100 sq. m) in 24 hours.
2. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have relative humidity level measurement acceptable to manufacturer.

C. Nonporous Substrates: For ceramic tile, quarry tile, and terrazzo substrates, remove waxes, sealants, and other contaminants that might impair underlayment bond, and prepare surfaces according to manufacturer's written instructions.

D. Adhesion Tests: After substrate preparation, test substrate for adhesion with underlayment according to manufacturer's written instructions.

3.3 APPLICATION

A. General: Mix and apply underlayment components according to manufacturer's written instructions.

1. Close areas to traffic during underlayment application and for time period after application recommended in writing by manufacturer.
2. Coordinate application of components to provide optimum underlayment-to-substrate and intercoat adhesion.
3. At substrate expansion, isolation, and other moving joints, allow joint of same width to continue through underlayment.
4. Install perimeter isolation strip along the base of partitions prior to installation of topping. Cut isolation strip flush with finished floor.
5. Apply primer over prepared substrate at manufacturer's recommended spreading rate.

B. Apply underlayment to produce uniform, level surface.

1. Apply a final layer without aggregate to produce surface.
2. Feather edges to match adjacent floor elevations.

C. Cure underlayment according to manufacturer's written instructions. Prevent contamination during application and curing processes.

D. Do not install floor coverings over underlayment until after time period recommended in writing by underlayment manufacturer.

E. Remove and replace underlayment areas that evidence lack of bond with substrate, including areas that emit a "hollow" sound when tapped.

3.4 PROTECTION

A. Protect underlayment from concentrated and rolling loads for remainder of construction period.

END OF SECTION 035416

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Steel framing and supports for ceiling supported laboratory equipment and other items indicated on Drawings.
2. Steel framing and supports for mechanical and electrical equipment.
3. Steel framing and supports for applications where framing and supports are not specified in other Sections.
4. Unistrut

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Paint products.
2. Grout.
3. Unistrut

B. Shop Drawings: Detail fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

1.3 INFORMATIONAL SUBMITTALS

A. Welding Certificates: Copies of certificates for welding procedures and personnel.

B. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: A firm experienced in producing metal fabrications similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

B. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."
2. AWS D1.3, "Structural Welding Code--Sheet Steel."

3. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

1.5 PROJECT CONDITIONS

A. Field Measurements: Where metal fabrications are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions. Allow for trimming and fitting.

1.6 COORDINATION

A. Coordinate installation of anchorages for metal fabrications. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: For metal fabrications 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.

2.2 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Steel Tubing: Cold-formed steel tubing complying with ASTM A 500. For exterior installations and where indicated, provide tubing with hot-dip galvanized coating.

C. Steel Pipe: ASTM A 53, standard weight (Schedule 40), unless another weight is indicated or required by structural loads. For exterior installations and where indicated, provide pipe with hot-dip galvanized coating.

D. Slotted Channel Framing: Cold-formed metal channels with flange edges returned toward web and with 9/16-inch- wide slotted holes in webs at 2 inches o.c.

1. Width of Channels: 1-5/8 inches.
2. Depth of Channels: As indicated.

3. Metal and Thickness: Galvanized steel complying with ASTM A 653/A 653M, structural quality, Grade 33
4. Finish: Unfinished.

E. Malleable-Iron Castings: ASTM A 47, Grade 32510 (ASTM A 47M, Grade 22010).

F. Gray-Iron Castings: ASTM A 48, Class 30 (ASTM A 48M, Class 200), unless another class is indicated or required by structural loads.

G. Cast-in-Place Anchors in Concrete: Anchors of type indicated below, fabricated from corrosion-resistant materials capable of sustaining, without failure, the load imposed within a safety factor of 4, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

1. Threaded or wedge type; galvanized ferrous castings, either ASTM A 47 (ASTM A 47M) malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, hot-dip galvanized per ASTM A 153/A 153M.

H. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

2.3 PAINT

A. Shop Primer for Interior Ferrous Metal: Modified oil-alkyd primer, Tnemec 88-559 or 10-1009, or equivalent. Primer shall be compatible with finish paint specified in Section 099100.

B. Shop Primer for Galvanized Ferrous Metal: Polyamide epoxy primer, Tnemec F.C. Typoxy Series 27, or equivalent. Primer shall be compatible with finish paint specified in Section 099100.

C. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

D. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12, except containing no asbestos fibers, or cold-applied asphalt emulsion complying with ASTM D 1187.

2.4 FASTENERS

A. General: Provide Type 304 or 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, where built into exterior walls, except as noted below. Select fasteners for type, grade, and class required.

B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.

C. Anchor Bolts: ASTM F 1554, Grade 36.

D. Machine Screws: ASME B18.6.3 (ASME B18.6.7M).

E. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).

F. Wood Screws: Flat head, carbon steel, ASME B18.6.1.

G. Plain Washers: Round, carbon steel, ASME B18.22.1 (ASME B18.22M).

H. Lock Washers: Helical, spring type, carbon steel, ASME B18.21.1 (ASME B18.21.2M).

I. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

1. Material: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.

J. Toggle Bolts: FS FF-B-588, tumble-wing type, class and style as needed.

2.5 GROUT

A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.6 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Shear and punch metals cleanly and accurately. Remove burrs.

C. Ease exposed edges to a radius of approximately 1/32 inch (1 mm), unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Weld corners and seams continuously to comply 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. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

E. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

F. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

G. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.

H. Remove sharp or rough areas on exposed traffic surfaces.

I. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.

2.7 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports that are not a part of structural-steel framework as necessary to complete the Work.

B. Fabricate units from structural-steel shapes, plates, tubes, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.

1. Fabricate units from slotted channel framing where indicated.
2. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors 1-1/4 inches (32 mm) wide by 1/4 inch (6 mm) thick by 8 inches (200 mm) long at 24 inches (600 mm) o.c., unless otherwise indicated.
3. Furnish inserts if units must be installed after concrete is placed.

C. Galvanize miscellaneous framing and supports where indicated, and in exterior locations.

2.8 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal fabrications after assembly.

2.9 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:

1. ASTM A 123, for galvanizing steel and iron products.
2. ASTM A 153/A 153M, for galvanizing steel and iron hardware..

B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface-preparation specifications and environmental exposure conditions of installed metal fabrications:

1. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."

C. Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes indicated as unpainted, and those to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Paint embedded steel that is partially exposed on exposed portions and initial 2 inches of embedded areas only.

1. Do not paint surfaces to be welded or high-strength bolted with friction-type connections.
2. Apply 2 coats of paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal fabrications to in-place construction. Include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

D. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

E. Field Welding: Comply with the following requirements:

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. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings, if any.

3.3 ADJUSTING AND CLEANING

A. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 09 Section "Painting."

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 055000

SECTION 061053 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Wood blocking, cants, furring, supports, and nailers.
2. Plywood backing panels.

1.2 DEFINITIONS

A. Lumber grading agencies, and the abbreviations used to reference them, include the following:

1. NELMA - Northeastern Lumber Manufacturers Association.
2. NLGA - National Lumber Grades Authority.
3. SPIB - Southern Pine Inspection Bureau.
4. WCLIB - West Coast Lumber Inspection Bureau.
5. WWPA - Western Wood Products Association.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials, both before and after exposure to elevated temperatures when tested according to ASTM D 5516 and ASTM D 5664.
2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
3. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

B. Laboratory Test Reports: For composite wood products, indicating compliance with requirements for low-emitting materials.

1.4 INFORMATIONAL SUBMITTALS

A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses.

B. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:

1. Fire-retardant-treated wood.

1.5 QUALITY ASSURANCE

A. All composite wood, engineered wood, or agrifber products (e.g., plywood, particleboard, medium density fiberboard) shall contain no added urea-formaldehyde resins. Laminating adhesives used to fabricate on-site and shop-applied composite wood and agrifiber assemblies shall contain no added urea-formaldehyde resins. Acceptable resins and binders include, but are not limited to, phenol formaldehyde and methyl diisocyanate (MDI).

1.6 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber, plywood, and other panels; place spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings..

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of lumber grading agencies certified by the American Lumber Standards Committee Board of Review.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. Provide dressed lumber, S4S, unless otherwise indicated.
3. Provide dry lumber with 19 percent maximum moisture content at time of dressing for 2-inch nominal (38-mm actual) thickness or less, unless otherwise indicated.

B. Composite Wood Products: Products shall be made using ultra-low-emitting formaldehyde resins as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products" or shall be made with no added formaldehyde.

C. VOC Content: Composite wood products shall meet the requirements of Section 018117 “Low Emitting Material Requirements.”

2.2 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, materials shall 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. Use treatment that does not promote corrosion of metal fasteners.
2. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D3201 at 92 percent relative humidity. Use where exterior type is not indicated.

C. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency

2.3 MISCELLANEOUS LUMBER

A. Provide miscellaneous lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Furring.
4. Sleepers
5. Cants

B. For items of dimension lumber size, provide Construction, Stud, or No. 2 grade lumber with 19 percent maximum moisture content and the following species: Mixed southern pine; SPIB.

C. For concealed boards, provide lumber with 19 percent maximum moisture content of the following species and grades:

1. Spruce-pine-fir (south) or Spruce-pine-fir, Construction or 2 Common grade; NELMA, NLGA, WCLIB, or WWPA.

2.4 PLYWOOD PANELS

A. Telephone and Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2 inch (12.7 mm) thick.

1. Paint before mounting of equipment. Do not paint over fire-treatment labels.

B. Miscellaneous Concealed Plywood: Exposure 1 sheathing, span rating to suit framing in each location, and thickness as indicated but not less than ½ inch (13 mm).

1. Provide fire-retardant-treated panels for interior locations unless indicated.

2.5 MISCELLANEOUS MATERIALS

A. Fasteners:

1. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
2. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Discard units of material with defects that impair quality of carpentry and that are too small to use with minimum number of joints or optimum joint arrangement.

B. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, and similar supports to comply with requirements for attaching other construction.

C. Securely attach carpentry work as indicated and according to applicable codes and recognized standards.

D. Use fasteners of appropriate type and length. Predrill members when necessary to avoid splitting wood.

3.2 PANEL PRODUCT INSTALLATION

A. Fastening Methods: Fasten panels as indicated below:

1. Plywood Backing Panels: Screw to supports.
2. Miscellaneous Concealed Plywood Panels: Screw to supports.

3.3 WOOD BLOCKING, AND NAILER INSTALLATION

A. Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.

END OF SECTION 061053

SECTION 064020 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Slat wall.
2. Plywood enclosure at perimeter walls, at former induction units.

B. Related Work Specified Elsewhere:

1. Wood and metal laboratory casework is specified in Division 12 Section “Laboratory Casework.”

1.2 DEFINITIONS

A. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items, unless concealed within other construction before woodwork installation.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated, including cabinet hardware and accessories, and finishing materials and processes.

B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

1. Show details full size.
2. Show locations and sizes of furring, blocking, and hanging strips and clips, cabling and connectors, and attachment devices, including concealed blocking and reinforcement specified in other Sections.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Field Measurements: Where woodwork is 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 woodwork by field measurements before being enclosed and indicate measurements on Shop Drawings.

1.6 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide materials that comply with requirements of the AWI quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.

B. Low-Emitting Materials: All composite wood, engineered wood, or agrifber products (e.g., plywood, particleboard, medium density fiberboard) shall contain no added urea-formaldehyde resins. Laminating adhesives used to fabricate on-site and shop-applied composite wood and agrifiber assemblies shall contain no added urea-formaldehyde resins. Acceptable resins and binders include, but are not limited to, phenol formaldehyde and methyl diisocyanate (MDI)

C. Slatwall: Provide white melamine Slatwall in sizes and configurations as indicated on the Drawings with finished edge trim and aluminum insert channels.

D. Composite Wood Products: Products shall be made using ultra-low-emitting formaldehyde resins as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products" or shall be made with no added formaldehyde.

E. VOC Content: Composite wood products shall meet the requirements of Section 018117 “Low Emitting Material Requirements.”

F. Plywood: DOC PS 1, Medium Density Overlay on minimum one face (exposed face), thickness as indicated on Drawings.

2.2 INSTALLATION MATERIALS

A. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside

face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

2.3 FABRICATION, GENERAL

A. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:

1. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members and Rails: 1/16 inch (1.5 mm)

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. 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 indicated on Shop Drawings before disassembling for shipment.

C. Shop cut openings, to maximum extent possible, to receive hardware, 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.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).

B. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.

3.2 ADJUSTING AND CLEANING

A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean woodwork on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 064020

SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Penetrations in fire-resistance-rated walls.
2. Penetrations in fire-resistance-rate horizontal assemblies.
3. Penetrations in non-fire-resistance-rate horizontal assemblies.
4. Penetrations in smoke barriers, smoke partitions and smoke tight partitions.
5. Penetrations requiring firestopping include those for new work, those created by removals, and those existing in the work area and remain at Substantial Completion.

B. Related Sections:

1. Section 078446 "Fire-Resistive Joint Systems" for joints in or between fire-resistance-rated construction, and in smoke barriers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Product Schedule: For each penetration firestopping system. Include location and design designation of qualified testing and inspecting agency.

1. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping condition, submit illustration, with modifications marked, approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Installer Certificates: From Installer indicating penetration firestopping has been installed in compliance with requirements and manufacturer's written recommendations.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for penetration firestopping.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A firm experienced in installing penetration firestopping similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration firestopping products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

1. If multiple installers are used, each shall use products from the same manufacturer.

B. Fire-Test-Response Characteristics: Penetration firestopping shall comply with the following requirements:

1. Penetration firestopping tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
2. Penetration firestopping is identical to those tested per testing standard referenced in "Penetration Firestopping" Article. Provide rated systems complying with the following requirements:
   a. Penetration firestopping products bear classification marking of qualified testing and inspecting agency.
   b. Classification markings on penetration firestopping correspond to designations listed by the following:
      1) UL in its "Fire Resistance Directory."
      2) Intertek ETL SEMKO in its "Directory of Listed Building Products."
      3) FM Global in its "Building Materials Approval Guide."

C. Preinstallation Conference: Conduct conference at Project site.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Do not install penetration firestopping when ambient or substrate temperatures are outside limits permitted by penetration firestopping manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.

B. Install and cure penetration firestopping per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.6 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping is installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping.

C. Notify Owner's testing agency at least seven days in advance of penetration firestopping installations; confirm dates and times on day preceding each series of installations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. Penetration Firestop Systems specified in the Schedule in Part - 3 include:
   a. Fire Barrier Products, 3M Fire Protection Products
   b. RectorSeal Corporation.

2. Subject to compliance with specified requirements, provide Penetration Firestop Systems (XHEZ) listed in Volume II of the UL Fire Resistance Directory (BXRH), by one of the following:
   a. Hilti, Inc.
   b. Nelson Firestop Products.
   c. RectorSeal Corporation.
   d. Specified Technologies Inc.
   e. 3M Fire Protection Products.
   f. Wiremold/Legrand

2.2 PENETRATION FIRESTOPPING

A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

B. Penetrations in Fire-Resistance-Rated Walls: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).

1. Fire-resistance-rated walls include fire walls, fire-barrier walls, smoke-barrier walls, and fire partitions.
2. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. Penetrations in Horizontal Assemblies: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).

1. Horizontal assemblies include floors and floor/ceiling assemblies.
2. F-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated.
3. T-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.

D. Penetrations in Smoke Barriers: Provide penetration firestopping with ratings determined per UL 1479.

1. L-Rating: Not exceeding 5.0 cfm/sq. ft. (0.025 cu. m/s per sq. m) of penetration opening at 0.30-inch wg (74.7 Pa) at both ambient and elevated temperatures.

E. W-Rating: Provide penetration firestopping showing no evidence of water leakage when tested according to UL 1479.

F. Exposed Penetration Firestopping: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

G. VOC Content: Penetration firestopping sealants and sealant primers shall comply with Section 018117 “Low Emitting Material Requirements.”

H. 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 manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.

1. Permanent forming/damming/backing materials, including the following:
   a. Slag-wool-fiber or rock-wool-fiber insulation.
   b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
   c. Fire-rated form board.
   d. Fillers for sealants.

2. Temporary forming materials.
3. Substrate primers.
4. Collars.
5. 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 metallic sleeve lined with an intumescent strip, a radial extended 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 elastomeric sheet bonded to galvanized-steel sheet.

E. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.

F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

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: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. 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 of grade indicated below:

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces, and nonsag formulation for openings in vertical and sloped surfaces, unless indicated firestopping limits use of nonsag grade for both opening conditions.

2.4 MIXING

A. For those products requiring mixing before application, comply with penetration firestopping 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: Clean out openings immediately before installing penetration firestopping 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.

2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.
4. Remove existing firestopping at existing penetrations within the work area.

B. Priming: 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.

C. Masking Tape: Use masking tape to prevent penetration firestopping from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing firestopping's seal with substrates.

3.3 INSTALLATION

A. General: Install penetration firestopping 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 fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestopping.

C. Install fill materials for firestopping by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
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. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. 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.

B. Where deficiencies are found or penetration firestopping is damaged or removed because of testing, repair or replace penetration firestopping to comply with requirements.

C. Proceed with enclosing penetration firestopping 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 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 is 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 and install new materials to produce systems complying with specified requirements.

3.7 PENETRATION FIRESTOPPING SCHEDULE

A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHEZ.

B. For penetrations in non-fire rated horizontal assemblies, smoke barriers, smoke partitions and smoke tight partitions, provide systems tested for 1 hour unless otherwise noted.

C. Basis of Design Assemblies: Subject to compliance with requirements, provide the design indicated below or a comparable UL design by one of manufacturer’s listed in Part 2 above.

1. Schedule of construction components, type of penetrant, and U.L. Penetration Firestop Systems include, but are not limited to the following:
2. Schedule of construction components, type of penetrant, and U.L. Penetration Firestop Systems include, but are not limited to the following:

	P E N E T R A N T

	Metal Conduit	Cable Tray[4]	Cables	Non-Insul. Metal Pipe	Insul. Pipe	FR Polypro-pylene Pipe	Insul. Metal Duct
GWB Stud Wall, or Shaft Wall up to 2 Hr Rating	W-L-1001	W-L-4004	W-L-3001	W-L-1001	W-L-5011	W-L-2002	W-L-7006 [3]
CMU Wall up to 2 Hr Rating	C-AJ 1044	C-AJ-4003	C-AJ-3030	C-AJ-1044	C-AJ-5001	C-AJ-2001	C-AJ-7003[3], 7016[3]
Concrete Floor / Metal Deck 1 Hr Rated F and T-Rating[2]	C-AJ-1008	N/A	C-AJ-3029	C-AJ-1008	C-AJ-5002	F-A-2002	C-AJ-7009[5]
Concrete Floor / Metal Deck 2 Hr Rated F and T-Rating[2]	C-AJ-1008	N/A	C-AJ-3029	C-AJ-1008	C-AJ-5060	F-A-2002	N/A
Concrete Floor / Metal Deck up to 2 Hr F Rated[1]	F-A-1002	N/A	C-AJ-3030	C-AJ-1044	C-AJ-5001	F-A-2002	N/A

KEY TO NOTES

1. Penetration within wall cavity.
2. Penetration that does not fall within wall cavity, T-Rating required.
3. Up to 1 hour rating, submit engineered judgement firestopping system for this combination of penetrant, wall/floor assembly, and fire rating. Install fire dampers in 2-hour walls in accordance with manufacturer's instructions and testing agency requirements.
4. Where cable tray extends through wall.
5. For floor penetrations not enclosed above and below the floor with shaft wall.

D. Membrane Penetrations:

1. Firestop membrane penetrations by cables, pipes and conduit similar to through wall penetrations.
2. Provide putty pad box wrap firestopping for membrane penetrations in rated walls for electrical back boxes over 16 sq. inches, where any back boxes are located within 24 inches horizontal of another back box, or when total area of back boxes exceeds 100 sq in. in 100 sq. ft. of wall area.

E. Where another type of construction or penetrant is encountered, or if field conditions vary from those described in the U.L. System listed (i.e. annular space is greater/smaller, insulation type varies, etc.), provide firestopping systems which are appropriate, and U.L. tested, for that condition.

END OF SECTION 078413

SECTION 078446 - FIRE-RESISTIVE JOINT SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Joints in or between fire-resistance-rated constructions.
2. Joints in smoke barriers.

B. Related Sections:

1. Section 078413 "Penetration Firestopping" for penetrations in fire-resistance-rated walls, horizontal assemblies, and smoke barriers.

1.2 ACTION SUBMITTALS

1. Product Data: For each type of product indicated.

B. Product Schedule: For each fire-resistive joint system. Include location and design designation of qualified testing agency.

1. Where Project conditions require modification to a qualified testing agency's illustration for a particular fire-resistive joint system condition, submit illustration, with modifications marked, approved by fire-resistive joint system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Installer Certificates: From Installer indicating fire-resistive joint systems have been installed in compliance with requirements and manufacturer's written recommendations.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for fire-resistive joint systems.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A firm experienced in installing fire-resistive joint systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its fire-resistive joint

system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

B. Fire-Test-Response Characteristics: Fire-resistive joint systems shall comply with the following requirements:

1. Fire-resistive joint system tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
2. Fire-resistive joint systems are identical to those tested per testing standard referenced in "Fire-Resistive Joint Systems" Article. Provide rated systems complying with the following requirements:
   a. Fire-resistive joint system products bear classification marking of qualified testing agency.
   b. Fire-resistive joint systems correspond to those indicated by reference to designations listed by the following:
      1) UL in its "Fire Resistance Directory."

C. Preinstallation Conference: Conduct conference at Project site.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Do not install fire-resistive joint systems when ambient or substrate temperatures are outside limits permitted by fire-resistive joint system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Install and cure fire-resistive joint systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.6 COORDINATION

A. Coordinate construction of joints to ensure that fire-resistive joint systems are installed according to specified requirements.

B. Coordinate sizing of joints to accommodate fire-resistive joint systems.

C. Notify Owner's testing agency at least seven days in advance of fire-resistive joint system installations; confirm dates and times on day preceding each series of installations.

PART 2 - PRODUCTS

2.1 FIRE-RESISTIVE JOINT SYSTEMS

A. Where required, provide fire-resistive joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which fire-resistive joint systems are installed. Fire-resistive joint systems shall

accommodate building movements without impairing their ability to resist the passage of fire and hot gases.

B. Joints in or between Fire-Resistance-Rated Construction: Provide fire-resistive joint systems with ratings determined per ASTM E 1966 or UL 2079:

1. Joints include those installed in or between fire-resistance-rated walls, floor or floor/ceiling assemblies and roofs or roof/ceiling assemblies.
2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of construction they will join.
3. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
   a. Grace Construction Products.
   b. Hilti, Inc.
   c. RectorSeal Corporation.
   d. Specified Technologies Inc.
   e. 3M Fire Protection Products.
   f. Tremco, Inc.; Tremco Fire Protection Systems Group.

C. Joints in Smoke Barriers: Provide fire-resistive joint systems with ratings determined per UL 2079.

1. L-Rating: Not exceeding 5.0 cfm/ft (0.00775 cu. m/s x m) of joint at 0.30 inch wg (74.7 Pa) at both ambient and elevated temperatures.
2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
   a. Grace Construction Products.
   b. Hilti, Inc.
   c. Johns Manville.
   d. RectorSeal Corporation.
   e. Specified Technologies Inc.
   f. 3M Fire Protection Products.
   g. Tremco, Inc.; Tremco Fire Protection Systems Group.

D. Exposed Fire-Resistive Joint Systems: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

E. VOC Content: Fire-resistive joint system sealants and primers shall have VOC content meeting the requirements of Section 018117 “Low Emitting Material Requirements”.

F. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install fill materials and to maintain ratings required. Use only components specified by fire-resistive joint system manufacturer and approved by the qualified testing agency for systems 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: Clean joints immediately before installing fire-resistive joint systems 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 fill materials.
2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with fill materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by fire-resistive joint 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. Masking Tape: Use masking tape to prevent fill materials of fire-resistive joint system from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing fire-resistive joint system's seal with substrates.

3.3 INSTALLATION

A. General: Install fire-resistive joint 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 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 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 fill materials for fire-resistive joint systems by proven techniques to produce the following results:

1. Fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
2. Apply fill materials so they contact and adhere to substrates formed by joints.

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. Identify fire-resistive joint systems with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of joint edge so labels will be visible to anyone seeking to remove or penetrate joint 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 - Fire-Resistive Joint System - 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. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Where deficiencies are found or fire-resistive joint systems are damaged or removed due to testing, repair or replace fire-resistive joint systems so they comply with requirements.

C. Proceed with enclosing fire-resistive joint systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTING

A. Clean off excess fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by fire-resistive joint 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 fire-resistive joint 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 fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

3.7 FIRE-RESISTIVE JOINT SYSTEM / FIRESTOP JOINT SYSTEM SCHEDULE

A. Where UL-classified firestop joint systems are indicated, they refer to alphanumeric designations listed in UL's "Fire Resistance Directory" under product Category XHBN.

Firestop Joint System Location	Basis-of-Design	Assembly Rating	Nominal Joint Width	Movement Capabilities [2]
Floor-to-Wall				
Rated concrete masonry wall construction intersection with adjacent floor construction	FW-D-1012, FW-D-1013	1 hour or 2 hours[1]	As indicated, or required by tested assembly	Class II
Head-of-Wall				
Rated gypsum wall construction intersection with steel floor deck above	HW-D-0087, or HW-D-0089	1 hour or 2 hours[1]	As indicated, or required by tested assembly	Class II or III,
Rated gypsum wall construction intersection with concrete floor deck above	HW-D-0083, HW-D-209	1 hour or 2 hours[1]	As indicated, or required by tested assembly	Class II
Rated concrete masonry wall construction intersection with steel floor deck above	HW-D-0081, or HW-D-0098	1 hour or 2 hours[1]	As indicated, or required by tested assembly	Class II
Rated concrete masonry wall construction intersection with concrete floor deck above	HW-D-0268, HW-D-0097	1 hour or 2 hours[1]	As indicated, or required by tested assembly	Class II
Bottom-of-Wall				
Rated gypsum wall construction intersection with concrete floor	BW-S-0002	1 hour or 2 hours[1]	As indicated, or required by tested assembly	Static

1. Rating to match wall construction.
2. Class UL2079

B. Where another type of construction is encountered, or if field conditions vary from those described in the U.L. System listed (i.e. annular space is greater/smaller, insulation type varies, etc.), provide firestopping systems which are appropriate, and U.L. tested, for that condition.

END OF SECTION 078446

ATTACHMENT: FIRESTOP JOINT SYSTEMS SUBMITTAL SHEET

3.8 FIRESTOP JOINT SYSTEMS SUBMITTAL SHEET

A. **HEAD-OF-WALL FIRESTOPPING:** Fill in the U.L. Design number and attach copy of U.L. Test. Insert n/a if condition is not applicable.

1. Gypsum wall construction intersection with floor deck above: _____. Gypsum wall construction intersection with roof deck above: _____.
2. Concrete masonry wall construction intersection with floor deck above: _____.
3. Concrete masonry wall construction intersection with roof deck above: _____.

B. **FLOOR-TO-WALL FIRESTOPPING:** Fill in the U.L. Design number and attach copy of U.L. Test. Insert n/a if condition is not applicable.

1. Concrete masonry wall construction intersection with adjacent floor construction: _____.

C. **BOTTOM-OF-WALL FIRESTOPPING:** Fill in the U.L. Design number and attach copy of U.L. Test. Insert n/a if condition is not applicable.

1. Gypsum wall construction intersection with floor deck: _____. Gypsum wall construction intersection with roof deck above: _____.
2. Concrete masonry wall construction intersection with floor _____.
3. Concrete masonry wall construction intersection with roof deck above: _____.

D. **CURTAIN WALL FIRESTOPPING:** Fill in the design number and copy test. Insert n/a if condition is not applicable.

1. Aluminum mullion and glass spandrel panel curtainwall intersection with adjacent floor construction:
2. Gypsum sheathed curtainwall intersection with adjacent floor construction: _____.

E. **OTHER:** Where another type of construction or penetrant is encountered, attach a separate sheet listing each condition and attach copy of the U.L. Test.

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes joint sealants for the following locations:

1. Exterior joints in the following vertical surfaces and nontraffic horizontal surfaces:

   a. Perimeter joints between exterior wall surfaces and frames of louvers and windows.
   b. Other joints as indicated.

2. Interior joints in the following vertical surfaces and horizontal nontraffic surfaces:

   a. Perimeter joints of exterior openings.
   b. Perimeter joints between interior wall surfaces and frames of interior doors.
   c. Joints between plumbing fixtures and adjoining walls, floors, and counters.
   d. Other joints as indicated.

3. Interior joints in the following horizontal traffic surfaces:

   a. Joints as indicated.

B. Related Sections include the following:

1. Sealants used in glazing are specified in Division 08 "Glazing."

1.2 SYSTEM PERFORMANCE REQUIREMENTS

A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

1.3 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Samples for initial selection purposes in form of manufacturer's standard bead samples, consisting of strips of actual products showing full range of colors available, for each product exposed to view.

C. Samples for verification purposes of each type and color of joint sealant required. Install joint sealant samples in 1/2-inch (13-mm)) wide joints formed between two 6-inch (150-

mm) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

1.4 INFORMATIONAL SUBMITTALS

A. Certificates from manufacturers of joint sealants attesting that their products comply with specification requirements and are suitable for the use indicated.

B. Qualification data complying with requirements specified in "Quality Assurance" article. Include list of completed projects with project names addresses, names of Architects and Owners, plus other information specified.

C. Compatibility and adhesion test reports from elastomeric sealant manufacturer indicating that materials forming joint substrates and joint sealant backings have been tested for compatibility and adhesion with joint sealants. Include sealant manufacturer's interpretation of test results relative to sealant performance and recommendations for primers and substrate preparation needed to obtain adhesion.

D. Product test reports for each type of joint sealants indicated, evidencing compliance with requirements specified.

E. Preconstruction field test reports indicating which products and joint preparation methods demonstrate acceptable adhesion to joint substrates.

F. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an installer who has successfully completed at least three (3) joint sealer applications similar in type and size to that of this project within the last five (5) years. All workers used for work of this Section shall be experienced in the techniques of sealant application and shall be completely familiar with the published recommendations of the manufacturer of the joint sealant materials being used.

B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

C. Preconstruction Field Testing: Prior to installation of joint sealants, field-test their adhesion to joint substrates as follows:

1. Locate test joints where indicated or, if not indicated, as directed by Architect.
2. Conduct field tests for each application indicated below:
   a. Each type of elastomeric sealant and joint substrate indicated.
   b. Each type of non-elastomeric sealant and joint substrate indicated.

3. Extent of Testing:
   a. Perform ten tests for the first 1000 feet of joint length for each type of sealant and joint substrate.
   b. Perform one test for each 1000 feet of joint length thereafter.

4. Notify Architect one week in advance of the dates and times when mock-ups will be erected.
5. Arrange for tests to take place with joint sealant manufacturer's technical representative present.
6. Test Method: Test joint sealants by Method A, Field-Applied Sealant Joint Hand Pull Tab, in ASTM C 1521.
7. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
8. Inspect tested joints and report on the following:
   a. Whether sealants filled joint cavities and are free of voids.
   b. Whether sealant dimensions and configurations comply with specified requirements.
   c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.
9. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
10. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.
11. Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.
12. Do not use sealants that fail to adhere to joint substrates during testing.

D. Field-Constructed Mock-Ups: Prior to installation of joint sealants, apply elastomeric sealants as follows to verify selections made under sample submittals and to demonstrate aesthetic effects as well as qualities of materials and execution:

1. Joints in field-constructed mock-ups of assemblies specified in other Sections that are indicated to receive elastomeric joint sealants specified in this Section.

E. Pre-Installation Conference: Conduct conference at Project site to comply with requirements of the Division 01 Section covering this activity.

F. Random Field Tests: Periodically test sealants, in place, for adhesion, using methods recommended by sealant manufacturer. Promptly replace any sealant that does not adhere, fails to cure, or fails to perform as specified by the sealant manufacturer.

G. Field Water Test: Perform two field water tests on completed areas including as many conditions as possible. If leakage occurs during testing, repair as required, and re-test area and also test two additional locations.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials in compliance with manufacturer's recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.7 PROJECT CONDITIONS

A. Environmental Conditions: Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside the limits permitted by joint sealant manufacturer or below 40 deg F (4 deg C).
2. When joint substrates are wet.

B. Joint Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than allowed by joint sealant manufacturer for application indicated.

C. Joint Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with their adhesion are removed from joint substrates.

1.8 COORDINATION

A. Coordinate the work with all sections referencing this section.

1.9 WARRANTY

A. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Manufacturer’s Warranty: Provide written warranty agreeing to repair or replace, at no cost to Owner, defective materials for twenty (20) years, and workmanship for two (2) years from the Date of Substantial Completion. Defective materials and workmanship shall include, but are not limited to:

1. Deterioration, aging or weathering of the work;
2. Water leakage and/or air leakage;
3. Sealant loss of adhesion, loss of cohesion, cracking or discoloration;

4. Staining or discoloration of adjacent surfaces;
5. Joint failure due to building or joint movement up to the limits prescribed by the manufacturer;
6. Cracks or bubbles on sealant surface.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, joint fillers, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

B. Colors: Provide color of exposed joint sealants to comply with the following:

1. Provide selections made by Architect from manufacturer’s standards or custom colors to match Architect's samples, as directed by Architect.

C. Additional Movement Capability: Where additional movement capability is specified, provide products with the capability, when tested for adhesion and cohesion under maximum cyclic movement per ASTM C 719, to withstand the specified percentage change in the joint width existing at time of installation and remain in compliance with other requirements of ASTM C 920 for Uses indicated.

D. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project

2.2 LATEX JOINT SEALANT

A. Acrylic-Emulsion Sealant: Manufacturer's standard, one part, nonsag, mildew-resistant, paintable latex acrylic-emulsion sealant complying with ASTM C 834, formulated to be paintable and recommended for exposed applications on interior locations involving joint movement of not more than plus or minus 5 percent.

1. Available Products: Subject to compliance with requirements, latex joint sealants that may be incorporated in the Work include, but are not limited to, the following:
   a. AC-20; Pecora Corporation.
   b. Tremflex 834; Tremco.
   c. ALEX PLUS; DAP .

B. Uses: General interior use, paintable.

2.3 MILDEW-RESISTANT SILICONE JOINT SEALANT

A. Single-Component Mildew-Resistant Silicone Sealant: Manufacturer's standard, non-modified, one-part, silicone sealant; complying with ASTM C 920, Type S, Grade NS,

Class 25, Uses NT, G, A, and, as applicable to non-porous joint substrates indicated, O. Formulate sealant with fungicide and specifically intended for sealing interior joints with nonporous substrates and subject to in-service exposure to conditions of high humidity and temperature extremes.

1. Available Products: Subject to compliance with requirements, silicone joint sealants that may be incorporated in the Work include, but are not limited to, the following:
   a. 786 Mildew Resistant; Dow Corning.
   b. Sanitary 1700; GE Silicones.
   c. 898 Silicone Sanitary Sealant; Pecora Corporation.
   d. Tremsil 600 White; Tremco.

B. Uses: Interior use in wet locations, and all toilet and shower rooms.

2.4 NONSAG URETHANE JOINT SEALANT

A. Multicomponent Nonsag Urethane Sealant: Manufacturer's standard, non-modified, multi-part, nonsag urethane sealant; complying with ASTM C 920, Type M, Grade NS, Class 25, Uses NT, M, G, A, and as applicable to joint substrates indicated, O.

1. Available Products: Subject to compliance with requirements, urethane joint sealants that may be incorporated in the Work include, but are not limited to, the following:
   a. Dynatrol II, Pecora Corporation
   b. Sikaflex-2c NS, Sika Corporation
   c. Dymeric 240FC; Tremco.
   d. Masterseal NP 2; Master Builders Solutions Div., BASF

B. Uses: Interior use for exposed concrete or masonry wall control joints

2.5 SILICONE JOINT SEALANT

A. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100, for Use G, A, M, O; non-staining and field-tintable.

1. Basis of Design Product: Provide Pecora Corporation “890FTS” sealant or equal manufactured by one of the following:
   a. Dow Corning Corporation.
   b. GE Advanced Materials - Silicones
   c. Sika Corporation, Construction Products Division
   d. Tremco Incorporated

B. Additional Movement Capability: 100 percent movement in extension and 50 percent in compression for a total of 150 percent movement.

C. Uses: General exterior use.

2.6 POURABLE URETHANE JOINT SEALANT

A. Multicomponent Pourable Urethane Sealant: Manufacturer's standard, non-modified, two-part, urethane sealant; complying with ASTM C 920, Type M, Grade P, Class 25, Uses T, M, A and, as applicable to joint substrates indicated, O.

1. Available Products: Subject to compliance with requirements, urethane joint sealants that may be incorporated in the Work include, but are not limited to, the following:
   a. NR-200 Urexpan, Pecora Corporation
   b. Sikaflex 2c SL, Sika Corporation
   c. Masterseal SL 2; Master Builders Solutions Div., BASF

B. Uses: Interior or exterior use for level pavement or slab joints.

2.7 NONSAG URETHANE JOINT SEALANT

A. Multi-Part Non-Sag Urethane Sealant: Except as otherwise indicated, provide manufacturer's standard, non-modified, two-part, urethane sealant; complying with ASTM C 920, Type M, Grade NS, Class 25, Uses T, M, A and, as applicable to joint substrates indicated, O.

1. Available Products: Subject to compliance with requirements, urethane joint sealants that may be incorporated in the Work include, but are not limited to, the following:
   a. Sikaflex 2c NS; Sika Corp
   b. Dynatred, Pecora Corporation
   c. Masterseal NP 2; Master Builders Solutions Div., BASF

B. Uses: Interior or exterior use for pavement or slab joints where slope exceeds one percent.

2.8 ACOUSTICAL JOINT SEALANTS

A. Acoustical Sealant: Non-sag (gun grade), non-flammable, latex-based sealant designed to limit sound transmission through interior STC-rated partitions. Sealant remains flexible and adhered to metal, wood, plaster, gypsum, and concrete after drying.

1. Maintains the STC rating of partitions with intersections and penetrations sealed with product: Tested by independent, accredited, NVLAP facility according to ASTM E 90.
2. Products: Provide one of the following:
   a. QuietZone Acoustic Sealant by Owens Corning.
   b. OSI GreenSeries SC-175 Draft & Acoustical Sound Sealant by Henkel Corporation
   c. Pecora AIS-919: Acoustical and Insulation Latex Sealant by Pecora Corporation
   d. Smoke ‘N’ Sound Acoustical Sealant by Specified Technologies Inc.

B. Uses: At penetrations through and intersections of sound-rated wall, floor and ceiling assemblies in order to preserve their ability to reduce airborne sound impact noise transmission.

2.9 JOINT SEALANT BACKING

A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Plastic Foam Joint Fillers: Preformed, compressible, resilient, nonstaining, nonwaxing, nonextruding strips of flexible plastic foam of material indicated below and of size, shape, and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

1. Closed-cell polyethylene foam, nonabsorbent to liquid water and gas, nonoutgassing in unruptured state.
2. Manufacturer: Provide Cera-Rod manufactured by W.R. Meadows, Inc., or equivalent.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape as recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.10 JOINT FILLERS FOR EXTERIOR CONCRETE SLABS

A. General: Provide joint fillers of thickness and depth indicated, or if not indicated 1/2" thick by depth of joint.

B. Bituminous Fiber Joint Filler: Provide preformed strips of with asphalt binder encased between two layers of saturated felt or glass-fiber felt, complying with ASTM D 1751.

1. Protect top edge of joint filler during concrete placement with a metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint and seal with sealant.

2.11 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming in any way joint substrates and adjacent nonporous surfaces, and formulated to promote optimum adhesion of sealants with joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

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 joint sealant performance. Do not proceed with installation of joint sealants until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with recommendations of joint sealant manufacturer 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 concrete, masonry, unglazed surfaces of ceramic tile, and similar porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air.
3. Remove laitance and form release agents from concrete.
4. Clean metal, glass, porcelain enamel, glazed surfaces of ceramic tile, and other nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

B. Joint Priming: Prime joint substrates where indicated or where recommended by joint sealant manufacturer based on preconstruction joint sealant-substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer's recommendations. 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 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 printed installation instructions applicable to products and applications indicated, except where more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations of ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Installation of Sealant Backings: Install sealant backings to comply with the following requirements:

1. Install joint fillers of type indicated to provide support of sealants during application and at position required to produce the cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
   a. Do not leave gaps between ends of joint fillers.
   b. Do not stretch, twist, puncture, or tear joint fillers.
   c. Remove absorbent joint fillers that have become wet prior to sealant application and replace with dry material.

2. Install bond breaker tape between sealants where backer rods are not used between sealants and joint fillers or back of joints.

D. Installation of Sealants: Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability. Install sealants at the same time sealant backings are installed.

E. Tooling of Nonsag Sealants: Immediately after sealant application and prior to time skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated, 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.

1. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.
   a. Use masking tape to protect adjacent surfaces of recessed tooled joints.

3.4 CLEANING

A. Clean off excess sealants or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved 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 or from damage resulting from construction operations or other causes so that

they are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so that and installations with repaired areas are indistinguishable from original work.

END OF SECTION 079200

SECTION 080671 – DOOR HARDWARE SCHEDULE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section references specification sections relating to commercial door hardware for the following:

1. Swinging doors.
2. Other doors to the extent indicated.

B. Commercial door hardware includes, but is not necessarily limited to, the following:

1. Mechanical door hardware.
2. Electromechanical and access control door hardware.
3. Electromechanical and access control door hardware power supplies, back-ups and surge protection.
4. Automatic operators.
5. Cylinders specified for doors in other sections.

C. Related Sections:

1. Division 08 Section “Door Hardware”.

D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ICC A117.1 - Accessible and Usable Buildings and Facilities.
2. 2025 Building Code of New York State (BCNYS)
3. 2025 Fire Code of New York State (FCNYS)
4. 2025 Existing Building Code of New York State (EBCNYS)
5. NFPA 70 - National Electrical Code.
6. NFPA 80 - Fire Doors and Windows.

E. Standards: Reference Related Sections for requirements regarding compliance with applicable industry standards.

1.3 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."

2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.

3. Content: Include the following information:

   a. Type, style, function, size, label, hand, and finish of each door hardware item.
   b. Manufacturer of each item.
   c. Fastenings and other pertinent information.
   d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
   e. Explanation of abbreviations, symbols, and codes contained in schedule.
   f. Mounting locations for door hardware.
   g. Door and frame sizes and materials.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Keying Schedule: Prepared under the supervision of the Owner, separate schedule detailing final keying instructions for locksets and cylinders in writing. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner to approve submitted keying schedule prior to the ordering of permanent cylinders.

D. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

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

F. Warranties and Maintenance: Special warranties and maintenance agreements specified in the Related Sections.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.5 WARRANTY

A. All Hardware shall be warranted by the manufacturer to be free from defects in materials and workmanship for a period of not less than two years from the date of substantial completion of the Project.
   1. Manufacturer shall warrantee door closers for ten years from date of manufacture.
   2. Manufacturer shall warrantee mortise locks and latches for ten years from date of manufacture.
   3. Manufacturer shall warrantee exit devices, and motorized latch retraction exit devices for five years.
   4. Where the manufacturer’s standard warranty period is greater than two years for any item of hardware, the standard warranty period shall apply.
   5. Where manufacturer's standard warranty is less than two years, Contractor shall provide necessary extended warranty at no cost to Owner.

1.6 MAINTENANCE SERVICE

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

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. Refer to “PART 3 – EXECUTION” for required specification sections.

PART 3 - EXECUTION

3.1 DOOR HARDWARE SETS

A. The door hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

1. Quantities listed are for each pair of doors, or for each single door.

2. The supplier is responsible for handing and sizing all products.

3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.

4. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.

B. Products listed in the hardware sets shall be supplied by and in accordance with the requirements described in the specification section as noted for each item.

1. Section 08 71 00 – Door Hardware.

C. Manufacturer’s Abbreviations:
   1. SA - SARGENT
   2. SU - Securitron
   3. MK - McKinney
   4. RO - Rockwood
   5. BE - BEST Locks & Closers
   6. RF - Rixson
   7. NO - Norton

D. ⚡ Lightning bolt symbol indicates hardware is electrified.

Hardware Sets

Set: 1.0

Doors: 1023, 1024, 1026, 1027, 1059

3 Hinge, Half Mortise, Hvy Wt	Existing to Remain		-	-
1 Access Control Mort Lock	IN220-82278 BIPS MB J-ET-MI- LH-36, furnished and installed by security integrator.	US32D	SA	087100
1 Electric Power Transfer	CEPT-C5E, furnished and installed by security integrator.	630	SU	087100
1 Interchangeable Core	As Required, Return existing to owner. Provide account or sales number to campus locksmith.	626	BE	087100
1 Conc Overhead Stop	1-X36	630	NO	087100
1 Surface Closer	7500	689	NO	087100
1 Kick Plate	K1050 6" high BEV CSK	US32D	RO	087100
2 Silencer	608		RO	087100
1 PoE Harness - Door	PoE-C400RJ, furnished and installed by security integrator.		MK	087100
1 PoE Harness - Frame	PoE-C1300RJ, furnished and installed by security integrator.		MK	087100
1 Position Switch	DPS-M, furnished and installed by security integrator.		SU	087100
1 Wiring Diagram	Elevation and Point to Point as Specified		OT	

Operational Narrative: Entry by valid credential, momentarily unlocking trim. Key outside retract latch. Access control system can lock & unlock all devices during events. Doors are monitored by door position switch, request to exit, and latchbolt monitoring inside of lockset. Free egress at all times. In event of power outage or fire alarm, door remains latched and locked (fail secure). Shelter-in-place function is integrated into the IN220 device.

Set: 2.0

Doors: 1028A, 1028B

3 Hinge, Half Mortise, Hvy Wt	Existing to Remain		-	-
1 Access Control Mort Lock	IN220-82278 BIPS MB J-ET-MI-RH-36, furnished and installed by security integrator.	US32D	SA	087100
1 Electric Power Transfer	CEPT-C5E, furnished and installed by security integrator.	630	SU	087100

1 Interchangeable Core	As Required, Return existing to owner. Provide account or sales number to campus locksmith.	626	BE	087100
1 Conc Overhead Stop	1-X36	630	NO	087100
1 Surface Closer	7500	689	NO	087100
1 Kick Plate	K1050 6" high BEV CSK	US32D	RO	087100
2 Silencer	608		RO	087100
1 PoE Harness - Door	PoE-C400RJ, furnished and installed by security integrator.		MK	087100
1 PoE Harness - Frame	PoE-C1300RJ, furnished and installed by security integrator.		MK	087100
1 Position Switch	DPS-M, furnished and installed by security integrator.		SU	087100
1 Wiring Diagram	Elevation and Point to Point as Specified		OT	

Operational Narrative: Entry by valid credential, momentarily unlocking trim. Key outside retract latch. Access control system can lock & unlock all devices during events. Doors are monitored by door position switch, request to exit, and latchbolt monitoring inside of lockset. Free egress at all times. In event of power outage or fire alarm, door remains latched and locked (fail secure). Shelter-in-place function is integrated into the IN220 device.

Set: 2.1

Doors: 1030

3 Hinge, Half Mortise, Hvy Wt	Existing to Remain		-	-
1 Access Control Mort Lock	IN220-8977 BIPS MB J-ET-MI-US32D- RHR-42, furnished and installed by security integrator.	US32D	SA	087100
1 Electric Power Transfer	CEPT-C5E, furnished and installed by security integrator.	630	SU	087100
1 Interchangeable Core	As Required, Return existing to owner. Provide account or sales number to campus locksmith.	626	BE	087100
1 Conc Overhead Stop	1-X36	630	NO	087100
1 Surface Closer	7500	689	NO	087100
1 Kick Plate	K1050 6" high BEV CSK	US32D	RO	087100
2 Silencer	608		RO	087100
1 PoE Harness - Door	PoE-C400RJ, furnished and installed by security integrator.		MK	087100
1 PoE Harness - Frame	PoE-C1300RJ, furnished and installed by security integrator.		MK	087100
1 Position Switch	DPS-M, furnished and installed by		SU	087100

	security integrator.	
1 Wiring Diagram	Elevation and Point to Point as Specified	OT

Notes: Entry by valid credential, momentarily unlocking trim. Key outside retract latch. Access control system can lock & unlock all devices during events. Doors are monitored by door position switch, request to exit, and latchbolt monitoring inside of lockset. Free egress at all times. In event of power outage or fire alarm, door remains latched and locked (fail secure). Shelter-in-place function is integrated into the IN220 device.

Set: 3.0

Doors: 1009A, 1016, 1051, 1051B, 2049B, 3008B

3 Hinge, Half Mortise, Hvy Wt	T4A3786 [NRP] FT	US26D	MK	087100
1 Access Control Mort Lock	8200 MI-O-T1-LE1-US32D, Function 37 Classroom	US32D	SA	087100
1 Interchangeable Core	As Required, Provide account or sales number to campus locksmith.	626	BE	087100
1 Conc Overhead Stop	1-X36	630	NO	087100
1 Surface Closer	7500	689	NO	087100
1 Kick Plate	K1050 6" high BEV CSK	US32D	RO	087100
2 Silencer	608		RO	087100

Notes: N/A

Set: 4.0

Doors: 2026

3 Hinge, Half Mortise, Hvy Wt	T4A3786 [NRP] FT	US26D	MK	087100
1 Access Control Mort Lock	8200 MI-O-T1-LE1-US32D, Function 37 Classroom	US32D	SA	087100
1 Dust Proof Strike	570	US26D	RO	087100
2 Flush Bolt	555 / 557 (12”/72” AFF)	US26D	RO	087100
2 Interchangeable Core	As Required, Provide account or sales number to campus locksmith.	626	BE	087100
1 Conc Overhead Stop	1-X36	630	NO	087100
1 Surface Closer	7500	689	NO	087100
1 Kick Plate	K1050 6" high BEV CSK	US32D	RO	087100
1 Door Stop	440	US26D	RO	087100
2 Silencer	608		RO	087100

Notes: N/A

END OF SECTION 080671

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the following hollow-metal work:

1. Steel doors
2. Steel door frames

B. Related Requirements:

1. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.
2. Section 088000 “Glazing” for glazing inserted in hollow metal doors and frames.

1.2 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings according to 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 preparation of shop drawings for hollow metal doors and frames with door hardware submittals specified in Section 087100. Shop drawings for work of this section will not be reviewed and approved until the hardware submittals in Section 087100 are submitted and approved.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product. Include construction details, material descriptions, core descriptions, fire-resistance ratings, and finishes.

B. Shop Drawings: Include the following:

1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.

3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, joints, field splices, and connections.
7. Details of accessories.
8. Details of moldings, removable stops, and glazing.
9. Details of conduit and preparations for power, signal, and control systems.

C. Schedule: Provide a schedule of hollow-metal work 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.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch- (102-mm-) high wood blocking. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

1.7 WARRANTY

A. Manufacturer's standard warranty agreeing to repair, replace or otherwise correct any product acknowledged by the manufacturer to be defective in materials or workmanship for a period of one year from Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. Ceco Door Products; an Assa Abloy Group company.
2. Curries Company; an Assa Abloy Group company.
3. Fleming Doors, an Assa Abloy Group company

B. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

2.2 INTERIOR DOORS AND FRAMES

A. Construct interior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3. Provide for interior door and frame locations.

1. Physical Performance: Level A according to SDI A250.4.
2. Doors:
   a. Type: As indicated in the Door and Frame Schedule.
   b. Thickness: 1-3/4 inches.
   c. Face: Uncoated, cold-rolled steel sheet, minimum thickness of 16 gage 0.053 inch.
   d. Edge Construction: Model 1, Full Flush
   e. Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.
   f. Basis of Design Product: Regent Door by Ceco Doors or one of the following:
      1) 707 Series by Curries
      2) D Series by by Fleming Doors.

3. Frames:

   a. Materials: Minimum thickness of 14 gage, 0.067 inch (1.7 mm), uncoated, steel sheet (except provide metallic coated where door is metallic coated) for the following locations:
      1) Level 3 steel doors

   b. Construction: Full profile welded.

4. Exposed Finish: Prime door and frames

2.3 FRAME ANCHORS

A. Jamb Anchors:.

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch (1.0 mm) thick, with corrugated or perforated straps not less than 2 inches (51 mm) wide by 10 inches (254 mm) long; or wire anchors not less than 0.177 inch (4.5 mm) thick.
2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.
3. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch (1.0 mm), and as follows:

1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch (51-mm) height adjustment. Terminate bottom of frames at finish floor surface.

2.4 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

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. Grout: ASTM C 476, except with a maximum slump of 4 inches (102 mm), as measured according to ASTM C 143/C 143M.

G. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

H. Glazing: Comply with requirements in Sections 088000 "Glazing".

I. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.5 FABRICATION

A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Hollow-Metal Doors:

1. Steel-Stiffened Door Cores: Provide minimum thickness 0.026 inch (0.66 mm), steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inches (152 mm) apart. Spot weld to face sheets no more than 5 inches (127 mm) o.c. Fill spaces between stiffeners with glass- or mineral-fiber insulation.
2. Vertical Edges for Single-Acting Doors: Bevel edges 1/8 inch in 2 inches (3.2 mm in 51 mm).
3. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets.
4. Bottom Edge Closures: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets.

C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
2. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
3. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
4. Jamb Anchors: Provide number and spacing of anchors as follows:
   a. Masonry Type: Locate anchors not more than 16 inches (406 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c., to match coursing, and as follows:

      1) Two anchors per jamb up to 60 inches (1524 mm) high.
      2) Three anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
      3) Four anchors per jamb from 90 to 120 inches (2286 to 3048 mm) high.
      4) Four anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 120 inches (3048 mm) high.

   b. Stud-Wall Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:

      1) Three anchors per jamb up to 60 inches (1524 mm) high.
      2) Four anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
      3) Five anchors per jamb from 90 to 96 inches (2286 to 2438 mm) high.
      4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 96 inches (2438 mm) high.

c. Postinstalled Expansion Type: Locate anchors not more than 6 inches (152 mm) from top and bottom of frame. Space anchors not more than 26 inches (660 mm) o.c.

5. Head Anchors: Two anchors per head for frames more than 42 inches (1067 mm) wide and mounted in metal-stud partitions.
6. 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.

D. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.

E. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.

1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.

F. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with butted or mitered hairline joints.

1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work.
2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
4. Provide loose stops and moldings on inside of hollow-metal work.
5. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

2.6 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.

2.7 ACCESSORIES

A. Grout Guards: Formed from same material as frames, not less than 0.016 inch (0.4 mm) thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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.

B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.

B. Hollow-Metal Frames: Install hollow-metal frames of size and profile indicated. Comply with SDI A250.11 as required by standards specified.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
   a. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
   b. Install frames with removable stops located on secure side of opening.
   c. Install door silencers in frames before grouting.
   d. Remove temporary braces necessary for installation only after frames have been properly set and secured.
   e. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
   f. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.

    a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
5. Concrete Walls: Solidly fill space between frames and concrete with mineral-fiber insulation.
6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
7. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
    a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
    c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.

C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Steel Doors:
    a. Between Door and Frame Jambs and Head: 1/8 inch (3.2 mm) plus or minus 1/32 inch (0.8 mm).
    b. Between Edges of Pairs of Doors: 1/8 inch (3.2 mm) to 1/4 inch (6.3 mm) plus or minus 1/32 inch (0.8 mm).
    c. At Bottom of Door: 3/4 inch (19.1 mm) plus or minus 1/32 inch (0.8 mm).
    d. Between Door Face and Stop: 1/16 inch (1.6 mm) to 1/8 inch (3.2 mm) plus or minus 1/32 inch (0.8 mm).

D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (51 mm) o.c. from each corner.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow-metal work immediately after installation.

C. 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.

END OF SECTION 081113

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes commercial door hardware for the following:

1. Swinging doors.
2. Sliding doors.
3. Other doors to the extent indicated.

B. Door hardware includes, but is not necessarily limited to, the following:

1. Mechanical door hardware.
2. Electromechanical door hardware.
3. Automatic operators.
4. Cylinders specified for doors in other sections.

C. Related Sections:

1. Division 08 Section “Hollow Metal Doors and Frames”.

D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
2. 2025 Building Code of New York State (BCNYS)
3. 2025 Fire Code of New York State (FCNYS)
4. 2025 Existing Building Code of New York State (EBCNYS)
5. ICC/IBC - International Building Code.
6. NFPA 70 - National Electrical Code.
7. NFPA 80 - Fire Doors and Windows.
8. NFPA 101 - Life Safety Code.
9. NFPA 105 - Installation of Smoke Door Assemblies.
10. State Building Codes, Local Amendments.

E. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:

1. ANSI/BHMA Certified Product Standards - A156 Series.

2. UL10C - Positive Pressure Fire Tests of Door Assemblies.
3. ANSI/UL 294 - Access Control System Units.
4. UL 305 - Panic Hardware.
5. ANSI/UL 437- Key Locks.

1.3 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing, fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
3. Content: Include the following information:

   a. Type, style, function, size, label, hand, and finish of each door hardware item.
   b. Manufacturer of each item.
   c. Fastenings and other pertinent information.
   d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
   e. Explanation of abbreviations, symbols, and codes contained in schedule.
   f. Mounting locations for door hardware.
   g. Door and frame sizes and materials.
   h. Warranty information for each product.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Shop Drawings: Details of electrified access control hardware indicating the following:

1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:

a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
b. Complete (risers, point-to-point) access control system block wiring diagrams.
c. Wiring instructions for each electronic component scheduled herein.

2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.

D. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.

E. Informational Submittals:

1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

1.4 CLOSEOUT SUBMITTALS

A. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.

B. Project Record Documents: Provide record documentation of as-built door hardware sets in digital format (.pdf, .docx, .xlsx, .csv) and as required in Division 01, Project Record Documents.

1.5 QUALITY ASSURANCE

A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.

B. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).

C. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

D. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.

1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.

F. Each unit to bear third party permanent label indicating compliance with the referenced testing standards.

G. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:

1. Function of building, purpose of each area and degree of security required.
2. Plans for existing and future key system expansion.
3. Requirements for key control storage and software.
4. Installation of permanent keys, cylinder cores and software.
5. Address and requirements for delivery of keys.

H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.

1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
3. Review sequence of operation narratives for each unique access controlled opening.
4. Review and finalize construction schedule and verify availability of materials.

5. Review the required inspecting, testing, commissioning, and demonstration procedures

I. At completion of installation, provide written documentation that components were applied according to manufacturer's instructions and recommendations and according to approved schedule.

1.6 DELIVERY, STORAGE AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.7 COORDINATION

A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

B. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.8 WARRANTY

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

B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.

2. Faulty operation of the hardware.
3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
4. Electrical component defects and failures within the systems operation.

C. Warranty Period: Unless otherwise indicated, warranty shall be one year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.

B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:

1. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.

C. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 MATERIALS

A. Hardware shall not have any visible manufacturer names on exposed materials, except cylinders, when the door is in a closed position.

2.3 BUTT HINGES

A. Hinges: ANSI/BHMA A156.1 butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.

1. Quantity: Provide the following hinge quantity:

a. Two Hinges: For doors with heights up to 60 inches.
b. Three Hinges: For doors with heights 61 to 90 inches.
c. Four Hinges: For doors with heights 91 to 120 inches.
d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.

2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:

   a. Widths up to 3’0”: 4-1/2” standard or heavy weight as specified.
   b. Sizes from 3’1” to 4’0”: 5” standard or heavy weight as specified.

3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:

   a. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.

4. Hinge Options: Comply with the following:

   a. Non-removable Pins: With the exception of electric through wire hinges, provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for all out-swinging lockable doors.

5. Manufacturers:

   a. **BASIS OF DESIGN:** McKinney (MK) - TA/T4A Series, 5-knuckle.
   b. Hager Companies (HA) - BB Series, 5-knuckle.
   c. dormakaba BEST (ST) - F/FBB Series, 5-knuckle.

2.4 DOOR OPERATING TRIM

A. Flush Bolts and Surface Bolts: Provide products conforming to ANSI/BHMA A156.3 and A156.16, Grade 1.

1. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately six feet from the floor.
2. Furnish dust proof strikes for bottom bolts.
3. Surface bolts to be minimum 8” in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.
4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.
5. Manufacturers:

   a. **BASIS OF DESIGN:** Rockwood (RO).
   b. Burns Manufacturing (BU).
   c. Trimco (TC).

2.5 CYLINDERS AND KEYING

A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.

1. Manufacturers:

   a. dormakaba BEST (BE).
   b. Match Existing, Field Verify.

B. Cylinder Types: Original manufacturer cylinders able to supply the following cylinder formats and types:

1. Threaded mortise cylinders with rings and cams to suit hardware application.
2. Rim cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
3. Bored or cylindrical lock cylinders with tailpieces as required to suit locks.
4. Tubular deadlocks and other auxiliary locks.
5. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
6. Keyway: Match Facility Standard.

C. Small Format Interchangeable Cores: Provide small format interchangeable cores (SFIC) as specified, core insert, removable by use of a special key; usable with other manufacturers' cylinders.

D. Keying System: Each type of lock and cylinders to be factory keyed.

1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.
2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
3. Existing System: Field verify and key cylinders to match Owner's existing system.

E. Key Quantity: Provide the following minimum number of keys:

1. Change Keys per Cylinder: Two (2)
2. Master Keys (per Master Key Level/Group): Five (5).
3. Construction Control Keys (where required): Two (2).
4. Permanent Control Keys (where required): Two (2).

F. Construction Keying: Provide temporary keyed construction cores.

G. Key Registration List (Bitting List):

1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
2. Provide transcript list in writing or electronic file as directed by the Owner.

2.6 MORTISE LOCKS AND LATCHING DEVICES

A. Mortise Locksets, Grade 1 (Heavy Duty): Provide ANSI/BHMA A156.13, Series 1000, Operational and Security Grade 1 Certified Products Directory (CPD) listed mortise

locksets. Listed manufacturers shall meet all functions and features as specified herein.

1. Provide locksets with functions and features as follows:

   a. Heavy duty 12-gauge wrought steel case.
   b. Stainless steel 3/4" one-piece anti-friction reversible latchbolt with a one-piece hardened stainless steel 1” projection deadbolt.
   c. Where required by code, provide knurling or abrasive coating on all levers leading to hazardous areas.
   d. Meets UL and CUL Standard 10C Positive Pressure, Fire Test of Door Assemblies with levers that meet A117.1 Accessibility Code.
   e. Meets UL Certification Directory ZHLL.R21744 for products used in windstorm rated assemblies.
   f. Status indicators inside, outside, or on both sides of doors as specified; available with wording for “locked/unlocked”, “vacant/occupied” or custom wording options. Indicator to be located above the cylinder with the inside thumb-turn not blocking the visibility of the indicator status.
   g. Ten-year limited warranty for mechanical functions.

2. Manufacturers:

   a. **BASIS OF DESIGN:** Sargent Manufacturing (SA) - 8200 Series.
   b. Corbin Russwin Hardware (RU) - ML2000 Series.
   c. Schlage (SC) - L9000 Series.

2.7 LOCK AND LATCH STRIKES

A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:

   1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
   2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
   3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
   4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.

B. Standards: Comply with the following:

   1. Strikes for Mortise Locks and Latches: BHMA A156.13.
   2. Strikes for Bored Locks and Latches: BHMA A156.2.
   3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
   4. Dustproof Strikes: BHMA A156.16.

2.8 ELECTROMAGNETIC LOCKING DEVICES

A. Surface Electromagnetic Locks (Heavy Duty): Electromagnetic locks to be surface mounted type conforming to ANSI A156.23, Grade 2 with minimum holding force strength of 1,200 pounds. Locks to be capable of accepting between 12 to 24 volts direct current and be UL listed for use on fire rated door assemblies. Electromagnetic coils are to consume no more than 1.5W during normal operation. Locks are to have an integrated door position switch, tamper switch, and lock bond sensor. Locks are to have integrated motion sensor and/or security camera as indicated in the hardware sets. Locks to be capable of detecting door prop conditions and entering low power mode. Provide mounting accessories as needed to suit opening conditions. Power supply to be by the same manufacturer as the lock with combined products having a lifetime replacement warranty.

1. Manufacturers:

   a. Securitron (SU) - M680E Series.

2.9 ELECTRIC STRIKES

A. Standard Electric Strikes: Electric strikes conforming to ANSI/BHMA A156.31, Grade 1, for use on non-rated or fire rated openings. Strikes shall be of stainless steel construction tested to a minimum of 1500 pounds of static strength and 70 foot-pounds of dynamic strength with a minimum endurance of 1 million operating cycles. Provide strikes with 12 or 24 VDC capability, fail-secure unless otherwise specified. Where specified provide latchbolt and latchbolt strike monitoring indicating both the position of the latchbolt and locked condition of the strike.

1. Manufacturers:

   a. Folger Adam (FO) - 700 Series.
   b. HES (HS) - 1006 Series.
   c. HES (HS) - 1500/1600 Series.
   d. Von Duprin (VD) - 6200/6400 Series.

B. Surface Mounted Rim Electric Strikes: Surface mounted rim exit device electric strikes conforming to ANSI/BHMA A156.31, Grade 1, and UL Listed for both Burglary Resistance and for use on fire rated door assemblies. Construction includes internally mounted solenoid with two heavy-duty, stainless steel locking mechanisms operating independently to provide tamper resistance. Strikes tested for a minimum of 500,000 operating cycles. Provide strikes with 12 or 24 VDC capability supplied standard as fail-secure unless otherwise specified. Option available for latchbolt and latchbolt strike monitoring indicating both the position of the latchbolt and locked condition of the strike. Strike requires no cutting to the jamb prior to installation.

1. Manufacturers:

   a. Adams Rite (AD) - 7800 Series.
   b. HES (HS) - 9400/9500/9600/9700/9800 Series.

c. Von Duprin (VD) - VD3146/6200/6300 Series.

C. Provide electric strikes with in-line power controller and surge suppressor by the same manufacturer as the strike with the combined products having a five year warranty.

2.10 SURFACE DOOR CLOSERS

A. All door closers specified herein shall meet or exceed the following criteria:

1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.
2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.
4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.

B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.

1. Heavy duty surface mounted door closers shall have a 30-year warranty.

2. Manufacturers:

a. **BASIS OF DESIGN:** Norton Rixson (NO) - 7500 Series.
b. Corbin Russwin Hardware (RU) - DC6000 Series.
c. Sargent Manufacturing (SA) - 351 Series.

2.11 ARCHITECTURAL TRIM

A. Door Protective Trim

1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1" LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
3. Where plates are applied to fire rated doors with the top of the plate more than 16" above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer's catalog and template book for specific requirements for size and applications.
4. Protection Plates: ANSI/BHMA A156.6 protection plates (kick, armor, or mop), fabricated from the following:

    a. Stainless Steel: 300 grade, 050-inch thick.

5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.
6. Manufacturers:

    a. **BASIS OF DESIGN:** Rockwood (RO).
    b. Burns Manufacturing (BU).
    c. Hiawatha, Inc. (HI).

2.12 DOOR STOPS AND HOLDERS

A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.

B. Overhead Door Stops and Holders: ANSI/BHMA A156.8, Grade 1 Certified Products Directory (CPD) listed overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.

1. Manufacturers:

    a. **BASIS OF DESIGN:** Rockwood (RO).
    b. Norton Rixson (RF).
    c. Sargent Manufacturing (SA).

2.13 ELECTRONIC ACCESSORIES

A. Door Position Switches: Door position magnetic reed contact switches specifically designed for use in commercial door applications. On recessed models the contact and magnetic housing snap-lock into a 1" diameter hole. Surface mounted models include wide gap distance design complete with armored flex cabling. Provide SPDT, N/O

switches with optional Rare Earth Magnet installation on steel doors with flush top channels.

1. Manufacturers:

   a. **BASIS OF DESIGN:** Securitron (SU) - DPS Series.
   b. Sargent Manufacturing (SA) - 3280 Series.
   c. Security Door Controls (SD) - DPS Series.

B. Linear Power Supplies: Filtered and regulated power for electrified hardware. Listed manufacturers shall meet all functions and features as specified herein.

1. Provide power supplies with functions and features as follows:

   a. 120VAC input with selectable output at 12VDC (6 amp) or 24VDC (3 amp).
   b. Internal back-up battery (batteries not included) charging circuit.
   c. Regulated and filtered, fuse protected outputs.
   d. Each output can be individually turned on and off via a jumper.
   e. Power status of each output is shown by an LED.
   f. Fire alarm interface; dry contacts NO/NC, 9-33VDC, 3-15mA.

2. Manufacturers:

   a. **BASIS OF DESIGN:** Sargent (SA) - LSP Series.
   b. No Substitution.

C. Switching Power Supplies: Provide the least number of power supplies at the appropriate amperage level sufficient to exceed the required total draw for the specified electrified hardware and access control equipment.

1. Power supplies shall meet all functions and features as specified herein.

   a. UL listed dual voltage 12 or 24 VDC field selectable continuous output.
   b. Tolerates brownout or overvoltage input ± 15% of nominal voltage.
   c. Thermal shutdown protection with auto restart.
   d. Circuit breaker protection against overcurrent and reverse battery faults.
   e. Integrated battery charging circuit to prevent overvoltage on locking devices.
   f. Available with a single relay fire trigger or individually triggered relayed outputs.
   g. Monitoring options as specified.

2. Manufacturers:

   a. **BASIS OF DESIGN:** Securitron (SU) - AQD Series.
   b. Altronix (AS) - Maximal 3.
   c. Life Safety Power (LP).
   d. No Substitution.

2.14 FABRICATION

A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.15 FINISHES

A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.

B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware

C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.

B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.

1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.

B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
2. DHI TDH-007-20: Installation Guide for Doors and Hardware.
3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.

C. Retrofitting: Install door hardware to comply with manufacturer's published templates and 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 specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

D. Push Plates and Door Pulls: When through-bolt fasteners are in the same location as a push plate, countersink the fasteners flush with the door face allowing the push plate to sit flat against the door.

E. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

F. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

A. Field Inspection (Punch Report): Reference Division 01 Sections “Closeout Procedures”. Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.

1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

3.5 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.

3.6 CLEANING AND PROTECTION

A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.

B. Clean adjacent surfaces soiled by door hardware installation.

C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SETS

A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

1. Quantities listed are for each pair of doors, or for each single door.
2. The supplier is responsible for handing and sizing all products.
3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.
4. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.

B. Refer to Section 080671, Door Hardware Sets, for hardware sets.

END OF SECTION 087100

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:

1. Doors.

1.2 SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.

1. Include product data on sealants, indicating VOC content

B. Glazing Schedule: Use same designations indicated on Drawings for glazed openings in preparing a schedule listing glass types and thicknesses for each size opening and location.

D. Product Certificates: Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.

E. Qualification Data: For Installers.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for Project and whose work has resulted in construction with a record of successful in-service performance.

B. Source Limitations: Obtain each type of glass from one primary-glass manufacturer.

C. Safety Glass: Category II materials complying with testing requirements in 16 CFR 1201 and ANSI Z97.1.

1. Subject to compliance with requirements, permanently mark safety glass with certification label of Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction.
2. Safety glass includes fully tempered glass, laminated glass and fire-resistant glass.

D. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are

indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. SIGMA Publications: SIGMA TM-3000, "Vertical Glazing Guidelines."
2. GANA Publications: GANA'S "Glazing Manual"

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.5 PROJECT 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 liquid glazing sealants when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer or below 40 deg F (4.4 deg C).

PART 2 - PRODUCTS

2.1 PRIMARY FLOAT GLASS

A. Float Glass: ASTM C 1036, Type I (transparent glass, flat), Quality q3 (glazing select); Class 1 unless otherwise indicated in schedules at the end of Part 3.

2.2 HEAT-TREATED FLOAT GLASS

A. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed, unless otherwise indicated.

B. Heat-Treated Float Glass: ASTM C 1048; Type I (transparent glass, flat); Quality q3 (glazing select); class, kind, and condition as indicated in schedules at the end of Part 3

2.4 ELASTOMERIC GLAZING SEALANTS

A. General: Provide products of type indicated, complying with the following requirements:

1. Compatibility: Select glazing sealants that are compatible with one another and with other materials they will 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 for this characteristic.

B. Single-Component Neutral-Curing Silicone Sealant: ASTM C 920; Type S; Grade NS; Class 50; Uses NT, M, G, A, and, as applicable to joint substrates indicated, O.

1. Products:
   a. Dow Corning Corporation; 791.
   b. Dow Corning Corporation; 795.
   c. GE Silicones; SilPruf NB SCS9000.
   d. GE Silicones; UltraPruf II SCS2900.
   e. Pecora Corporation; 865.
   f. Pecora Corporation; 895.
   g. Pecora Corporation; 898

C. VOC Content: Sealants installed on the interior shall have a VOC content in compliance with Section 018117 "Low Emitting Material Requirements".

2.5 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tape: Preformed, butyl-based elastomeric tape with a solids content of 100 percent; 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; packaged on rolls with a release paper backing; and complying with ASTM C 1281 and AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.

B. Expanded Cellular Glazing Tape: Closed-cell, PVC foam tape; factory coated with adhesive on both surfaces; packaged on rolls with release liner protecting adhesive; and complying with AAMA 800 for the following types:

1. Type 1, for glazing applications in which tape acts as the primary sealant.
2. Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.6 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of 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.

C. Setting Blocks: Silicone elastomeric material with a Shore A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions with a Shore A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.7 FABRICATION OF GLASS AND OTHER GLAZING PRODUCTS

A. Fabricate glass and other glazing products in sizes required to glaze 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 standard, to comply with system performance requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing glazing, 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 system.
3. Minimum required face or 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.

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. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.

E. 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.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass lites where the length plus width is larger than 50 inches (1270 mm) as follows:

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 (3-mm) 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.

H. 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 according to requirements in referenced glazing publications.

I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

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. Where framing joints are vertical, cover these joints by applying tapes to heads and sills first and then to jambs. Where framing joints are horizontal, cover these joints by applying tapes to jambs and 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 just 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 GASKET GLAZING (DRY)

A. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with stretch allowance during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Center glass lites in openings on setting blocks and press firmly against soft compression gasket 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. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Install gaskets so they protrude past face of glazing stops.

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 PROTECTION AND CLEANING

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove them immediately as recommended by glass manufacturer.

C. 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 build-up of dirt, scum, alkaline deposits, or stains; remove as recommended by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, abraded, or damaged in any way, including natural causes, accidents, and vandalism, during construction period.

1. All glass shall be free from scratches visible from a 2'-0" distance. Contractor shall replace all visibly scratched glass at no cost to the owner.

E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended by glass manufacturer.

3.8 GLASS SCHEDULE

A. Interior Glazing:

1. Non-Fire Rated Doors: 1/4 inch clear fully tempered glass (Kind FT).

END OF SECTION 088000

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Non-load-bearing steel framing systems for interior gypsum board assemblies.
2. Suspension systems for interior gypsum ceilings, soffits, and grid systems.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 PRECONSTRUCTION MEETING

A. Conduct a preconstruction meeting prior to installing any new partitions. Mark-out proposed locations for the layout of all partitions on the floor slab and review with Architect at the preconstruction meeting.

PART 2 - PRODUCTS

2.1 FRAMING SYSTEMS

A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
2. Protective Coating: ASTM A 653/A 653M, G40 (Z120), hot-dip galvanized, unless otherwise indicated.

B. Studs and Runners: ASTM C 645. EQ studs not permitted.

1. Steel Studs and Runners:
   a. Minimum Base-Metal Thickness: 0.0296 inch, 30 mils.
   b. Depth: As scheduled on Drawings for each location.

C. Slip-Type Head Joints: Provide one of the following:

1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch- (51-mm-) deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous cold rolled channel bridging attached to each stud located within 12 inches (305 mm) of the top of studs to provide lateral bracing.

2. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch- (51-mm-) deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.
3. Deflection Track: Steel sheet top runner 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.
   a. Products: Subject to compliance with requirements, provide one of the following:
      1) ClarkDietrich; MaxTrak Slotted Deflection Track
      2) Steel Network Inc. (The); VertiClip SLD Series.
      3) Telling Industries; True-Action™ Slotted Track.

D. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Minimum Base-Metal Thickness: 0.033 inch, 33 mil.

E. Cold-Rolled Channel Bridging: Steel, 0.053-inch (1.34-mm) minimum base-metal thickness, with minimum 1/2-inch- (13-mm-) wide flanges.

1. Depth: 1-1/2 inches (38 mm) unless otherwise indicated.
2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38 by 38 mm), 0.068-inch- (1.72-mm-) thick, galvanized steel.

F. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

1. Minimum Base-Metal Thickness: 0.018 inch (0.45 mm).
2. Depth: 7/8 inch (22.2 mm) unless otherwise indicated.

G. Resilient Furring Channels: 1/2-inch- (13-mm-) deep, steel sheet members designed to reduce sound transmission.

1. Configuration: Asymmetrical.

H. Cold-Rolled Furring Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges.

1. Depth: 3/4 inch (19 mm) unless otherwise indicated.
2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum uncoated-steel thickness of 0.033 inch (0.8 mm).
3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.

2.2 SUSPENSION SYSTEMS

A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.

B. Hanger Attachments to Concrete:

1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by an independent testing agency.
   a. Type: Postinstalled, chemical anchor or postinstalled, expansion anchor.

2. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E 1190 by an independent testing agency.

C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch (4.12 mm) in diameter.

D. Flat Hangers: Steel sheet, 1 by 3/16 inch (25 by 5 mm) by length indicated.

E. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.053 inch (1.34 mm) and minimum 1/2-inch- (13-mm-) wide flanges.

1. Depth: 1-1/2 inches (38 mm) unless otherwise indicated on Drawings.

F. Furring Channels (Furring Members):

1. Cold-Rolled Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges, 3/4 inch (19 mm) deep.
2. Steel Studs and Runners: ASTM C 645.
   a. Minimum Base-Metal Thickness: 0.018 inch, 18 mil.
   b. Depth: As indicated on Drawings.

3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch (22 mm) deep.
   a. Minimum Base-Metal Thickness: 0.018 inch, 18 mil.

4. Resilient Furring Channels: 1/2-inch- (13-mm-) deep members designed to reduce sound transmission.
   a. Configuration: Asymmetrical or hat shaped.

G. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include the following:
   a. Armstrong World Industries, Inc.; Drywall Grid Systems.
   b. Chicago Metallic Corporation; Drywall Grid System.
   c. USG Corporation; Drywall Suspension System.

2.3 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Isolation Strip at Exterior Walls: Provide one of the following:

1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.
2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.

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 C 754, except comply with framing sizes and spacing indicated.

1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

C. Install bracing at terminations in assemblies.

D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

E. Cutting, Notching and Boring Holes in Nonstructural Steel Wall Framing:

1. Flanges and lips of nonstructural steel wall studs shall not be cut or notched.
2. Holes in webs of nonstructural steel wall studs shall be permitted along the centerline of the web of the framing member, shall not exceed 1-1/2 inches (38 mm) in width or 4 inches (102 mm) in length, and the holes shall not be spaced less than 24 inches (610 mm) center to center from another hole or less than 10 inches (254 mm) from the bearing end.

3.4 INSTALLING FRAMED ASSEMBLIES

A. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

B. Install studs so flanges within framing system point in same direction.

1. Space studs at 16 inches (406 mm) o.c. unless otherwise indicated.

C. Install tracks (runners) 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 penetrating 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 runner 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 (13-mm) 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. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

D. Install steel studs used as furring with clip angles at midpoint of wall span. Install additional clips to limit deflection to L/240 for walls finished with gypsum wall board and L/360 for walls finished with tile or plaster when subject to 5 psf (239 Pa) lateral load.

E. Direct Furring: Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.

F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

3.5 INSTALLING SUSPENSION SYSTEMS

A. Install suspension system components in sizes and spacings indicated on Drawings, but not less than those required by referenced installation standards for assembly types and other assembly components indicated.

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 attach hangers to steel roof deck.
6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
8. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. 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.

E. Installation Tolerances: Install suspension systems that are level to within **1**/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.
2. Sound-attenuation blankets
3. Sound barrier mullion trim cap at partition to window wall connection.

B. Related Requirements:

1. Section 092216 "Non-Structural Metal Framing" for non-structural framing and suspension systems that support gypsum board panels.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include product data indicating low-emitting properties, including printed statement of VOC content.

B. Samples: For the following products:

1. Trim Accessories: Full-size Sample in 12-inch- (300-mm-) long length for each trim accessory indicated.
2. Sound Barrier Mullion Trim Cap: Full-size sample in 6-inch- (150-mm-) long length in selected finish.

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each sound barrier mullion trim cap assembly, for ASTM E 90 tests performed by a qualified third party testing agency

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications (for Sound Barrier Mullion Trim Cap Assembly): Laboratory accredited by IAS as complying with ISO/IEC Standard 17025.

B. Mockups: Before beginning gypsum board installation, install mockups of at least 100 sq. ft. (9 sq. m) in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Install mockups for the following:
   a. Each level of gypsum board finish indicated for use in exposed locations.

2. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.
3. Simulate finished lighting conditions for review of mockups.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 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.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, 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, those that are moisture damaged, and those that are 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.

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 PERFORMANCE REQUIREMENTS

A. VOC Content: Gypsum board and cement board panels, finishing materials, adhesives and sealants shall have VOC content meeting the requirements of Section 018117 “Low Emitting Material Requirements”.

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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. CertainTeed Corp.
   2. Georgia-Pacific Gypsum LLC.
   3. Lafarge North America Inc.
   4. National Gypsum Company.
   5. USG Corporation.

B. Gypsum Wallboard: ASTM C 1396/C 1396M.
   1. Thickness: 5/8 inch (15.9 mm).
   2. Where drawings indicate regular type 5/8 inch (15.9 mm), provide 5/8 inch (15.9 mm) Type X.
   3. Long Edges: Tapered.

C. Gypsum Ceiling Board: ASTM C 1396/C 1396M.
   1. Thickness: 5/8 inch.
   2. Long Edges: Tapered

D. Moisture- and Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces, in 5/8 inch thickness unless otherwise indicated, with tapered edges; panels shall be classified as Type X

   1. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
   2. Products: Subject to compliance with requirements, provide one of the following or equal:
      a. National Gypsum Company; Type XP/PR
      b. United States Gypsum Co.; Mold Tough
      c. Georgia Pacific; ToughRock Fireguard X Mold-Guard

E. Abuse-Resistant Gypsum Board: ASTM C 1629/C 1629M.
   1. Core: 5/8 inch (15.9 mm), Type X.
   2. Long Edges: Tapered.
   3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
   4. Performance Data:
      a. Surface Abrasion: ASTM C1629. Classification Level 2
      b. Surface Indentation: ASTM C1629. Classification Level 1
      c. Soft-body Impact Test: ASTM C1629. Classification Level 1
   5. Products: Subject to compliance with requirements, provide one of the following or equal:
      a. Protecta AR 100 Type X with Mold Defense; Lafarge North America Inc.
      b. ProRoc Gypsum Board Panels; Certainteed, Division of BPB.
      c. Dens Armor Plus Abuse-Resistant; Georgia Pacific

F. Flexible Gypsum Board: ASTM C 1396/C 1396M. Manufactured to bend to fit radii and to be more flexible than standard regular-type gypsum board of same thickness.

1. Thickness: 1/4 inch (6.4 mm).
2. Long Edges: Tapered

2.4 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.
1. Material: Galvanized-coated steel sheet or rolled zinc
2. Shapes:
a. Cornerbead.
b. Bullnose bead.
c. LC-Bead: J-shaped; exposed long flange receives joint compound.
d. L-Bead: L-shaped; exposed long flange receives joint compound.
e. Expansion (control) joint.
f. Curved-Edge Cornerbead: With notched or flexible flanges.

B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Fry Reglet Corp.
b. Gordon, Inc.
c. Pittcon Industries.
2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221 (ASTM B 221M), Alloy 6063-T5.
3. Finish:
a. Curved Drywall Trim: Corrosion-resistant primer compatible with joint compound and finish materials specified.

4. Basis of Design Products:
a. Curved Drywall Trim: Provide Contura curved drywall trim by Gordon Inc. for locations indicated on the Drawings, in sizes required.

C. Sound Barrier Mullion Trim Cap: Provide sound barrier mullion trim caps of design, basic profile, materials, and operation indicated. Provide units with capability to accommodate variations in adjacent surfaces. Fabricate from aluminum extrusions minimum 0.125” thick with sound absorbing insulation, compressible foam and metal end cap for partition, and as follows:
1. Sound Transmission: STC varies according to gap size and baseline wall STC.
2. Sound Absorbing Foam: Meeting ASTM E84, Class A for flammability.
3. Compressible Foam: Between edge of extrusion and interior face of curtain wall glass or mullion; of thickness as required to accommodate mullion deflection, color as selected by Architect.
4. Sizes: Varies; provide for opening sizes as indicated on Drawings for each location.
5. Length: Custom lengths as required to meet project conditions or provide in standard incremental foot lengths cut to exact length at jobsite.
6. Finish: Field painted to match adjacent wall color and sheen.
7. Accessories: Provide Mullion Mate End Caps for end of partition in sizes as required. Paint to match mullion partition gap closures.
8. Basis of Design Product: Mullion Mate Plus Against the Mullion and Mullion Mate Plus Against the Glass by Gordon or equal product of the following:

a. MULL-it-OVER Products, or equal

2.5 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:
1. Interior Gypsum Board: Paper.

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, 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 factory mixed drying-type, all-purpose compound.
a. Use setting-type compound for installing paper-faced metal trim accessories.
3. Fill Coat: For second coat, use factory mixed drying-type, all-purpose compound.
4. Finish Coat: For third coat, use setting-type, sandable topping compound.
5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound.

2.6 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.

C. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
1. Laminating adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
1. Basis of Design Product: Provide Thermafiber SAFB by Owens Corning, or one of the following:
a. MinWool® Sound Attenuation Fire Batt (SAFB) by Johns Manville.
b. Rockwool AFB by Rockwool

E. Acoustical Joint Sealant: As specified in Section 079200 “Joint Sealants”

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and framing, with Installer present, for compliance with requirements and other conditions affecting performance.

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 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

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 (1.5 mm) 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. (0.7 sq. m) 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- (6.4- to 9.5-mm-) wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) 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. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:
   1. Type X: Vertical surfaces unless otherwise indicated.
   2. Ceiling Type: Ceiling surfaces.
   3. Abuse-Resistant Type: As indicated on Drawings.
   4. Moisture- and Mold-Resistant Type: As indicated on Drawings.
   5. Flexible Type: Apply in double layer at curved assemblies.

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 (400 mm) 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. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

A. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.

B. Curved Surfaces:

1. Install panels horizontally (perpendicular to supports) and unbroken, to extent possible, across curved surface plus 12-inch- (300-mm-) long straight sections at ends of curves and tangent to them.
2. For double-layer construction, fasten base layer to studs with screws 16 inches (400 mm) o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced 12 inches (300 mm) o.c

3.4 INSTALLING 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 according to ASTM C 840 and in specific locations approved by Architect for visual effect.
1. Install control joints on 30 foot maximum centers, for all partitions, at locations indicated, and as detailed. Align control joints with door frames wherever possible, with space between edges of adjoining gypsum panels, as well as supporting framing behind gypsum panels.
2. Install control joints at 50 foot maximum centers, with areas not to exceed 2,500 sq. ft. for all ceiling areas, at locations indicated, and as detailed.

C. Interior Trim: Install in the following locations:
1. Cornerbead: Use at outside corners unless otherwise indicated.
2. Bullnose Bead: Use where indicated.
3. LC-Bead: Use at exposed panel edges.
4. L-Bead: Use where indicated.
5. Curved-Edge Cornerbead: Use at curved openings.

D. Aluminum Trim: Install in locations indicated on Drawings.

E. Sound Barrier Mullion Trim Caps: Install in accordance with manufacturer’s directions, in locations indicated on Drawings. Notch as required at window mullions.

3.5 FINISHING 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 according to ASTM C 840:
1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 2: Panels that are substrate for tile.

3. Level 4: At all panel surfaces that will be exposed to view unless otherwise indicated.
4. Level 5: Provide Level 5 finish at all areas where wall washed lighting is indicated and at surfaces scheduled to receive gloss paint or wallcoverings, and elsewhere specifically indicated on Drawings and schedules.

3.6 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 092900

SECTION 096500 - RESILIENT FLOORING AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Rubber sheet flooring.
2. Rubber wall base.
3. Resilient flooring accessories

1.2 ACTION SUBMITTALS

A. Product data for each type of product specified.

B. Samples for verification purposes in form of actual flooring or sections of accessories for each color and pattern specified.

1. For heat-welding bead, manufacturer's standard-size samples, but not less than 9 inches (230 mm) long, of each color specified.

C. Shop Drawings: Indicate decorative pattern layout, if any. Show location of seams and edges. Indicate location of columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutout locations.

1.3 INFORMATIONAL SUBMITTALS

A. Maintenance data for resilient flooring and accessories.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage an installer who is competent in the technique required by sheet flooring manufacturer for heat-welding seams.

B. Single-Source Responsibility for Sheet Flooring and Accessories: Obtain each type, color, and pattern of sheet floor covering specified from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.

C. Fire Performance Characteristics: Provide resilient flooring with the following fire performance characteristics as determined by testing products per ASTM test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

1. Critical Radiant Flux: 0.45 watts per sq. cm or more per ASTM E 648.

2. Smoke Density: Less than 450 per ASTM E 662.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store resilient materials on flat surface in dry space protected from the weather with ambient temperatures maintained between 50 deg F (10 deg C) and 90 deg F (32 deg C)

B. Store rolls of sheet flooring upright.

C. Move floor coverings and installation accessories into spaces where they will be installed at least 48 hours before installation, unless longer conditioning periods are recommended in writing by manufacturer.

1.6 PROJECT CONDITIONS

A. Maintain a minimum temperature of 70 deg F (21 deg C) in spaces to receive resilient flooring for at least 72 hours prior to installation, during installation, and for not less than 72 hours after installation. After this period, maintain a temperature of not less than 55 deg F (13 deg C).

B. Moisture Testing of Concrete Substrates: Perform moisture tests recommended by manufacturer and as follows:

1. Testing Procedures: Perform calcium chloride or moisture meter tests as required by floor topping and resilient flooring manufacturers.
   a. Calcium Chloride Testing: Anhydrous calcium chloride test, ASTM F 1869.
   b. Moisture Meter Testing: Relative humidity test using in situ probes, ASTM F 2170.

2. Proceed with installation only after substrates do not exceed maximum moisture-vapor-emission rate or relative humidity level measurement acceptable to flooring material manufacturer.

C. Do not install flooring or accessories until they are at the same temperature as the space where they are to be installed.

D. Close spaces to traffic during flooring installation.

1.7 SEQUENCING AND SCHEDULING

A. Install flooring and accessories after other finishing operations, including painting, have been completed.

1.8 EXTRA MATERIALS

A. Extra Materials: Furnished from same production run as resilient tile, base and accessories installed. Furnish 5% of each type and color of material provided in the work.

Package materials with protective covering and identify with labels describing contents. Deliver extra materials to Owner.

1. Extra materials of sheet floor covering is not required.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

A. Colors, Textures, and Patterns: Provide tile, sheet goods and accessories in color, texture and pattern to match specified products. Colors and patterns indicated by reference to manufacturer's name and designations are for color and pattern identification only and are not intended to limit selection of other manufacturer's products with similar colors and patterns. If no colors or patterns are indicated, provide color(s) and pattern(s) as selected by Architect from manufacturer’s standards.

B. Resilient flooring and base shall comply with RFCI FloorScore Program.

2.2 RESILIENT SHEET FLOORING

A. Rubber Sheet (RUB-1): Rubber sheet flooring without backing complying with ASTM F1859, Type 1, and as follows:

1. Sheet Size: 6 ft x 50 ft
2. Thickness: 0.100" (2.5 mm)
3. Surface: Smooth
4. Warranty: 20 years
5. Color: S139 Deep Navy
6. Basis of Design Product: Envire Rubber Sheet by Roppe.
7. Other Acceptable Products:
   a. Interface Noraplan; environcare™, 3.0mm sheet, Article 1463, 7077 Graduation
   b. Mondo; dharma, Midnight 3mm

8. Accessories: Provide welding rod matching flooring.

2.3 RESILIENT WALL BASE

A. Rubber Wall Base (RB-1): ASTM F 1861, Type TS, Group 1 (solid), 4" high, 1/8" thick, smooth surface, and as follows:

1. Style: Cove base with toe (set-on type)
2. Lengths: Coils in manufacturer's standard length.
3. Inside and Outside Corners: Preformed.
4. Products: Roppe Pinnacle Rubber Base.
5. Color: Brown 110.
6. Other Acceptable Products:

a. Flexco; Wallflowers Rubber Wall Base, in Chocolate 072
b. nora by Interface; nora wall base, in 6254 Dark Chocolate

B. Sheet Rubber Cove Base: Provide integral flash cove wall base using sheet flooring and provide plastic cap at top edge.

2.4 MISCELLANEOUS RESILIENT ACCESSORIES

A. Color: As selected by Architect from manufacturer's full range of colors produced for accessory molding complying with requirements indicated.

B. Rubber Accessory Moldings: Provide rubber accessory molding complying with the following:

1. Product Description: Carpet edge for glue-down applications, carpet nosing, nosing for rubber tile, reducer strip for resilient flooring, and tile and carpet joiner.
2. Profile and Dimensions: As indicated or required.

2.5 INSTALLATION ACCESSORIES

A. Concrete Slab Primer: Nonstaining type as recommended by flooring manufacturer.

B. Concrete Sealer: Type recommended and approved by resilient flooring manufacturer and adhesive manufacturer to ensure proper adhesion of resilient flooring to substrate.

C. Trowelable Underlayments and Patching Compounds: Latex-modified, portland-cement-based formulation provided or approved by flooring manufacturer for applications indicated.

D. Adhesives (Cements): Products supplied by resilient flooring and accessory manufacturers, of type recommended to suit resilient products and substrate conditions

1. Use adhesives that are suitable for moisture conditions of substrate at time of installation.

E. Heat-Welding Bead: Solid-strand product of floor covering manufacturer for heat-welding seams.

1. Color and Pattern: Match color and pattern of sheet floor covering.

F. Floor Polish: Acrylic type, as recommended by flooring material manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. General: Examine areas where installation of flooring will occur, with Installer present, to verify that substrates and conditions are satisfactory for flooring installation and comply with flooring manufacturer's requirements and those specified in this Section.

B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:

1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials whose presence would interfere with bonding of adhesive. Determine adhesion and dryness characteristics by performing bond tests recommended by flooring manufacturer.
2. Finishes of subfloors comply with tolerances and other requirements specified in Division 03 Section "Cast-In-Place Concrete" for slabs receiving resilient flooring.
3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits of any kind.

C. Concrete Moisture Emission Tests: Perform calcium chloride test or relative humidity test as per manufacturer's directions, as follows, and other tests if recommended by resilient flooring and adhesive manufacturer:

1. Perform moisture test at rate of one per 2,000 sq.ft. of new and existing floor area to be covered.
2. Report test results in writing to Architect, and Contractor within 24 hours after tests are completed. Reports of concrete moisture emission tests shall contain the Project identification name and number, date of test location of test within structure.
3. Perform additional moisture emission tests of in-place concrete when test results indicate specified moisture content has been exceeded, as directed by Architect.
   a. Repeat test one week after initial test minimally and additionally repeat test if required by field conditions to determine moisture levels in area of resilient flooring application.

D. Do not proceed with installation until unsatisfactory conditions have been corrected.

1. If ASTM F2170 or ASTM F1869 test results exceed the prescribed limits, a moisture mitigation product recommended by the flooring manufacturer shall be installed prior to proceeding with installation.

3.2 PREPARATION

A. General: Comply with manufacturer's installation specifications to prepare substrates indicated to receive flooring.

B. Use trowelable leveling and patching compounds per flooring manufacturer's directions to fill cracks, holes, and depressions in substrates and to patch and level floors as required to provide suitable substrate for flooring application.

C. Remove coatings, including curing compounds, and other substances that are incompatible with flooring adhesives by using a grinder, sander, or polishing machine with a heavy-duty wire brush.

D. Broom or vacuum clean substrates to be covered by flooring immediately before installation of flooring. Following cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust.

E. Apply concrete slab primer, if recommended by flooring manufacturer, prior to applying adhesive. Apply according to manufacturer's directions.

F. Seal concrete substrates as required by moisture test results to ensure proper adhesion of resilient flooring to substrate.

3.3 SHEET FLOORING INSTALLATION

A. General: Comply with sheet floor covering manufacturer's written installation instructions.

B. Unroll sheet floor coverings and allow them to stabilize before cutting and fitting, if recommended in writing by manufacturer.

C. Lay out sheet floor coverings to comply with the following requirements:

1. Maintain uniformity of sheet floor covering direction.
2. Arrange for a minimum number of seams and place them in inconspicuous and low-traffic areas, and not less than 6 inches (150 mm) away from parallel joints in flooring substrates.
3. Match edges of sheet floor coverings for color shading and pattern at seams according to manufacturer's written recommendations.
4. Avoid cross seams.

D. Scribe, cut, and fit sheet floor coverings to butt neatly and tightly to vertical surfaces and permanent fixtures, including built-in furniture, cabinets, pipes, outlets, edgings, door frames, thresholds, and nosings.

E. Extend sheet floor coverings into toe spaces, door reveals, closets, and similar openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use chalk or other nonpermanent, nonstaining marking device.

G. Install sheet floor coverings on covers for telephone and electrical ducts, and similar items in finished floor areas. Maintain overall continuity of color and pattern with pieces of flooring installed on covers. Tightly adhere edges to perimeter of floor around covers and to covers.

H. Adhere sheet floor coverings to flooring substrates to comply with floor covering manufacturer's written instructions, including those for trowel notching, adhesive mixing, and adhesive open and working times.

1. Produce completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

I. Heat-Welded Seams: Rout joints and heat weld with welding bead, permanently fusing sections into a seamless floor covering. Prepare, weld, and finish seams according to manufacturer's written instructions and ASTM F 1516 to produce surfaces flush with adjoining floor covering surfaces.

J. Hand roll sheet floor coverings in both directions from center out to embed floor coverings in adhesive and eliminate trapped air. At walls, door casings, and other locations where access by roller is impractical, press floor coverings firmly in place with flat-bladed instrument.

3.4 INSTALLATION OF WALL BASE AND ACCESSORIES

A. General: Install resilient accessories according to manufacturer's written installation instructions.

B. Apply resilient wall base to walls, pilasters, casework, and other permanent fixtures in rooms and areas where base is required. Install wall base in lengths as long as practicable. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

1. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient wall base with manufacturer's recommended adhesive filler material.
2. Install preformed corners as per manufacturer’s directions.

C. Provide integral flash cove wall base by extending sheet rubber flooring 4 in. up the wall using adhesive, welding rod, and accessories recommended and approved by the flooring manufacturer. Install plastic cap at top of base.

D. Place resilient accessories so they are butted to adjacent materials of type indicated and bond to substrates with adhesive. Install reducer strips at edges of flooring that otherwise would be exposed.

3.5 CLEANING AND PROTECTION

A. Perform the following operations immediately after completing installation:

1. Remove visible adhesive and other surface blemishes using cleaner recommended by manufacturers.
2. Sweep or vacuum floor thoroughly.
3. Do not wash floor until after time period recommended by resilient flooring manufacturer.

4. Damp-mop flooring to remove black marks and soil.

B. Protect flooring against mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods indicated or recommended by flooring manufacturer.

1. Apply protective floor polish to flooring surfaces that are free from soil, visible adhesive, and surface blemishes. Coordinate selection of floor polish with Owner's maintenance service requirements.
2. Cover flooring with undyed, untreated building paper until inspection for Substantial Completion.

C. Clean flooring not more than 4 days prior to dates scheduled for inspections intended to establish date of Substantial Completion in each area of Project. Clean flooring using method recommended by manufacturer.

1. Strip protective floor polish that was applied after completing installation prior to cleaning.
2. Reapply floor polish after cleaning.

END OF SECTION 096500

SECTION 099100 - PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes surface preparation and the application of paint systems, including epoxy wall coatings, on the following interior and exterior substrates:

1. Steel and iron.
2. Gypsum board.
3. Wood

B. Related Sections include the following:

1. Division 05 Sections for shop priming of metal substrates with primers specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Initial Selection: For each type of topcoat product indicated.

C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat indicated.

1. Submit Samples on rigid backing, 8 inches (200 mm) square.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

D. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

1.3 QUALITY ASSURANCE

A. MPI Standards: Maintain copy of this standard at the Project site at all times.

1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."

2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

B. Mockups: Apply benchmark samples of each paint system indicated and each color and finish selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
   a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
   b. Other Items: Architect will designate items or areas required.

2. Apply benchmark samples after permanent lighting and other environmental services have been activated.
3. Final approval of color selections will be based on benchmark samples.
   a. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by Architect at no added cost to Owner.

1.4 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 (7 deg C).

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.5 PROJECT CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

C. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

1.6 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. Paints and Coatings: One unopened gallon of each paint type and color and one each type of primer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Benjamin Moore & Co.
2. PPG Architectural Finishes, Inc.
3. Sherwin-Williams Company (The).
4. Tnemec

2.2 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. VOC Content: Use paints and coatings that meet the requirements of Section 018117 "Low Emitting Material Requirements"

C. Colors: As scheduled or if not scheduled, as selected by Architect from manufacturer's full range.

1. Colors scheduled are for color matching only.

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 work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Gypsum Board: 12 percent.
2. Wood: 15 percent

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Remove plates, machined surfaces, and similar items already in place that 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.
2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.

D. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.

E. Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth.

F. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.

1. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
2. Prime, stain, or seal wood to be painted immediately on delivery. Prime edges, ends, faces, undersides, and backsides of wood, including cabinets, counters, cases, and paneling.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions.

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.

B. Application Procedures: Apply paints and coatings by brush or roller according to the manufacturer's directions, except s noted below. Spray application is not permitted for trim, ceilings and walls, unless specifically approved by Architect in advance for each individual situation. Roller application on woodwork is not permitted.

1. 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.
2. Brushes: Use brushes best suited for the type of material applied. Use brush of appropriate size for the surface or item being painted.
3. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by the manufacturer for the material and texture required.

C. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate. Provide the total dry film thickness of the entire system as recommended by the manufacturer.

D. 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.

E. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

F. 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.

G. Painting Mechanical and Electrical Work: Paint items exposed in equipment rooms and occupied spaces including, but not limited to, the following:

1. Mechanical Work:
   a. Uninsulated metal piping.
   b. Uninsulated plastic piping.
   c. Pipe hangers and supports.
   d. Tanks that do not have factory-applied final finishes.
   e. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
   f. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
   g. Mechanical equipment that is indicated to have a factory-primed finish for field painting.

2. Electrical Work:
   a. Switchgear.
   b. Panelboards.

c. Electrical equipment that is indicated to have a factory-primed finish for field painting.

3.4 FIELD QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when paints are being applied:

1. Owner will engage the services of a qualified testing agency to sample paint materials being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying-paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

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.

1. Do not paint cabling and other systems that should not have any paint applied as required to maintain their rated integrity.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

A. General: Provide listed products or equal products of other named manufacturers in Part 2.

B. Gypsum Board Ceilings: Flat acrylic finish.

1. Prime Coat: Latex-based, interior primer; MPI # 50, X-Green 50, 149, X-Green 149, LEED 2009, LEED V4, CHPS Certified.
   a. Benjamin Moore; Ultra Spec 500 Interior Latex Primer N534

2. Intermediate Coat and Topcoat: Factory-formulated flat acrylic latex paint for interior application; MPI # 53, X-Green 53, 143, X-Green 143, LEED 2009, LEED V4, CHPS Certified.
   a. Benjamin Moore; Ultra Spec 500 Interior Latex Flat N536

C. Gypsum Drywall Walls: Low-luster (eggshell), acrylic finish.

1. Prime Coat: Latex-based, interior primer; MPI # 50, X-Green 50, 149, X-Green 149, LEED 2009, LEED V4, CHPS Certified.
   a. Benjamin Moore; Ultra Spec 500 Interior Latex Primer N534

2. Intermediate Coat and Topcoat: Low-luster (eggshell or satin), acrylic-latex, interior enamel; MPI # 52, X-Green 52, 145, X-Green 145, 139, X-Green 139, LEED 2009 LEED V4, CHPS Certified.
   a. Benjamin Moore; Ultra Spec 500 Latex Eggshell T538.

D. Hollow Metal Doors, Frames, and Sidelights, and Ferrous Metals: Semigloss, acrylic-enamel finish.

1. Prime Coat: Rust-Inhibitive Primer (Water Based), MPI #107, X-Green 107, 134, LEED 2009, CHPS Certified.
   a. Benjamin Moore; Super Spec HP Acrylic Metal Primer P04.

2. Intermediate Coat and Topcoat: Factory-formulated semigloss acrylic-latex enamel for interior application; MPI # 141, X-Green 141, 153, X-Green 153, LEED 2009, LEED V4.
   a. Benjamin Moore; Ultra Spec HP D.T.M. Acrylic Semi-Gloss Enamel, HP29

E. Painted Woodwork: Semigloss, acrylic finish.

1. Prime Coat: Latex-based, interior primer; MPI # 50, X-Green 50, 149, X-Green 149, LEED 2009, LEED V4, CHPS Certified.
   a. Benjamin Moore; Ultra Spec 500 Interior Latex Primer N534

2. Intermediate Coat and Topcoat: Semigloss acrylic-latex, interior enamel; MPI # 43, X-Green 43, 146, X-Green 146, 140, X-Green 140, LEED 2009, LEED V4, CHPS Certified.
   a. Benjamin Moore; Ultra Spec 500 Latex Semigloss N539.

END OF SECTION 099100

SECTION 101000 - VISUAL DISPLAY SURFACES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following types of visual display boards:

1. Glass marker board

1.2 ACTION SUBMITTALS

A. Product Data: Provide manufacturer's product data for each type of visual display board specified.

B. Shop Drawings: For each type of visual display board required, including dimensioned elevations. Show location of joints between individual panels where unit dimensions exceed maximum panel length. Include sections of typical trim members. Show anchors, grounds, reinforcement, accessories, layout, and installation details.

C. Samples for Verification: Of the following products, showing color and texture or finish selected. Where finishes involve normal color and texture variations, include Sample sets showing the full range of variations expected. Prepare Samples from the same material to be used for the Work.

1. Aluminum Trim and Accessories: Samples of each finish type and color, on 6-inch-(150-mm-) long sections of extrusions and not less than 4-inch (100-mm) squares of sheet or plate. Include Sample sets showing the full range of color variations expected.

1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain visual display boards through one source from a single manufacturer.

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. Glass Markerboards:
   a. Krystal
   b. Quartet.

c. Egan Visual
d. Clarus Glassboards

2.2 MATERIALS, GENERAL

A. VOC Limits for Installation Adhesives and Glues: Use installation adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Wood Glues: 30 g/L.
2. Contact Adhesive: 80 g/L

2.3 GLASS MARKERBOARD

A. Provide frameless, magnetic glass markerboards fabricated from 1/4" thick, fully tempered glass, backcoated with magnetic color coating, with aluminum marker tray. Include all mounting hardware (pass-through, standoff type) for each markerboard provided.

1. Color: White
2. Basis of Design Product: Krystal Glass Markerboards by Krystal Glass Writing Boards, Inc. or equal.
3. Size: As indicated on Drawings.

2.4 ACCESSORIES

A. Metal Trim and Accessories: Fabricate frames and trim of not less than 0.062-inch- (1.57-mm-) thick, extruded-aluminum alloy, size and shape as indicated, to suit type of installation. Provide straight, single-length units. Keep joints to a minimum. Miter corners to a neat, hairline closure.

1. Where size of visual display boards or other conditions require support in addition to normal trim, provide structural supports or modify trim as indicated or as selected by the Architect from manufacturer's standard structural support accessories to suit conditions indicated.

2.5 FABRICATION

A. Assembly: Provide factory-assembled markerboard units in single units without joints.

2.6 FINISHES

A. General: Comply with NAAMM "Metal Finishes Manual" for recommendations relative to application and designations of finishes.

B. Finish designations prefixed by "AA" conform to the system established by the Aluminum Association for designating aluminum finishes.

C. Class II Clear Anodized Finish: AA-M12C22A31 (Mechanical Finish: as fabricated, nonspecular; Chemical Finish: etched, medium matte; Anodic Coating: Class II Architectural, clear film thicker than 0.4 mil).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine wall surfaces, with Installer present, for compliance with requirements and other conditions affecting installation of visual display boards.

1. Surfaces to receive markerboards shall be free of dirt, scaling paint, and projections or depressions that would affect smooth, finished surfaces of markerboards.
2. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. A.Install units in locations and at mounting heights as indicated on drawings; comply with manufacturer's installation instructions. Keep perimeter lines straight, plumb, and level. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for a complete installation.

B. Coordinate Project-site-assembled units with grounds, trim, and accessories. Join parts with a neat, precision fit.

3.3 ADJUST AND CLEAN

A. Verify that accessories required for each unit have been properly installed and that operating units function properly.

B. Clean units in accordance with the manufacturer's instructions. Break in markerboards only as recommended by the manufacturer.

END OF SECTION 101000

SECTION 105200 - FIRE-PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Portable fire extinguishers.
2. Fire-protection cabinets for portable fire extinguishers.
3. Fire-protection accessories.

1.2 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire-protection specialties.

1. Fire Extinguishers: Include rating and classification.
2. Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.

1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain fire extinguishers and cabinets through one source from a single manufacturer.

B. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Standard for Portable Fire Extinguishers."

C. State Fire Code Compliance: Fabricate and label fire extinguishers to comply with New York State Fire Code.

D. Fire Extinguishers: FM listed and labeled for type, rating, and classification specified.

E. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements of ASTM E 814 for fire-resistance rating of walls where they are installed.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cold-Rolled Steel Sheet: Carbon steel, complying with ASTM A 366/A 366M, commercial quality, stretcher leveled, temper rolled.

2.2 PORTABLE FIRE EXTINGUISHERS

A. General: Provide fire extinguishers of type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.

B. Multipurpose Dry-Chemical Type: UL-rated 10-A:120-B:C, 20-lb nominal capacity, in enameled-steel container.

1. Available Product: MP 20, Larsen's Manufacturing Company.

2.3 FIRE-PROTECTION CABINETS

A. Basis-of-Design Product: Architectural Series Model SS-2712-SM, as manufactured by Larsen's Manufacturing Co., or one of the following:

1. JL Industries; 2013V10 Ambassador Series White Steel Cabinet for 20 lb. Fire Extinguishers with Vertical Window, Surface Mount, and 8 1/4" Depth.
2. Safety One Industries; 208-EL Elite Architectural Series Surface Mounted 20 lb. Fire Extinguisher Cabinet with Vertical Duo Door (Non-Rated), Baked White Enamel (Standard), ADA Recessed Handles

B. Cabinet Construction: Provide manufacturer's standard box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated. Weld joints and grind smooth. Miter and weld perimeter door frames.

1. Fire-Rated Cabinets: Listed and labeled to meet requirements of ASTM E 814 for fire-resistance rating of wall where it is installed.
   a. Construct fire-rated cabinets with double walls fabricated from 0.0478 inch (1.2 mm) thick, cold-rolled steel sheet lined with minimum 5/8 inch (16 mm) thick, fire-barrier material.
   b. Provide factory-drilled mounting holes.

C. Cabinet Size: Suitable for specified fire extinguisher.

D. Cabinet Style: Exposed trim with exposed hinge and door inset flush with surrounding frame.

E. Cabinet Construction: Provide manufacturer's standard box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated. Weld joints and grind smooth. Miter and weld perimeter door frames.

1. Cabinet Material: Enameled-steel sheet.
2. Cabinet Type: Surface Mounted Cabinet

F. Door Construction: Fabricate doors according to manufacturer's standards, of materials indicated, and coordinated with cabinet types and trim styles selected.

1. Door Material: Enameled-steel sheet in color selected by Architect.
2. Door Style: Flush, solid panel.
3. Door Hardware: Ensure hardware meets ADA requirements. Provide manufacturer's built-in cylinder lock system (*Larsen-Loc*™), or approved equivalent, and door-

operating hardware of proper type for cabinet type, trim style, and door material and style indicated. Provide either lever handle with cam-action latch, or exposed or concealed door pull and friction latch. Provide concealed or continuous-type hinge permitting door to open 180 degrees.

4. Lettering: Provide factory applied lettering that reads “IN CASE OF FIRE ONLY - PULL FIRMLY ON HANDLE.”

2.4 ACCESSORIES

A. Mounting Brackets: Manufacturer's standard steel, designed to secure extinguisher, of sizes required for types and capacities of extinguishers indicated, with plated or baked-enamel finish. Provide brackets for extinguishers not located in cabinets.

B. Identification: Provide lettering to comply with authorities having jurisdiction for letter style, color, size, spacing, and location. Locate as indicated by Architect.

1. Identify fire extinguisher in fire protection cabinet with the words "FIRE EXTINGUISHER."
   a. Location: Applied to cabinet door.
   b. Application Process: Die cut.
   c. Lettering Color and Style: As selected by Architect.

2. Identify bracket-mounted extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to wall surface.

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. Surface Preparation: Clean surfaces of dirt, oil, grease, mill scale, rust, and other contaminants that could impair paint bond using manufacturer's standard methods.

D. Steel Finishes: Manufacturer’s standard baked-enamel paint in color selected by Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged units.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing fire-protection specialties.

B. Install in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.

1. Fasten mounting brackets to structure, square and plumb.
2. Fasten cabinets to structure, square and plumb.

3.3 ADJUSTING, CLEANING, AND PROTECTION

A. Adjust cabinet doors that do not swing or operate freely.

B. Refinish or replace cabinets and doors damaged during installation.

C. Provide final protection and maintain conditions that ensure that cabinets and doors are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 105200

SECTION 11 53 00
LABORATORY EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install the following; refer to the equipment schedule for additional details:
1. Coat Hooks
2. Snorkels (Fume Extraction Units) with associated supports
3. Cylinder restraints
4. Barricade racks
5. Icemaker Unit(s)
6. Glasswasher Unit(s)
7. Autoclave(s)
8. Laboratory fire extinguishers and cabinets
9. Coat bars / shelves
10. Gas / oxygen depletion sensors

B. Include all fasteners, anchors, blocking, supports, connections and coordination with other trades for a complete installation.

1.2 RELATED REQUIREMENTS

A. General Conditions and General Requirements of the Contract for Construction are applicable to the work of this section. Attention is to be given to related work sections, including but not limited to:

B. Section 05 50 00 – MISCELLANEOUS METAL FABRICATIONS: Requirements for structured channel system supports for work of this section.

C. Section 06 10 53 – ROUGH CARPENTRY: Blocking, grounds and supports for work of this section.

D. Section 11 53 43 – SERVICE FITTINGS AND ACCESSORIES.

E. Section 12 35 53.13 – METAL LABORATORY CASEWORK.

F. Section 12 36 53 – LABORATORY COUNTERTOPS.

G. Division 22 –PLUMBING: Piped services connections including but not limited to air, vacuum, potable and non potable water, drains and vents, natural gas, and laboratory gasses.

H. Division 23 – HEATING, VENTILATING AND AIR CONDITIONING: Ductwork for exhaust, including fume hoods, snorkels, biosafety cabinets, and ventilated cabinets or enclosures.

I. Division 25 – INTEGRATED AUTOMATION: All fittings, equipment, coordination and controls for integration of laboratory equipment items with building controls.

J. Division 26 – ELECTRICAL: All electrical fittings, wiring and components, complete, including all connections.

K. Division 27 – COMMUNICATIONS: All electrical fittings, wiring and components, complete, including all connections for coordination with IT and low voltage communications.

1.3 REFERENCES

A. Reference Standards: Comply with applicable requirements of the following standards and those others referenced in this Section and Section 12 35 52, under the provisions of Division 1 – GENERAL REQUIREMENTS. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.

1. Scientific Equipment and Furniture Association (SEFA), 5th Edition Desk Reference:
   a. SEFA 2 - Recommended Practices for Installation.
2. Refer to Section 12 35 52 for additional references

1.4 QUALITY ASSURANCE

A. General: Comply with performance, fabrication, installation, and cleaning requirements of Section 12 35 52 – COMMON WORK RESULTS FOR LABORATORY FURNITURE AND CASEWORK.

B. Notify the Architect where conflicts apply between referenced standards and existing materials, and existing methods of construction.

1.5 SUBMITTALS

A. Submit the following under provisions of Division 1 – GENERAL REQUIREMENTS:

1. Literature: Manufacturer's product data sheets, specifications, performance data, physical properties and installation instructions for each item furnished hereunder.
2. Materials schedule: A complete schedule of components supplied under this section, coordinated with the Contract Drawings.
3. Manufacturer’s instructions: Manufacturer’s installation instructions indicating special procedures, and perimeter conditions requiring special attention.
4. Warranty: Provide sample copies of manufacturers' actual warranties for all materials to be furnished under this Section, clearly defining all terms, conditions, and time periods for the coverage thereof.
5. Quality Assurance Reports: Provide literature from all fabricators, suppliers, and installers providing work under this section.
   a. Provide test data showing compliance with Quality Assurance requirements of this section and Section 12 35 52
   b. For each element of the work, Provide manufacturer's written certification stating that equipment and all related items to be furnished hereunder, meet or exceed the requirements specified under this Section.
6. Shop Drawings in sufficient detail to show fabrication, installation, anchorage, and interface of the work of this Section with the work of adjacent trades.
   a. Include locations of service connections and operable parts, and indicate clearances for installation and removal, and for maintenance and operation of all fittings.
   b. Dow adjacent construction and all anchors and connections.
   c. Components shall be identified on shop drawings via manufacturer’s part numbers, correlated with Materials schedule.
7. Selection samples:

a. Manufacturer's full line of standard colors for each type of finish used on components of work supplied under this section.

b. Manufacturer's cut sheet for selection of options (including lettering styles, readouts, etc.) for each element of the work provided under this section.

8. Verification samples:

a. Where colors or finishes are selected to match Architect's sample or existing condition, provide verification sample demonstrating color and gloss match prior to fabrication.

9. Operation and maintenance manuals

a. Complete operation and maintenance data for each piece of equipment, including:

1) Parts lists
2) Troubleshooting guides
3) User operating procedures
4) Vendor contact
5) Copy of warranty, installation drawings, and submittal literature.

1.6 SEQUENCING AND SCHEDULING

A. Provide shop drawings and submittals in a timely fashion to permit fabrication of long-lead items and maintain overall construction schedule.

B. Coordinate delivery and installation of work provided under this section with related sections including supports and mechanical, electrical and plumbing connections to expedite work and minimize delays.

1.7 PRODUCT HANDLING

A. Comply with requirements of Section 12 35 52 for delivery, storage, and handling, and for acceptable site conditions for receiving and installing work of this section.

B. Deliver all materials in manufacturer's original packaging. Provide secured storage for all equipment items until those items are permanently affixed to the remainder of the work.

C. Contractor shall secure all tools, spares, printed literature and the like required for each element of the work under this section, and provide to the Owner at Substantial completion.

1.8 WARRANTY

A. Submit manufacturer's standard warranties at Project Closeout under provisions of Division 1 – GENERAL REQUIREMENTS.

1. Warranty period shall not be less than one year against all defects in material or workmanship. Warranty for any element of the work shall not commence prior to the date of Owner's beneficial occupancy of the space in which the work is installed.

2. Include with warranties all manufacturer's field quality control reports of field inspections, including:

a. Revised "as-built" shop drawings showing final installed conditions.

b. Manufacturer's start up report noting any deficiencies uncovered at startup.

c. Manufacturer's final punch list showing resolution of all issues uncovered during startup, and repair of any damage or deficiency to equipment.

1.9 PRE-INSTALLATION CONFERENCE

A. Installer of the Work of this Section is required to attend pre-installation conference specified under Section 123552 - COMMON WORK RESULTS FOR LABORATORY FURNITURE AND CASEWORK

PART 2 - PRODUCTS

2.1 LABORATORY EQUIPMENT

A. Coat hook: Surface-mounted hat and coat hook
1. Basis of design Bobrick model Nº. B-6827
2. Acceptable alternate manufacturers : Bradley, American Specialties, Inc.
3. Type 304 stainless steel with satin finish.
4. Concealed wall plate anchor.
5. 3” nominal standoff from wall surface.

B. Fume Extraction Snorkel: Flexible-arm fume extractor with gas-spring counterbalances.
1. Basis of Design (Specified Manufacturer): To establish a standard of quality, design and function desired, Drawings and specifications have been based on Alsident Systems A/S, Hammel Denmark, Product: “Alsident System 100”
2. Acceptable alternate manufacturers : Cole-Parmer, Movex, Nederman
3. 3 joint / 2 gas spring design, anodized aluminum arms (typ) non-conductive polypropylene arms at ESD locations and electronics labs, Min 1500 mm working range.
4. Clear terminal-end bell, min 8” diameter
5. 100-200 CFM operating volume
6. Provide 4” square ceiling or wall mounting bracket, including duct connection.
7. Provide structured channel framing supports as specified in Section 05 50 00, and all fasteners an auxiliary hardware for a complete installation.

C. Twin cylinder wall restraint: Stainless steel restraint for pair of cylinders up to A size.
1. Basis of design Justrite Stainless steel support bracket, wall mount 35266.
2. Acceptable alternate manufacturers – Airgas, USA Safety, Uline, Ohuas.
3. Provide nylon straps and cinch buckles for each cylinder position.
4. Provide units with auxiliary chain points and chains for each cylinder position.
5. Construction to be 304 or 316 stainless steel, satin finish.

D. Cylinder barricade rack: Multi-compartment rack for A-size gas cylinders, in sizes indicated
1. Basis of design Justrite 35118 or similar as required by number of cylinders to be held.
2. Acceptable alternate manufacturers – Airgas, USA Safety, Uline
3. Full welded powder coat steel, 2” x 2” hollow structural sections.
4. Provide safety chains for each cylinder position.
5. Unit to be prepped for bolt-down mount to floors.

E. Ice Flaker: Under counter self-contained Ice maker / flaker with storage.

1. Basis of Design (Specified Manufacturer) To establish a standard of quality, design, and function required, drawings and specifications are based on Scotsman, Product SS-FLK-UF424
2. Alternate acceptable manufacturers: Hoshizaki, Avantco
3. Stainless steel construction
4. External air filter
5. 120V 50/60 Hz 15A power
6. Slide door
7. Touch pad controls
8. 24” wide x 33.5” tall
9. 400 lb / day production, 80 lb storage
10. Provide auxiliary normally open contact for connection to BMS for remote alarm.

F. Benchtop drying rack for glassware:
1. Basis of Design: Heathrow Scientific SKU 120791
2. Alternate acceptable manufacturers: SP Scienceware, Bel-Art
3. Min 20” tall x 18” wide Min 40 lbs capacity.
4. Non-corroding (ABS, Phenolic, or polypropylene) body and pegs. Coated wire body is not acceptable. Min 50 adjustable and removeable pegs

G. Glasswasher: Under counter glassware washer.
1. Basis of Design (Specified Manufacturer) To establish a standard of quality, design, and function required, drawings and specifications are based on Steris, Reliance 100
2. Alternate acceptable manufacturers – Labconco, Lancer
3. Under counter installation
4. 115V, 60 Hz, 1 phase, 20A max
5. 36 spindle lower rack, upper standard rack option, upper spindle rack option.
6. View window
7. Drainwater cooling kit
8. Base stand
9. 24” nominal width
10. 304 stainless steel construction, except 316 stainless steel for wash chamber.
11. Removable debris filter screen
12. Steam generator
13. Pure water rinse
14. Sanitizing high heat (180degF) wash temperature
15. Forced air drying
16. Up to 9 programmable cleaning cycles.
17. Provide auxiliary normally open contact for connection to BMS for remote alarm.

H. Autoclave: Floor standing
1. Basis of Design (Specified Manufacturer) To establish a standard of quality, design, and function required, drawings and specifications are based on Steris,AMSCO 250LS
2. Alternate acceptable manufacturers – Labconco, Gettinge Lancer

3. Floor standing installation – provide finished back and side panels.
4. Provide effluent cooldown system.
5. Provide with electric steam generator option for local steam generation.
6. Controls shall be all-digital with record keeping for 1000 events.
7. Vertical sliding chamber door.

I. Laboratory coat racks
1. Basis of design (Specified manufacturer) To establish a standard of quality, design and function required, drawings and specifications are based on Modern Office Y540x series (6, 7, 8, or 9, for 24”, 36”, 48”, or 60” length as shown.
2. Alternate acceptable manufacturers: Knape and Voght, Interion, Global Industrial
3. Wall mounted with minimum 2 points of attachment per bracket, and bracket spacing not greater than 4’ O.C,
4. Stainless steel hanging bar
5. All steel or all stainless steel bracket and shelf construction. Mild steel to be powder coat finished.

J. Gas Sensors
1. Basis of design (Specified manufacturer) To establish a standard of quality, design and function required, drawings and specifications are based on PureAire Monitoring Systems, Lake Zurich, IL
   a. CO2 Monitor – PureAire 99174
   b. O2 Depletion Monitor – PureAire 99016
   c. Toxic Gas Detection Sensor – PureAire 99030
2. Alternate acceptable manufacturers: Brasch, Draeger, Honeywell
   a. Universal, wall mount installation, minimum 2 points of attachment.
   b. Included 24V DC power supply and NEMA 5-15P plug for connection to any standard receptacle
   c. Visual and audible alarms, with factory presets.
   d. LED visual display.
   e. Units shall operate without drift or loss of accuracy at 0-95% RH, -40 to + 50 degrees Centigrade, and without being affected by changes in barometric pressure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Inspect all surfaces and verify that they are in proper condition to receive the work of this Section. Notify the Contractor, and copy to Architect, in writing of any conditions detrimental to the proper and timely completion of the work, and do not proceed with the work until said conditions are corrected.
   1. Confirm adequate in-wall blocking is installed at wall-mounted accessories.

B. Verify clearances required for equipment.

C. Verify ventilation outlets, service connections, and supports are correct and in required location.

D. Verify that electric power is available and of the correct characteristics.

E. Verify that piped services including potable or non-potable water, deionized water, or compressed air are available and of the correct characteristics.

F. Beginning of installation means acceptance of existing site conditions.

3.2 INSTALLATION

A. Install each product in accordance with manufacturers' instructions.

1. Maximum variation for installed equipment, from true position of 1/16 inch in 8 feet for plumb and level and a maximum of 1/32 inch offsets in adjoining surfaces intended to be flush.

B. Sequence installation and erection to ensure correct mechanical and electrical utility connections are achieved.

C. Anchor equipment using devices appropriate for equipment, substrate and expected usage.

D. Support floor-standing equipment evenly, do not permit to rock or vibrate.

3.3 TESTING

A. Provide manufacturer's start up and field testing for all operating equipment.

1. Include final, accepted, test reports in as-built documentation.
2. Include all startup checklists and functional tests.

B. Operate each component of equipment. During and after testing, there shall be no evidence of leaks, electrical malfunction, or other symptom of failure.

C. For units that fail testing, make adjustments and corrections to installation, or replace equipment, and repeat tests until equipment operates properly.

3.4 ADJUSTING

A. Adjust equipment to ensure proper working order and conditions.

B. Remove and replace equipment creating excessive noise, or vibration.

C. After installation is completed, ensure that operating parts work freely and fit neatly. Adjust hardware and catches as required. Repair or replace damaged parts showing dents, buckling, abrasions, scrapes or other damage affecting the appearance or serviceability.

3.5 CLEANING

A. Clean Work:

1. Wash and clean equipment.
2. Clean and polish glass, plastic, hardware and accessories.

B. Remove protective coverings from prefinished work just prior to Owner's acceptance of facility.

End of Section

SECTION 115313
LABORATORY FUME HOODS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Furnish and install all fume hoods, worktops, and understructures including all filler panels, knee space panels and scribes as shown on Drawings.

1. Provide all service outlets, accessory fittings, electrical receptacles and switches, as indicated or shown on equipment schedules or Drawings.
   a. Refer to AS4-Series Drawings and Equipment Schedule for services at each hood.
2. Provide hoods in sizes shown on Drawings with fixed or movable casework below.
3. Provide ADA units with compliant fittings as indicated.
4. Electrical items shall be prewired and ready for installation at a single connection point for each hood.
   a. Electrical fixtures shall be listed to UL Standards for Safety by Underwriters Laboratories Inc. (UL).
   b. Coordinate services requirements and connection point with Division 26 – ELECTRICAL.

1.2 RELATED SECTIONS

A. General Conditions and General Requirements of the Contract for Construction are applicable to the work of this section. Attention is to be given to related work sections, including but not limited to:

B. Section 06 10 00 – ROUGH CARPENTRY: Nailers, blocking and in-wall supports for items of this Section and related work.

C. Section 12 35 52 – COMMON WORK RESULTS FOR LABORATORY FURNITURE AND CASEWORK: Performance, fabrication, installation, and cleaning requirements for work of this Section.

A. Section 12 35 53.13 – METAL LABORATORY CASEWORK: Casework to receive fittings and accessories provided in this section.

B. Section 12 36 53 – LABORATORY COUNTERTOPS: Laboratory epoxy countertops to be installed in conjunction with the work of this Section

C. Division 25 – INTEGRATED AUTOMATION: All fittings, equipment, coordination and controls for integration of laboratory fume hoods with building controls.

D. Division 26 – ELECTRICAL: All electrical fittings, wiring and components, related to work of this and related sections.

1.3 REFERENCES

A. Comply with applicable requirements of the following standards and those others referenced in this Section and Section 12 35 52, under the provisions of Division 1 – GENERAL REQUIREMENTS. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.

1. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE):
   a. ASHRAE Standard 110 - Method of Testing Performance of Laboratory Fume Hoods.
2. Refer to Section 12 35 52 for additional references
3. American Conference of Industrial Hygienists (ACGIH)
   a. *Industrial Ventilation: A Manual of Recommended Practices*.
4. American National Standards Institute (ANSI):
   a. ANSI / AIHA (American Industrial Hygiene Association) Z9.5- Laboratory Ventilation Standard.
5. Scientific Equipment and Furniture Association (SEFA), 5th Edition Desk Reference.
   a. SEFA 1 - *Recommended Practices for Laboratory Fume Hoods.*

B. Regulatory Requirements:
1. OSHA (Occupational Safety and Health Administration) CFR 29 Part 1910.1450 - *Occupational Exposure to Hazardous Chemicals in Laboratories*.

C. Definitions:
1. Refer to Section 12 35 52 for definitions used in this section.

1.4 QUALITY ASSURANCE

A. General: Comply with performance, fabrication, installation, and cleaning requirements of Section 12 35 52 – COMMON WORK RESULTS FOR LABORATORY FURNITURE AND CASEWORK.

B. Sole Source: Obtain products required for the Work of this Section from a single manufacturer, or from manufacturers recommended by the prime manufacturer of fume hoods.

C. General Performance: Provide certification that fume hoods meet the performance requirements described herein.

1.5 SUBMITTALS

A. Submit the following under provisions of Division 1 – GENERAL REQUIREMENTS:
1. Literature: Manufacturer's product data sheets, specifications, performance data, physical properties for fume hoods and associated fixtures and accessories included in the work.
2. Materials schedule: A complete schedule of components supplied under this section, coordinated with the Contract Drawings.
3. Manufacturer’s instructions: Manufacturer’s installation instructions indicating special procedures, requirements for anchoring and supporting work, and conditions requiring special attention.
4. Warranty: Sample warranty for approval, and executed warranty as part of closeout documents.
5. Quality Assurance reports: Literature from fabricators, suppliers, and installers showing compliance with Quality Assurance requirements of Section 12 35 52
   a. Submit test data showing compliance with required finish and function tests described in this section and in Section 12 35 52.
   b. Where other tests are prescribed by the requirements of SEFA 1, SEFA 7, or SEFA 8 for specific elements such as included fixtures and fittings, cabinet

bases, and auxiliary equipment provided under this section, submit all test data in accordance with SEFA standards.

6. Shop drawings for fume hoods, showing plan layout, elevations, ends, cross-sections, service run-spaces, location and type of fixtures and service fittings, together with indication of associated service supply connections required.
   a. Include details and location of anchorages and fitting to floors, walls, and base.
   b. Include layout of units with relation to surrounding walls, doors, windows, lighting and air-conditioning fixtures, connections of hood-to-hood exhaust system, location of access doors, cut-off valves, junction boxes.
   c. Coordinate shop drawings with other trades whose work affects installation or performance of fume hood.
   d. Provide roughing-in drawings for mechanical and electrical services.
   e. Components shall be identified on shop drawings via manufacturer's part numbers, correlated with Materials schedule.
7. Selection samples:
   a. Manufacturer's full line of finishes for fume hood exterior body.
   b. Manufacturer's finish samples for specified hood liners in full range of available finishes.

1.6 SEQUENCING AND SCHEDULING

A. Provide shop drawings and submittals in a timely fashion to permit fabrication of long-lead items and maintain overall construction schedule.

B. Coordinate delivery of fume hoods with delivery of other laboratory casework components.
   1. Coordinate installation of fume hoods and installation of associated MEP systems to prevent fume hoods from being exposed to harmful conditions due to excessive or inadequate airflows, pressure, voltages, or amperages.

1.7 PRODUCT HANDLING

A. Comply with requirements of Section 12 35 52 for delivery, storage, and handling, and for acceptable site conditions for receiving and installing work of this section and of casework supporting work of this section.

1.8 WARRANTY

A. Provide manufacturer's one-year warranty against all defects in material or workmanship. Warranty for any element of the work shall not commence prior to the date of Owner's beneficial occupancy of the space in which the work is installed.

B. Provide longer specific warranties for particular components, as indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design (Specified Manufacturer): To establish a standard of quality, design and function desired, Drawings and specifications have been based on Captair by Erlab

B. Alternate Acceptable Manufacturers: Subject to compliance with performance and function requirements products from the following manufacturers may be provided:

1. Air Science Inc
2. Cleantech, LLC, Orange CA
3. Marketlab, Inc

2.2 PRODUCTS

A. Basis of Design: Erlab Captair Ductless filtering fume hoods
1. 49 5/8” Hood – Erlab Captair 714
a. Provide utilities as indicated on plans.
b. Provide utilities as indicated on Lab Equipment Schedule.

2.3 PERFORMANCE REQUIREMENTS

A. Airfoils:
1. Fume hoods shall be of flush-sill airfoil design to insure maximum operating efficiency and energy conservation. Foil sections at the front facias of the hood shall minimize eddying of air currents at the hood face and the hood interior geometry shall assure containment.

B. Containment:
1. The performance of the bidder’s laboratory fume hood shall be pre-qualified according to ASHRAE 110, as described herein. At their option, the Owner or their designated representatives may require the same tests to be performed and the same performance be achieved before acceptance of the hood after award of contract. The Owner or their representative shall witness the tests. Failure to meet the performance specified shall be cause for rejection of the bidder.
2. Test Method:
a. The hood shall be tested per the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) Standard 110, current edition.
3. Location of Tests and Test Facility: All tests referenced herein shall be performed in the bidder's fume hood test facility..
a. The test facility shall meet the following requirements:
1) The test facility shall have sufficient area so that a minimum of 5 feet of clear space is available in front of and on both sides of the hood for viewing tests.
2) The facility's ventilation system shall have adequate heating and air conditioning so that room air temperatures can be maintained within the desired ranges.
3) Standard room air currents in the test area shall be less than 15 FPM.
4) The hood exhaust system shall be properly calibrated so that the desired exhaust air volumes can be easily attained.
4. Instrumentation, Equipment and Test Personnel: Qualified personnel to perform the tests shall be supplied by the bidder. Instrumentation and equipment required shall be supplied by the bidder at their expense. Required instrumentation shall include but not be limited to the following items:
a. Thermal anemometer capable of measuring air velocities from 10 to 600 ft./minute
b. Three dozen one-half minute smoke candles
c. Four ounces of Titanium Tetrachloride

d. ITI Leakmeter 120 or Miran 103 calibrated to indicate concentration of sulfur hexafluoride or equivalent

e. Flowmeter - 150 ml/minute capacity

f. Flowmeter - 15 L/minute capacity

g. Two size 3 tanks of sulfur hexafluoride with a two-stage regulator or other tracer gas suitable for detector to be used

h. Adjustable mannequin, 5' 0' to 5'8" in height, with reasonable human proportions and arms hanging at its side

i. ASHRAE 110 tracer gas ejector

j. ASHRAE Standard 110 Test:

k. Hood shall be tested with a face velocity of 100 FPM through right, left, and center horizontal sash openings for hoods with sliding and combination sashes, and with a face velocity of 100 FPM per table 1.02.B.2 at a 10" vertical opening right, left, and center for hoods with combination and vertical rising sashes. The hood shall have a performance rating in the static portion of ASHRAE 110 (Section 7.1-7.10) of 4.0 AM 0.01 or better wherein:

1) 4.0 = tracer gas release in liters/minute AM = as manufactured

2) 0.01 = level of control of tracer gas in parts per million (ppm).

5. ASHRAE 110 Perimeter, Sash Movement, and Cross Draft Tests: The hood shall have a maximum perimeter reading (Section 7.11) of 0.01 PPM or less. The hood shall have a maximum sash movement value (Section 7.12) of 0.05 PPM or less. A cross draft to the air input vector of 40 FPM shall be established using a variable speed room air fan. In all specified positions listed in parts 1-6 above, the addition of this cross draft shall not produce a SF6 concentration in the manikin breathing zone greater than 0.05 PPM.

C. Ductless hood operating characteristics

1. The fume hood sash shall be as described in Part 2.4 of this section. Sashes and sash openings to yield the maximum openings detailed in the chart below

2. The maximum exhaust value for each hood shall be as detailed in the following chart.

Nominal hood size (benchtop)	Horiz FPM	Max CFM
40”	100	250
50”	100	390
71”	100	520

2.4 MATERIALS

A. Exterior Panels, Framing Members, and Furring Panels: Cold rolled and levelled mild steel and shall conform to ASTM A1008/A1008M.

B. Exterior Metal Finish: Manufacturer's standard with acid-resistant and alkali-resistant, baked-on finish. Provide in color as selected by Architect from manufacturer's standard range of available colors.

1. Fume hood exterior metal finish shall meet requirements of Section 12 35 52 – Part 2.1-A, Tests 1, 12, 13, 15, 16, and 20.

C. Stainless Steel: AISI Type 316 with No. 4 satin finish.

D. Laminated Safety Glass: Two sheets of clear float glass, complying with ASTM C 1036 requirements for Type I, Class I, Quality q3 glass, permanently laminated to clear polyvinyl butyral interlayer. ¼" nominal total thickness

E. Acrylic Sheet: ¼" nominal thickness clear meeting UL 94 v-0

2.5 COMPONENTS:

A. Hoods to be completely plumbed and wired in the factory and delivered ready for installation and final utility connections. Deliver larger hoods broken down for handling but with each portion plumbed and wired in the factory. Final assembly and utility connections are to be completed as part of installation.

B. Fume hood enclosure:
1. Minimum 18 gauge for exterior panels, closures, and end caps.
2. Minimum 14 gauge for structural elements supporting finish panels or liners.
3. Provide finish on all surfaces, whether or not exposed to view.

C. Vision panels
1. Manufacturer standard chemical resistant vision panels at back and sides.

D. Work surfaces: Provide monolithic worksurface at entire area of fume hood.
1. Epoxy work tops and associated cupsinks where called for shall be as specified under Section 12 36 53 – LABORATORY COUNTERTOPS.
2. Stainless steel work tops shall be integrally fabricated with stainless steel liners, minimum 14ga, channel reinforced to support a load of not less than 200 lb / sf.

E. Filter sets:
1. 4 column filtration, each with
   a. Carbon filters:
      1) Type BE+ - organic vapors and acid vapors
   b. Particulate filters
      1) HEPA H14 – 99.95% efficiency

F. Sashes: The fume hood sash shall be a counterbalanced, narrow framed sash configured as indicated.
1. Vertical and combination sashes shall be configured to permit vertical position sensors.
2. Panels in vertical sashes to be manufacturer's standard chemical resistant acrylic.
3. Sash guides: Track shall be corrosion resistant polyvinyl chloride (PVC).
4. Sash Chain: #35 hardened
5. Sprocket system for Sash Chain: Hardened sprockets with one full width shaft per sash running in ball bearings.

G. Fume Hood Liners and Baffles:

1. Baffle support brackets shall be fabricated from the same material as the liners and baffles.
2. General requirements:
   a. Products shall meet requirements of Section 12 35 52-Part 2.1-A, Tests 1, 12, and 13.
   b. Flame spread of material as measured by ASTM E84 shall be 6.2 or less.
   c. To assure proper punching and coordination with remaining pieces of assembled fume hood superstructure, liner material must be manufactured at the same geographic location and time as the fume hood superstructure
3. Fiberglass Reinforced Polyester Liners (general purpose): Where indicated provide interior liner and baffles consisting of minimum 1/4” thick FRP sheets free from sags, deflection or displacement under normal operation of the hood, and of a neutral color.

H. Electrical Components:
1. Light Switches: Light switch devices shall be integrated with hood controls and shall be UL and CSA approved.
2. Provide integral LED interior lamp to provide 100 foot candles at center of hood work surface. Provide vapor tight 1/4" thick safety glass shield, fixed in place, and access to light fixture via front or top of hood, not through hood working compartment.
3. Electrical service shall be single point connection, hardwired.

I. Screws: Interior fastening devices; stainless steel screws complete with corrosion resistant plastic caps.

J. Controls components::
1. Digital Face Velocity Alarm: Fume hoods shall be provided with an alarm system to detect low hood face velocities. The alarm system shall indicate the actual face velocity of the hood regardless of sash position or orientation. The system shall have an air velocity sensor mounted on the interior side liner of the hood connected to a perforated averaging tube running across the entire front interior of the hood. The velocity monitor shall have a digital display of the air velocity through the hood face in feet per minute. The alarm signals shall activate any time the face velocity falls below the low velocity alarm set point or rises above the high velocity alarm set point. There shall be both visual and audible alarm signals. The audible alarm shall have a mute. The unit shall have local switches for testing and reset. Alarms shall automatically reset when airflow returns to within preset range. Contacts shall be provided for remote monitoring. A scroll-type recorded readout of alarm events for the past hour will also be displayed.
   a. Error of the instrument shall be no greater than +/-10% at 100 FPM. A confirming test at constant volume 10" vertical and right, center, and left horizontal positions shall be conducted as part of start up for all fume hoods.
2. Sash position Alarm: Fume hoods shall be provided with sash position sensors capable of reporting with +/- ¼” accuracy the height of vertical sashes, and the lateral position of horizontal sashes. Contacts shall be provided for remote monitoring. Sash position alarm shall provide an audible and visual alarm when sash is opened beyond preset position. Provide sash alarms with test, reset, silence (for audible alarm only) switches
3. Fan failure alarm: Fume hoods shall be provided with alarm system to indicate failure of fans, and fan failure alarms shall be provided for each fan in banked fan systems.

4. Filter saturation: Ductless fume hoods shall be provided with filter saturation detection capable of reporting filter saturation from none to total, and providing an audible and visual alarm for saturations above a user pre-set point.

2.6 FABRICATION

A. General: Design hoods to be highly fume resistant, to collect, retain and dispose of hazardous fumes with complete safety, minimum purging of air from room supply, and minimum turbulence within hood chamber.

1. Provide fume hoods with service fittings loose for installation in base cabinets below by other trades.

B. Fume hood enclosure:

1. Superstructure: Freestanding heavy gage steel members, reinforced, braced and assembled to insure strength and rigidity and to support exterior panels, interior liner, and baffle panels.

A. Superstructure shall allow for exterior and interior liner panels to be removable without disassembly of the frame structure or adjacent panel assemblies.

2. Enclosure: Fabricate exterior of minimum 18-gage cold-rolled steel with component parts screwed together to allow removal of end panels, front-end fascia pieces, top fascia and airfoil strips, and to allow access to plumbing lines and service fittings.

a. Provide finished side and back panels at all locations where sides and backs of enclosures would otherwise be visible.

b. Exposed panels shall be removable without requiring access to the interior working space of the fume hood.

C. Liner and Baffles: Liner shall be continuous at all interior faces of hood, with all joints sealed and any openings or access panels closed and gasketed with compatible materials. Arrange baffles, to provide adequate containment and airflow within the fume hood at all heights above the work surface.

D. Working Surface: Fabricate working surface with marine edge to form a watertight pan not less than 3/8 inch deep and with a 6 inch wide safety ledge along the front edge.

E. Fume hood alarms and controls system: Install face velocity alarms and sash position alarms at front of unit within user reach range. Provide RJ45 connection for remote alarm.

F. Assembled fume hood components shall be given a pre-paint treatment for adhesion of the final finish system and to aid in the prevention of corrosion due to humidity or presence of chemicals. Physical and chemical cleaning of the steel shall be accomplished by washing with an alkaline cleaner, followed by a spray treatment with a complex metallic phosphate solution to provide a uniform fine-grained crystalline phosphate surface.

G. After pre-paint treatment has fully cured provide all steel surfaces with a chemical and corrosion resistant, environmentally friendly, electrostatically applied powder coat finish. All components shall be individually painted, insuring that no area be vulnerable to corrosion due to lack of paint coverage. The coating shall then be cured by baking at elevated temperatures to provide maximum properties of corrosion and wear resistance.

2.7 ACCESSORIES

A. Sash Stops: Provide fume hoods with sash stops to limit sash opening to 18”.

1. Sash stops shall be able to be manually released to open sash fully for cleaning hood and for placing large apparatus within hood.
2. Sash stop release shall be visible and usable from outside the hood enclosure.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fume hoods, plumb, level, rigid, securely anchored to building and adjacent furniture in proper location, in accordance with manufacturer's instructions and the approved shop drawings. Provide filler panels between top of hood and ceiling. Securely attach access panels but provide for easy removal and secure reattachment. Do not install any damaged units.

3.2 FIELD QUALITY CONTROL

A. Field Test: Field test each fume hood after completion of installation to verify proper operation of hoods.

B. Field test hoods according to fume hood standard after completing installation to demonstrate proper operation according to ASHRAE Standard 110 to verify performance.
   1. Adjust fume hoods, and coordinate with the responsible trade for adjustment of hood exhaust fans and building's HVAC system, or replace hoods and make other corrections until tested hoods perform as specified.
   2. After making corrections, retest fume hoods that failed to perform as specified.

3.3 ADJUSTMENT, PROTECTION, AND CLEANING

A. General: Do not permit debris or rubbish to accumulate inside hood enclosures – promptly remove all rubbish and debris from work area.

B. After installation, protect all exposed finishes or components until final cleaning and acceptance.

C. Moving Parts: Carefully check and adjust moving parts to insure smooth, near-silent, and accurate sash operation with one hand and with uniform contact of rubber bumpers; ensure counter-balances operate without interference.

D. Clean surfaces, including both sides of glass prior to turnover.

E. Damaged Work: Repair equal to new undamaged work, or replace with new units, as acceptable to Architect.

END OF SECTION

SECTION 11 53 43
SERVICE FITTINGS AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install:

1. Service outlets, accessory fittings, electrical receptacles and switches, as indicated or shown on equipment schedules or Drawings.
   a. Service turrets at wall and countertop locations indicated on plans.
   b. Provide ADA compliant fittings at all ADA-compliant sinks and fume hoods, at 1/6 of movable tables and modular benches, and where indicated.

B. Provide overhead service panels for services to movable casework and tables where indicated, including class labs and project labs.

1. Ceiling and Wall Mounted Service Panel:
   a. Size: Refer to drawings for layouts. Panels are nominal 12” x 12”, 12” x 18” or 12” x 24” module to coordinate with acoustical ceiling trim. Color: white to match ceiling system metal trim.
   b. Each service panel shall be provided with devices and cut-outs as required for electrical, data, vacuum and air. Casework manufacturer is responsible to coordinate for appropriately sized device cutouts.
   c. Vacuum and air fittings to be quick disconnect type with white hoses from the student table to the fitting at the ceiling service panel. Lab vendor to provide the quick disconnect fitting and hose. Plumber to install fitting at ceiling service panel.
   d. Electrical device shall be provided with a twist lock receptacle. Refer to drawings for service panel types and layout. Services to include 110V and 208V power receptacles.
   e. Tele/Data: Provide cut-out for data service, using a single gang backbox for a two-port outlet. Casework manufacturer is responsible for cutouts and coordinating the cutout to the appropriate size for the specified devices. Coordinate with related electrical documents. Provide the number of tele/data white service drops to student tables as are indicated on drawings.
2. Provide metal universal strut system framing to support ceiling panels.

C. Furnish the following products to specified trades for installation on site.

1. General:
   a. Furnish electrical service fixtures, including nipples, required for mounting in or on fume hoods, modular casework, or other equipment. Furnish all fixtures unattached and unassembled to the installing subcontractor properly tagged and identified with installation information.
   b. Plumbing fittings mounted on the fume hood superstructures shall be pre-plumbed as specified under Section 11 53 13.
   c. Fixtures and fittings incorporated into tables and movable casework shall be pre-piped, pre-wired and shop installed as specified under Section 12 35 53.13
   d. Factory prewire electrical fixtures provided for fume hoods and for other integral fittings in student tables or benches ready for final service connections on-site by licensed electrician.

2. Recessed wall mounted combination eyewash/safety showers.
   a. Furnish to Division 22 - Plumbing for installation.
3. Othe plumbing and gas fixtures and fittings, including
   a. Nipples and locknuts, required for mounting in or on the equipment.
   b. All fixtures delivered unattached and unassembled, properly tagged and identified with installation information.
4. Light fixtures including switches, integral convenience receptacles and other components, for installation in or on the equipment. Fixtures and fittings that are a functional integral part of the equipment shall be factory installed and pre-wired.

D. Refer to laboratory table and modular casework details for required service fixtures and service lines at all movable units.
   1. Provide fixtures and fittings under this section for field installation by appropriate trades, or for shop installation in casework fabricator's facility.

1.2 RELATED SECTIONS:

A. General Conditions and General Requirements of the Contract for Construction are applicable to the work of this section. Attention is to be given to related work sections, including but not limited to:

B. SECTION 11 53 00 – LABORATORY EQUIPMENT: Requirements for equipment supporting or supported by countertops of this section..

C. Section 12 35 52 – COMMON WORK RESULTS FOR LABORATORY FURNITURE AND CASEWORK: Performance, fabrication, installation, and cleaning requirements for work of this and related sections.

D. Section 12 35 53.13 – METAL LABORATORY CASEWORK: Casework to receive fittings and accessories provided in this section.

E. Section 12 36 53 – LABORATORY COUNERTOPS Performance, fabrication, installation, and cleaning requirements for countertops to receive work specified under this section.

F. Division 22 –PLUMBING: Piped services connections for work of this and related sections.

G. Division 26 – ELECTRICAL: All electrical fittings, wiring and components, related to work of this and related sections.

H. Division 27 – COMMUNICATIONS: All electrical fittings, wiring and components for IT and low voltage communications connections to work of this and related sections.

1.3 REFERENCES

A. Reference Standards: Comply with applicable requirements of the following standards and those others referenced in this Section and Section 12 35 52, under the provisions of Division 1 – GENERAL REQUIREMENTS. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.
   1. Scientific Equipment and Furniture Association (SEFA), 5th Edition Desk Reference:
      a. SEFA 2 - Recommended Practices for Installation.
      b. SEFA 7 - Recommended Practices for Fixtures.
   2. Refer to Section 12 35 52 for additional references

B. Definitions

1. Refer to Section 12 35 52 for definitions used in this section.

1.4 QUALITY ASSURANCE

A. General: Comply with performance, fabrication, installation, and cleaning requirements of Section 12 35 52 – COMMON WORK RESULTS FOR LABORATORY FURNITURE AND CASEWORK.

1.5 SUBMITTALS

A. Submit the following under provisions of Division 1 – GENERAL REQUIREMENTS:

1. Literature: Manufacturer's product data sheets, specifications, performance data, physical properties for items included in the work.
2. Materials schedule: A complete schedule of components supplied under this section, coordinated with the Contract Drawings.
3. Manufacturer's instructions: Manufacturer's installation instructions indicating special procedures, requirements for anchoring and supporting work, and conditions requiring special attention.
4. Warranty: Sample warranty for approval, and executed warranty as part of closeout documents.
5. Quality Assurance reports: Literature from fabricators, suppliers, and installers showing compliance with Quality Assurance requirements of Section 12 35 52
   a. Submit test data showing compliance with required finish and function tests included in Section 12 35 52. As appropriate for the type of product supplied
   b. Where other tests are prescribed by the requirements of SEFA 7 for specific fittings required (including but not limited to temperature and pressure shock tests for faucets, pressure and leak tests) submit all test data in accordance with SEFA standards.
6. Shop Drawings in sufficient detail to show fabrication, installation, anchorage, and interface of the work of this Section with the work of adjacent trades.
   a. Include detailed shop drawings for overhead service panels showing configuration of service fixtures and service fittings, and clearances for maintenance and operation of all fittings
   b. Components shall be identified on shop drawings via manufacturer's part numbers, correlated with Materials schedule.
7. Selection samples:
   a. Manufacturer's full line of standard colors for powder coated finishes.
8. Operations and maintenance materials and manuals for all installed work.

1.6 SEQUENCING AND SCHEDULING

A. Provide shop drawings and submittals in a timely fashion to permit fabrication of long-lead items and maintain overall construction schedule.

1.7 PRODUCT HANDLING

A. Comply with requirements of Section 12 35 52 for delivery, storage, and handling, and for acceptable site conditions for receiving and installing work of this section and of casework supporting work of this section.

1.8 WARRANTY

A. Provide manufacturer's two year warranty against all defects in material or workmanship. Warranty for any element of the work shall not commence prior to the date of Owner's beneficial occupancy of the space in which the work is installed.

B. Provide longer specific warranties for particular components, as indicated.

PART 2 - PRODUCTS

2.1 GENERAL REQUIRMENTS

A. Service fixtures shall comply with SEFA 7, "Laboratory and Hospital Fixtures-Recommended Practices." Handles shall be color coded with matching color tabs identifying utility. Serrated hose ends shall have seven (7) serrations.

B. Fixture finishes shall be consistent across all fixtures of similar type provided in the work:

1. Powder coated finishes shall meet requirements of Section 12 35 52 – Part 2.1-A Test 16 and Test 18.
2. Chromed or metallic finishes shall meet requirements of Section 12 35 52 – Part 2.1-A, Tests 17 and 18.

C. Fixtures shall be tested to meet requirements of Section 12 35 52 – Part 2.1-A Test 19.

D. Fixtures shall meet any additional test requirements for the specific fixture type as indicated in SEFA-7 standard.

E. Fixtures for gas, air and vacuum shall be needle valve, large type. Water fixtures shall be compression type. Water fixtures shall have integral vacuum breaker. Drain fittings shall be polypropylene unless otherwise noted. Fixtures that serve special gases (N2, O2, NO2,etc.) and instrument air shall be lubricated, cleaned, capped, protected, and delivered certified for "Oxygen" service.

F. Provide fittings complete with washers, locknuts, nipples and other installation accessories. Include the deck flanges, escutcheons, handle extension rods and similar items.

G. Provide units that comply with recommendations in SEFA 7, Section 11, "Vandal-Resistant Faucets and Fixtures." where indicated

2.2 SERVICE IDENTIFICATION

A. Fixtures for liquids and gaseous mixtures shall have lettered and colored indexes for each service. Index buttons shall be mounted in valve and fixture handles and shall identify the service at the fixture through standardized color coding and lettering. All fixtures are required to have index buttons, even for fixtures where the handle body is color coded.

1. For special or unusual services not listed below, confirm coding requirement with Owner and Architect and provide custom color and lettering.
2. Color codes

	Service	Button Color	Lettering
a.	Hot Water	Red	HW
b.	Cold Water	Green	CW
c.	Process Chilled Water Supply	Green	CHWS
d.	Process Chilled Water Return	Green	CHWR
e.	RODI (Reagent Grade) Water	White	PW

1) Use “DI”, “RO”, and “DW” tags for deionized (only) water, Reverse osmosis treated (only) water and distilled (only) water where separate types of water treatment systems are provided.

f.	Compressed Air	Orange	CA
g.	Low Pressure Air	Orange	AIR
h.	Vacuum	Yellow	VAC
i.	High Vacuum	Yellow	HVAC
j.	Low Vacuum	Yellow	LVAC
k.	Steam	Black	STM
l.	Natural Gas	Blue	GAS
m.	Oxygen	Light Green	OXY
n.	Argon	Violet	AR
o.	Nitrogen	Brown	NIT
p.	Helium	Black	HE
q.	Hydrogen	Pink	HYD
r.	Acetylene	Violet	ACET
s.	Ammonia	Light Green	NH3
t.	Carbon Dioxide	Pink	CO2
u.	Carbon Monoxide	Silver	CO
v.	Special Gas (other)	Light Blue	SG

B. Electrical outlets, disconnects, switches, and connection points to equipment shall be tagged with circuit information in accordance with labeling requirements of Division 26.

C. Low voltage fixtures for telecommunications, data, audiovisual systems or security shall be tagged with information in accordance with labeling requirements of Division 27 and Division 28 specifications.

2.3 MANUFACTURERS

A. Plumbing and Piped Service Fixtures: To establish a standard of appearance, performance, and function, fixtures are based on Water Saver Faucet Company, Chicago, IL

B. Alternate manufacturers for plumbing and piped services: Subject to compliance with requirements, alternate products may be supplied by:

1. WaterSaver Faucet Company, Chicago, IL
2. Chicago Faucet Company, Des Plaines, IL
3. T & S, Travelers Rest, SC.

C. Electrical and Low Voltage Fixtures : To establish a standard of appearance, performance, and function, fixtures are based on Hubbell, Shelton, CT and Fisher Scientific, Waltham, MA

D. Alternate manufacturers for electrical and low voltage fixtures: Subject to compliance with requirements, alternate products may be supplied by:

1. Hubbell, Shelton CT
2. Eaton, Dublin, Ireland
3. Carlon, Brookfield, WI
4. Thomas Scientific, Swedesboro, NJ

2.4 MATERIALS

A. Plumbing Fixtures:

1. Water fixtures: gooseneck type with laboratory serrated hose nozzles and furnished with integral vacuum breakers. Provide with 2-gallon per minute flow regulators.
   a. Deck mounted single stem BOD: L414VB (L414VB-BH with hose barb at accessible sinks)
2. Water fixtures: for mounting at fume hoods
   a. Hood mounted outlet BOD: L071VB-WSA (Color coded finish)
   b. Hood mounted valve BOD: L3185 / L2885 for straight or angled applications
   c. Hood mounted valve BOD: L4285(H or V) for ADA applications
3. Water fixtures: Pre-rinse units with integral vacuum breaker
   a. Deck mounted single stem BOD: PR411-110 (PR411-110-BH with blade handles at accessible locations)
   b. Wall mount drench hose BOD: EW1016BP-VB. Furnish with LV214-WSA (less gooseneck) in lieu of TMV.
4. Pure Water fixtures: gooseneck type with laboratory serrated hose nozzle, diaphragm valve with brass stem and bonnet and inert elastomer diaphragm. Fully lined with inert polypropylene.
   a. Deck mounted BOD: L7853. Provide blade handles for ADA-compliant locations.
5. Safety shower and eyewash units:
   a. Deck mount eyewash / drench hose BOD (EW-1) : EW1022.
   b. Deck mounted unit, BOD (EW-2): Watersaver EWBF849 Barrier-Free Eyewash, Deck Mounted, AutoFlow™ 90º Swing-Down. (Handing varies with sink layout.)
   c. Wall mounted safety station with shower and pull-down eyewash, BOD (SS-1): WaterSaver SSBF2152, recessed installation.
      1) Provide SSBF2352 where unit is installed in a fire rated partition.
   d. Wall mounted safety station with shower and pull-down eyewash, BOD (SS-2): WaterSaver SSBF2173, surface mounted .
6. Furnish showers with polished chrome plated brass shower supply pipe for exposed length of run
7. Modesty curtains at safety showers, where indicated, shall be AP250-065, with stainless steel track, white polyester curtain with integral pocket and modesty smock, and tie backs for each curtain segment.

B. Needle Valves (Large): Provide large needle valves with a renewable valve seat and floating cone made of stainless steel or Monel metal with removable serrated outlet.
   1. Single wall mount BOD: L4880FT-325 by WaterSaver
   2. Double Wall mount BOD: L2880-141FT by WaterSaver
   3. Single deck mount BOD: L2880-131WSA by WaterSaver
   4. Double deck mount BOD: L2880-132AWSA by WaterSaver

C. Ball Valves (Large): Provide large ball valves with a renewable valve seat and with removable serrated outlet.
   1. Single wall mount BOD: L4200FT-325 by WaterSaver
   2. Double Wall mount BOD: L4200141FT by WaterSaver
   3. Single deck mount BOD: L4200-131WSA by WaterSaver
   4. Double deck mount BOD: L4200-132AWSA by WaterSaver

D. Fixtures at fume hoods: Provide remote control valves of type indicated, and outlets of type indicated. Needle or ball valves as indicated for specific service provided.

1. Hood mounted valve BOD: L3185 / L2885 for straight or angled needle valve applications
2. Hood mounted valve BOD: L4285(H or V) for ball valves and all ADA applications
3. Hood mounted outlet BOD: L2022WSA for hose barb connections.
4. Hood mounted outlet BOD: L2023WSA for quick connects.
5. Hood mounted outlet BOD: L2024WSA for ¼" OD compression fitting connections.

E. Fixtures for movable casework and tables:

1. Unless otherwise indicated, turrets, valves, fixtures and fittings mounted on movable casework shall match products used at fixed casework.
2. Quick Connects: Provide stainless steel bodies, with internal shut off that automatically closes when valve is disengaged, Provide color coding on quick connect bodies and receptacles to match color coding on piped services. Quick connects shall employ a keying system based on inner and outer diameter of the body and plug sleeve to prevent inadvertent cross connections.
   a. Basis of design: WaterSacer QCBL or QCFL for loose or panel mounted bodies.
   b. Water Saver QCD plugs.
3. Hose assemblies: PVC core, nylon braided reinforcement layer and PVC jacket, with swivel end connections permanently attached with barb or crimped ferrule to accept required quick connect as well as attachment to piped services.
   a. Basis of design WaterSaver Color Coded Hoses.
      1) Provide all white hoses, color coding only at quick connects.

F. Faucet Accessories: Cup sink and RODI water faucets to have serrated hose ends. Faucets are to be swivel type except reagent grade water.

G. Vacuum Breakers: ASSE 1035 Integral vacuum breakers, shall be supplied on all water fixtures. The fume hood fixture shall have the vacuum breaker exposed 7 ft A.F.F. on face of hood (exposed vacuum breaker and piping to have same finish as other fixtures). The vacuum breaker for the eye wash fixture shall be located under the sink cabinet, visible when the cabinet doors are open.

H. Electrical fixtures: Provide required holes or cut-outs where indicated on all cabinetwork or table tops. Provide receptacle boxes at base cabinets, tables and aprons as shown on Drawings.

1. Pedestal boxes shall be cast aluminum type.
   a. Pedestal Box BOD: Fisherbrand Custom Electrical Box, 2 chamber / 4 gang design, black epoxy finish, 1 or 2 ¾" conduit nipples as required by services provided.. Provide stainless steel cover plates to match services in each box. Provide blank cover plates at unused positions.
2. Receptacle (outlet) boxes: Galvanized of a type best adaptable to intended use, in general 4 inch square or octagon.
   a. Basis of Design: Raco series, Hubbell/Kellems, in sizes required for NEC compliance for services provided.
   b. Coordinate locations of receptacle boxes with Electrical Drawings.
   c. Boxes shall be solid flush type, square cornered, 1-2-3 and 4-gang, as required.

d. Provide boxes with only the holes necessary to accommodate the conduits connected. All boxes shall be furnished with lugs or ears for attachment of covers, and outlet devices.

3. Plates shall be polished stainless steel.

4. Pull and junction boxes: Galvanized code steel construction with removable cover plate secured by 1/4-inch brass machine screws, conforming to the requirements of the National Electrical Code.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install service fittings plumb, level, rigid, in accordance with manufacturer's instructions and approved shop drawings.

1. At all fixtures and fittings mounted in or on metal stud framed walls, provide blocking across the full width of the stud bay at the fixture location and support immediately at the turn to the outside face of wall.

2. Coordinate installation and pre-piping for fixtures at fume hoods with provider. Pre-pipe and pre-install components in fume hoods to the greatest extend possible.

B. Coordinate installation and testing of fittings with trades providing connections to service lines.

C. Clean, lubricate as necessary, and test all operable parts after installation. Protect installed fixtures and fittings from damage.

END OF SECTION

SECTION 122413 - ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes

1. Manual operation blackout shades.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions.

B. Shop Drawings: Show location and extent of roller shades. Include elevations, sections, details, and dimensions not shown in Product Data. Show installation details, mountings, attachments to other Work, operational clearances, and relationship to adjoining work

C. Samples for Verification:

1. Shade Material: Not less than 12-inch- (300-mm-) square section of fabric, from dye lot used for the Work, with specified treatments applied. Show complete pattern repeat. Mark top and face of material.

1.3 INFORMATIONAL SUBMITTALS

A. Maintenance Data: For roller shades to include in maintenance manuals. Include the following:

1. Methods for maintaining roller shades and finishes.
2. Precautions about cleaning materials and methods that could be detrimental to fabrics, finishes, and performance.
3. Operating hardware.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed installation of roller shades similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance

B. Source Limitations: Obtain roller shades through one source from a single manufacturer.

C. Fire-Test-Response Characteristics: Provide roller shade band materials with the fire-test-response characteristics indicated, as determined by testing identical products

per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. Flame-Resistance Ratings: Passes NFPA 701.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver shades in factory packages, marked with manufacturer and product name, fire-test-response characteristics, and location of installation using same room designations indicated on Drawings and in a window treatment schedule.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install roller shades until construction and wet and dirty finish work in spaces, including painting, is complete 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 operable glazed units' operation hardware throughout the entire operating range.

1.7 WARRANTY

A. Shadecloth: Manufacturer's standard non-depreciating twenty-five year limited warranty.

PART 2 - PRODUCTS

2.1 BASIS OF DESIGN PRODUCTS

A. Manual Single-Roll Shades: Provide RB 500+ Manual Shades by Hunter Douglas Architectural

1. Other Acceptable Products:
   a. UrbanShade Manual System by MechoShade.

2.2 MATERIALS

A. Room Darkening Fabric, Opaque Type: Opaque fabric 0% open style fabricated from 100% polyester with acrylic coating, .016 inches thick; provide Phifer SheerWeave 7500 or equal.

1. Color: Cloud.
2. Other Acceptable Product: MechoShade Classic Blackout 0700 Series, Light Grey 0702.

B. Brackets: Plated steel, with adequate projection to clear all window fixtures

C. Aluminum Extrusions: Alloy and temper recommended by manufacturer for use intended and as required for proper application of finish indicated but not less than the strength and durability properties specified in ASTM B 221 for 6063-T5.

2.3 FABRICATION

A. Product Description: Roller shade consisting of a roller, a means of supporting the roller, a flexible sheet or band of material carried by the roller, a means of attaching the material to the roller, a bottom bar, and an operating mechanism that lifts and lowers the shade

B. Components: Noncorrosive, self-lubricating materials.

C. Rollers: Electrogalvanized or epoxy primed steel or extruded-aluminum tube of diameter and wall thickness required to support and fit internal components of operating system and the weight and width of shade band material without sagging; designed to be easily removable from support brackets; with manufacturer's standard method for attaching shade material.

D. Direction of Roll: Regular, from back of roller.

E. Mounting Brackets:

1. Single Roll Shades: Galvanized or zinc-plated steel, style for between jamb mounting unless otherwise indicated.

F. Fascia: L-shaped, formed-steel sheet or extruded aluminum; long edges returned or rolled; continuous panel concealing front and bottom of shade roller, brackets, and operating hardware and operators; length as required for between the jambs mounting; removable design for access.

G. Bottom Bar: Steel or extruded aluminum, with plastic or metal capped ends. Provide concealed, by pocket of shade material, internal-type bottom bar with concealed weight bar as required for smooth, properly balanced shade operation.

H. Manual Shade Operation: Bead chain clutch operator.

1. Bead Chain Material: Stainless steel chain with minimum 110 lb. breaking strength.
2. Operator Location: On left or right side of shade as directed by Architect for each location.

I. Shade Units: Obtain units fabricated in sizes to fill window and other openings as follows, measured at 74 deg F (23 deg C):

1. Shade Units Installed between (Inside) Jambs: Edge of shade not more than 1/4 inch (6 mm) from face of jamb. Length equal to head to sill dimension of opening in which each shade is installed.

2. Shade Units Installed Outside Jambs: 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.

J. Installation Fasteners: Fabricated from metal that is noncorrosive to shade hardware and adjoining construction and to support shades as required by manufacturer's written instructions.

K. Color-Coated Finish: For metal components exposed to view, apply manufacturer's standard baked finish complying with manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.

L. Colors of Metal and Plastic Components Exposed to View: As selected by Architect from manufacturer's full range unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, , and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected

3.2 ROLLER SHADE INSTALLATION

A. Install roller shades level, plumb, square, and true according to manufacturer's written instructions, and located so shade band is not closer than 2 inches (50 mm) to interior face of glass. Allow clearances for window operation hardware.

B. Install metal parts isolated from concrete or mortar to prevent corrosion.

C. Install mounting brackets with not less than 2 fasteners per bracket.

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.

END OF SECTION 122413

SECTION 12 35 52
COMMON WORK RESULTS FOR LABORATORY FURNITURE AND CASEWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Performance, fabrication, installation, and cleaning requirements for laboratory furniture, casework, countertops, equipment, and service fixtures.

1.2 RELATED SECTIONS:

A. Section 11 153 00 – LABORATORY EQUIPMENT.

B. Section 11 53 13 – LABORATORY FUME HOODS.

C. Section 11 53 43 – SERVICE FITTINGS AND ACCESSORIES.

D. Section 12 35 53.13 – METAL LABORATORY CASEWORK.

E. Section 12 36 53 – LABORATORY COUNTERTOPS.

F. Division 22 –PLUMBING: Piped services connections including but not limited to air, vacuum, potable and non potable water, drains and vents, natural gas, and laboratory gasses.

G. Division 23 – HEATING, VENTILATING AND AIR CONDITIONING: Ductwork for exhaust, including fume hoods, snorkels, biosafety cabinets, and ventilated cabinets or enclosures.

H. Division 25 – INTEGRATED AUTOMATION: All fittings, equipment, coordination and controls for integration of laboratory furniture and casework elements with building controls.

I. Division 26 – ELECTRICAL: All electrical fittings, wiring and components, complete, including all connections.

J. Division 27 – COMMUNICATIONS: All electrical fittings, wiring and components, complete, including all connections for coordination with IT and low voltage communications.

1.3 REFERENCES

A. Comply with applicable requirements of the following standards and those others referenced in this Section, under the provisions of Division 1 – GENERAL REQUIREMENTS. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.

1. American National Standards Institute (ANSI):
   a. ANSI A208.1-Particleboard
   b. ANSI A135.4-Basic Hardboard
   c. ANSI / HPVA HP-1 American National Standard for Hardwood and Decorative Plywood.
   d. ANSI Z97.1 – Safety Glazing Materials Used in Buildings
2. American Society for Testing and Materials (ASTM):
   a. ASTM A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

b. ASTM A312 - Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
c. ASTM D570 - Standard Test Method for Water Absorption of Plastics
d. ASTM D695 - Standard Test Method for Compressive Properties of Rigid Plastics
e. ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
f. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials
g. ASTM A554 - Standard Specification for Welded Stainless Steel Mechanical Tubing
h. ASTM A513 - Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing
i. ASTM A1008 - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable
j. ASTM C 518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
k. ASTM D 523 - Standard Test Method for Specular Gloss.
l. ASTM D 552 – Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings
m. ASTM D 3359 – Standard Test Methods for measuring Adhesion by Tape Test – Test Method B
n. ASTM B456 Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium
o. ASTM B751 “Standard Test Method for Adhesion Testing of Metallic Coatings”

3. Builders Hardware Manufacturers Association (BHMA)
   a. BHMA / ANSI A156.9 – Cabinet Hardware
4. National Electrical Manufacturers Association (NEMA):
   a. NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum).
5. Fenestration and Glazing Industry Alliance (FGIA)
   a. FGIA 621 - Voluntary Specifications for High Performance Organic Coatings on Coil Coated Architectural Hot Dipped Galvanized (HDG) and Zinc Aluminum Coated Steel Substrates (Withdrawn)
6. National Glass Association (NGA)
7. National Fire Protection Association (NFPA)
   a. NFPA 30 Flammable and Combustible Liquids code
   b. NFPA 55 Compressed Gases and Cryogenic Fluids Code
   c. NFPA 70 National Electrical Code
   d. NFPA-45 – Standard on Fire Protection for Laboratories using Chemicals.
8. Scientific Equipment and Furniture Association (SEFA), 5th Edition Desk Reference, Version 4.0:
   a. SEFA 1: Laboratory Fume Hoods
   b. SEFA 2: Installation Requirements

c. SEFA 3: Work surfaces

d. SEFA 7: Laboratory and Hospital Fixtures

e. SEFA 8: Laboratory Furniture-Casework-Shelving and Tables – Recommended Practices

f. SEFA 9: Ductless Enclosures

g. SEFA 10 Adaptable Casework Systems

1.4 DEFINITIONS

A. ***Exposed Surfaces of Casework***: Surfaces visible when doors and drawers are closed, including bottoms of cabinets more than 48 inches (1200 mm) above floor, and visible surfaces in open cabinets or behind glass doors.

1. Ends of cabinets are defined as "exposed" even when installed against adjacent construction.

B. ***Semiexposed Surfaces of Casework****:* Surfaces behind opaque doors, such as cabinet interiors, shelves, and dividers; interiors and sides of drawers; and interior faces of doors. Tops of cabinets 78 inches (1980 mm) or more above floor are defined as "semiexposed."

C. ***Concealed Surfaces of Casework***: Concealed surfaces include sleepers, web frames, dust panels, and other surfaces not usually visible after installation.

D. ***Service Fixtures and Service Fittings:*** Plumbed or piped fittings and fixtures include specialty gas, natural gas, air, vacuum, and steam cocks, turrets, hot, cold and distilled water faucets, remote controlled valves, vacuum traps, vacuum breakers, eye washers, shower heads, sinks, cup sinks, traps and dirt traps. Wired or powered fittings and fixtures include electrical convenience outlet boxes, electrical pedestals, “C” type conduits, single or duplex A.C. or D.C. receptacles, switches, variable voltage units, LED lighting and fluorescent tube luminaires, and low-voltage receptacles for data, alarm connections, or security.

E. ***Service Lines*** Plumbed or piped service lines include gas, air, vacuum, hot, cold, reagent grade and reference grade water piping, drain lines, fittings and shut off valves necessary to carry respective services from building roughing-in floors or walls through equipment to the ***service fixture or service fitting.*** Wired or powered service lines include conduit, junction boxes, conduit fitting, wire disconnect switches and fuse or circuit breakers necessary to carry electrical services from building roughing-in outlets in floors or walls through equipment to ***service fixture or service fitting***

F. ***Standards*** are wall mounted, single and twin-tracked vertical shelf supports for attachment to walls or casework.

G. ***Brackets*** are supporting elements intended to anchor shelves to ***standards***, and may be below or above the surface of the shelf itself.

1.5 QUALITY ASSURANCE

A. Fabricators / Suppliers: Fabricators / suppliers of casework and related elements shall be a SEFA member, shall have completed not less than 3 projects of similar size, complexity, and technical requirements in the last 3 years.

B. Installer: Installer shall be certified by the fabricators / suppliers, and hall have completed not less than 3 projects of similar size, complexity, and technical requirements in the last 3 years.

C. Lab casework elements are included under multiple specification sections. It is the responsibility of the contractor to assemble a complete submittal package cross-referencing all specification sections and requirements and showing a complete casework package.

D. Installer shall coordinate delivery of all components of the work to ensure proper staging and shipment, and permit shop assembly, where possible, in installer's facilities. Installer hall confirm, prior to components of work arriving in field, that they are coordinated as to sizes, placement of fixtures and fittings, layouts, and other coordination issues.

E. Installer and contractor shall coordinate the work of the laboratory casework package with work of mechanical, electrical, plumbing, low voltage, and fire alarm trades to ensure timely installation of all service line connections, and all necessary inspections of same.

1.6 PRE-INSTALLATION CONFERENCE

A. Pre-installation Conference: Conduct a pre-installation conference at the Project Site at least two weeks before scheduled delivery of laboratory equipment, furniture and casework. Coordinate time of meeting to occur prior to installation of work under the related sections named below.

1. Required attendees: Architect/Engineer, Contractor, vendor(s) and installer(s) of laboratory equipment, furniture and casework. Additionally, representatives of other related trades shall attend as directed by the Architect or Contractor, and representatives for installers of related work specified under the following Sections:
2. Division 22 –PLUMBING
3. Division 23 – HEATING, VENTILATING AND AIR CONDITIONING
4. Division 25 – INTEGRATED AUTOMATION
5. Division 26 – ELECTRICAL
6. Division 27 – COMMUNICATIONS
7. Agenda:
   a. Scheduling for delivery, and installation of laboratory equipment, furniture and casework.
   b. Review of staging and material storage locations, and temporary protection of stored items.
   c. Ambient conditioning and environmental controls.
   d. Coordination of related work.
   e. Protection of installed laboratory equipment, furniture and casework.
8. Delivery and installation of laboratory equipment, furniture and casework may only proceed when everyone concerned agrees that required ambient conditions can be maintained.

1.7 FIELD MEASUREMENTS

A. Dimensions: The casework vendor is responsible for details and dimensions not controlled by Project conditions and shall show on the shop drawings all required field measurements beyond the vendor's control.

B. Field Measurements: Where casework is indicated to fit to other construction, verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings.

1. The casework vendor shall confirm all dimensions at the Project site relative to casework, all, and bring any significant discrepancies to the attention of the Architect prior to casework fabrication.

C. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating the casework without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions

1. The Contractor shall acknowledge the casework vendor's need for accurate field dimensions prior to custom fabrication.
2. The Contractor and the casework vendor shall cooperate to establish and maintain these field dimensions.

1.8 SCHEDULING AND COORDINATION

A. Coordinate the work of this Section with the respective trades responsible for installing interfacing work and ensure that the work performed hereunder is acceptable to such trades for the installation of their work.

1.9 DELIVERY, STORAGE AND HANDLING

A. Delivery and Acceptance Requirements:

1. Do not deliver items to the site, until all specified submittals have been submitted to, and approved by, the Architect.
2. Do not deliver or install laboratory equipment, furniture and casework until environmental limitations are in compliance, as specified herein under "Site Conditions".

B. Delivery and Storage: Deliver materials under protective cover and store within dry enclosed space.

C. Protection: Use all means necessary to protect materials of this Section during transition, before, during, and after installation and to protect installed work and materials of all other trades.

1. Store under cover in a ventilated building not exposed to extreme temperature and humidity changes.
2. Do not deliver casework to site until all concrete and masonry work is dry. Do not begin installation until veneer plaster has fully cured and is dry.

D. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect, at no change in Contract Sum.

1.10 SITE CONDITIONS

A. General: The laboratory equipment, furniture and casework supplier(s), installer(s) and the Contractor are together jointly responsible to make certain that laboratory equipment, furniture and casework is not delivered to either Site, or to storage areas, until such areas are sufficiently dry and conditioned so that the equipment and casework will not be damaged by changes in ambient humidity and relative moisture content, or by exposure to extremes of temperature or humidity.

B. Environmental Limitations: Do not deliver or install laboratory equipment, furniture and casework until ALL of the following conditions are in compliance:

1. Project is enclosed, and utility roughing-in is complete,

2. Concrete, masonry, plaster, tile and marble setting and polishing and other wet work has been completed and is dry.
3. Permanent HVAC system is operating and maintaining temperature between 60 and 90 degrees, and relative humidity between 25 and 55 percent for five calendar days before delivery, and during installation of laboratory equipment, furniture and casework, and that temperature and humidity shall be maintained after installation until Owner's Final Acceptance.

1.11 MOCKUP

A. Fabrication Samples: Prior to start of work, fabricate a complete 24 inch wide and 36" overall height base cabinet section with 1 drawer and 1 door, and epoxy work top with backsplash.
1. Sample shall show full construction of all joints in casework and shall include a sample joint in work top. Sample shall contain:
a. door with specified hardware including hinges, pulls and lock,
b. drawer with specified slides, stops, and pull hardware.
c. back and side panels.
2. Samples not fully conforming to this specification shall be rejected by the Architect.
3. Deliver sample to Job site. Sample will be used for the purposes of establishing a quality control standard, which can be compared to the remaining Work.
4. Reviewed and accepted sample shall be turned over to the Owner for disposition at the completion of the Work.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Performance Tests:
1. Chemical Spot test (finishes):
a. Substrate:
1) Sample substrate for test of wood finish will be red oak, rift-cut veneer without stain underneath the coating. Panels to be finished according to finishing supplier's guidelines and in accordance to casework manufacturer's standard procedures.
2) Sample substrate for test of metal finish shall be 18ga minimum meeting requirements of ASTM A505. Panels to be finished according to finishing supplier's guidelines and in accordance to casework manufacturer's standard procedures.
3) Sample substrate for countertops shall be a 1" thick panel of the countertop material, finished as required for the final installation.
4) Sample substrate for fume hood liners shall be of same thickness, color, and finish as the proposed liner material.
b. Obtain one sample panel measuring 14" x 24" (355.6mm x 609.6mm). The received sample to be tested for chemical resistance as described herein. Place panel on a flat surface, clean with soap and water and blot dry. Condition the panel for 48-hours at 73º +/- 3ºF (23º +/- 2ºC) and 50 +/- 5% relative humidity or the currently accepted guideline set by ASTM. Test the panel for chemical resistance using forty-nine different chemical reagents by one of the following methods.

c. Method A - Test volatile chemicals by placing a cotton ball saturated with reagent in the mouth of a 1-oz. (29.574cc) bottle and inverting the bottle on the surface of the panel.

d. Method B - Test non-volatile chemicals by placing five drops of the reagent on the surface of the panel and covering with a 24mm watch glass, convex side down

e. For both of the above methods, leave the reagents on the panel for the required time period. Wash off the panel with water, clean with detergent and naphtha, and rinse with deionized water. Dry with a towel and evaluate after 24-hours at 73º +/- 3ºF (23º +/- 2ºC) and 50 +/- 5% relative humidity, or the currently accepted guideline set by ASTM using the following rating system.

1) Level 0 - No detectable change.
2) Level 1 - Slight change in color or gloss.
3) Level 2 - Slight surface etching or severe staining.
4) Level 3 - Pitting, cratering, swelling, or erosion of coating. Obvious and significant deterioration.

f. Required time period for casework finishes : 1 hour.

g. Required time period for fume hood liners and counter top materials : 24 hours.

h. Chemical reagents (Method A) : Amyl Acetate, Ethyl Acetate, Acetone, Butyl Alcohol, Ethyl Alcohol, Methyl Alcohol, Benzene, Carbon Tetrachloride, Chloroform, Cresol, Dichloroacetic Acid, Dimethyl Formaldehyde, Dioxane, Ethyl Ether, 37% Formaldehyde, Furfural, Gasoline, Methyl Ethyl Ketone, Methylene Chloride, Monochlorobenzene, Naphthalene, 90% Phenol, Toluene, Trichloroethane, Xylene

i. Chemical reagents (Method B) : 98% Acetic Acid, 5% Acid Dichromate, 28% Ammonium Hydroxide, 60% Chromic Acid, 90% Formic Acid, 37% Hydrochloric Acid, 48% Hydrofluoric Acid, 30% Hydrogen Peroxide, Tincture of Iodine, 20%, 30%, and 70% Nitric Acid, 85% Phosphoric Acid, Saturated Silver Nitrate, 10%, 20% and 40% Sodium Hydroxide, and Sodium Hydroxide flake, Saturated Sodium Sulfide, 33%, 77% and 98% Sulfuric Acid, Mixture of equal parts 77% sulfuric and 70% nitric acid, Saturated Zinc Chloride.

j. Note: Percentages are by volume.

k. Laboratory grade finishes shall result in no more than four (4) Level 3 conditions. Individual test results, for the specified 49 reagents, will be verified with the established third party, independent SEFA 8 test submittal form.

l. Level 0 or Level 1 results are required for the following reagents:

Hydrochloric Acid, 37%	Methyl Alcohol
Sulfuric Acid, 33%	Ethyl Alcohol
Nitric Acid, 30%	Ethyl Acetate
98% Acetic Acid	Acetone
Phosphoric Acid, 75%	Methyl Ethyl Ketone
Ammonium Hydroxide, 28%	Benzene
Sodium Hydroxide, 10%	Toluene
Gasoline	Chloroform
Naphtha	Carbon Tetrachloride

2. Load test (base cabinet):

a. Conducted on a test cabinet as described in SEFA 8 (A base cabinet which shall be a combination of cupboard and drawer. The base cabinet shall be 48” +/- 1” (1219.2mm +/- 25.4mm) wide, 36” +/-1” (914.4mm +/- 25.4)mm high, and 22” +/- 1” (558 mm+/- 25.4mm) deep. Cabinet dimensions do not include drawer or door

front thickness. The drawer shall be above the cupboard, full width and approximately one fourth the height of the cabinet's face opening. Drawer shall be a minimum of 18" (457.2mm) deep outside dimension. When slides are used for drawers, slides shall be a minimum of 18" (457.2mm) deep. Cupboard shall be double-door design and provide unobstructed entry into the cabinet interior with the doors open. The unit shall contain one adjustable shelf.

b. The test cabinet shall no signs of permanent failure after being subjected to a distributed load of 2,000 lbs for 24 hours, once load is removed.
   1) Conduct distributed load test with drawer removed and doors open.

c. The test cabinet shall show no impairment to function of doors, drawers or shelves while subjected to a 200 lb concentrated load applied to the cabinet centerline.
   1) "No impairment" shall mean the operation of doors, drawers and shelves with the load applied and after its removal.

3. Load test (shelf)
   a. Load a sample shelf (fixed or supported on movable brackets, pins or other hardware, as will be applicable to the final installed condition) Load the shelf with a distributed load of 40 lb per square foot, starting from the center and working outward, not to exceed 200 lb for the entire shelf.
      1) Maximum deflection of the shelf under load shall be 1/180 of the span, or ¼", whichever is less.
      2) Brackets, pins, or other supporting hardware shall show no sign of failure, deformation or displacement.

4. Load test (wall cabinet)
   a. Install wall cabinet and interior shelves in the manner recommend by the manufacturer.
   b. Load bottom, top, and each shelf uniformly at 40 lbs / square foot, not to exceed 200 lbs per shelf, and not to exceed 600 lbs per cabinet. For a typical wall cabinet with 2 shelves, load top and bottom to 160 lbs, width permitting, and load middle shelves to 140 lbs each.
   c. After a period of 24 hours, test operation of doors – doors shall open and close with no impairment under full load.
   d. Remove all loads. One hour after removing loads, doors shall continue to show no evidence of impairment to their operation. Cabinet construction including joints, shelves, and hardware, shall show no evidence of deformation or damage.

5. Load Test (table)
   a. The test unit shall be a standing height, free-standing, four legged table frame. The table shall be nominally 60" wide", 24" deep, and 36" tall. Leg, apron, and any stiffeners or crossmembers shall be per manufacturer's standard. A top shall be provided made of 37-50 PCF medium density particleboard, installed per manufacturer's recommendation. The top shall overhang the table base 1" on all sides. Bottom of leg condition shall be glides, casters, or levelers consistent with the final work.
   b. Load the table surface evenly with solid steel bars, up to the manufacturer's specified live load, but not less than 300 lb for mobile tables, 600 lb for freestanding tables, and 2000 lb for fixed tables. Include the weight of the top in the live load.
   c. No structural breakage shall occur at full load. Aprons, rails and supports shall not deflect by any more than the lesser of 1/8", or 1/360 their length. Tables with

drawers or with integral utilities shall show no impairment to the function of those drawers or utilities under load.

d. After removal of loads, table shall show no signs of permanent damage or deformation.

6. Torsion Test (base cabinet)
   a. Conducted on a test cabinet as described in SEFA 8 (same as the test cabinet for the load test, above)
   b. Support the test cabinet with four 4”x4” wide blocks, one at each corner, not more than 6” on center from the corner,
      1) Measure diagonal corners and record as a pre-test baseline
   c. Load the rear corner with 350 lbs 7” in from the corner at a 45 degree angle. Load the diagonally opposite front corner with 200 lbs 7” from the corner at a 45 degree angle.
   d. Using a lift truck or similar device, lift the cabinet slightly up, and remove the corner block under the 200 lb load. Resettle the cabinet on the remaining 3 blocks for a period of 24 hours.
   e. After the 24 hour period, reverse the previous steps, and once the weights have been removed, re-meausre the diagonal corners and record the results.
   f. There shall be no impairment in the operation of the cabinet doors, drawer, or shelf after the completion of the test.
   g. Pre-to-post test measurements shall not show a change greater than 1/8”.
7. Submersion test (base cabinet)
   a. Using the same standard cabinet, measure the material thickness along the perimeter of the cabinet that will contact the floor, at increments of 6” Record the thicknesses of the material and calculate the arithmetic mean of the measurements taken.
   b. Place the entire cabinet, in its upright position, in a pan filled with 2” of water at room temperature. Allow the cabinet to stand 4 hours.
   c. After 4 hours, remove the cabinet from the pan, and immediately re-measure the points previously measured, and recalculate the arithmetic mean of the sampled dimensions.
      1) Increase in thickness shall not exceed 10% of the original mean measurements.
   d. Allow the cabinet to dry completely.
      1) Surfaces shall show no evidence of permanent deformation, deterioration, or delamination.
8. Hinge test (doors):
   a. Conducted with a test cabinet as described in SEFA 8. Remove the shelf for this test. Add sufficient weight to the top in order to prevent overturning.
   b. With cabinet door opened 90-degrees, hang a sling made up of two 100 pound (45.359 Kg) weights (shot bags or solid weights) over top of the door at a point 12” (304.8mm) out from the hinge centerline Slowly move door through two full cycles of the hinge at 160-degree arc. Remove weight and swing door through its full intended range of motion and close door.
   c. Operation of the door, after test shall show no significant permanent damage that will cause binding of the door or hinges or that will adversely affect operation of the catch

9. Cycle tests (doors)(drawers):
   a. Doors shall withstand 100,000 cycles as prescribed in SEFA 8 testing, Drawers shall withstand 50,000 cycles.
10. Load test (drawers)
   a. Conducted with a test cabinet as described in SEFA 8 and above.
   b. Extend the drawer 13”. Counterweight the cabinet as necessary to prevent overturning. Suspend a weight of 150 lbs from the drawer head, at the centerline of the drawer, for at least 5 minutes. At the completion of that time, remove the weight.
   c. After wight is removed, drawer shall show no impairment of function, and shall show no evidence of failure between the drawer face and the drawer body, or within any other element of the drawer construction.
11. Impact tests (drawers)
   a. Support the drawer at each corner on blocks on a level surface, and drop a 10 lb sand or shot bag on the center of the drawer bottom.
      1) Drawer bottom shall show no evidence of cracking, or failure. Joints between drawer bottom and sides shall show no evidence of failure. Drawer shall operate freely and properly when returned to the cabinet.
   b. Support the drawer at a 45 degree incline, with the drawer face down. Place a 2” x 12” round steel rod (approximately 10 lbs) on the drawer bottom 13” from the face. Allow to freely roll down to impact the drawer head at the centerline. Repeat this procedure 3 times for the drawer front, reverse the drawer and repeat 3 more times for the back.
      1) Drawer shall show no evidence of failure in joinery or construction. Drawer fronts and backs shall be free or cracks or delamination. Drawer shall operate freely and properly when returned to the cabinet.
12. Heat resistance (Finish) :
   a. Hot water (190 degrees-205 degrees) shall be allowed to trickle onto the surface, which shall be set at an angle of 45 degrees from horizontal for a period of 5 minutes. After cooling and wiping dry, the finish shall show no visible effect from the hot water.
13. Moisture resistance (Finish):
   a. A cellulose sponge (2 inches by 3 inches by 1 inch) shall be soaked with water and place on the surface of the finish for a period of 100 hours. The sponge shall be maintained in a wet condition throughout duration of tests. At the end of the test, the surface shall be dried and upon examination, shall show no blushing or whitening of the finish.
14. Impact resistance (Finish) :
   a. A one pound steel ball (approximately 2 inches in diameter) shall be dropped for a distance of one foot onto the finished surface of a 1/4" thick plywood panel, minimum 8” x 8” supported underneath by solid surface. There shall be no evidence of cracks or checks in the finish due to impact upon close examination.
15. Impact resistance (Finish) :
   a. A one pound steel ball (approximately 2 inches in diameter) shall be dropped for a distance of one foot onto the finished surface of an 18 gauge cold rolled steel panel, minimum 8” x 8” uniformly coated with 2-4 mils (dry film) of the manufacturers powder coated finish, supported underneath by solid surface. There shall be no evidence of cracks or checks in the finish due to impact upon close examination.

16. Adhesion (Powder Coated Finish):
    a. Using a finish sample on the surface of an 18 gauge cold rolled steel panel, minimum 8” x 8” uniformly coated with 2-4 mils (dry film) of the manufacturers powder coated finish, supported underneath by solid surface, test in accordance with ASTM D3359 Method B. A 4B rating (95% or more of finish remains intact) is required to pass.
17. Adhesion (Metallic Finish)
    a. Electrodeposited finishes on casework hardware as well as service fixtures and fittings shall meet requirements for adhesion specified in ASTM B571, Tests (i) burnishing, (ii) chisel-knife test (iii) file test, and (iv) peel test.
18. Fume test (fittings)
    a. Prepare samples of fittings having the corrosion resistant finish to be tested. Suspend samples in a container at least 6 cubic feet capacity, approximately 12” above open beakers, each containing 100 cc of 70% nitric acid, 94% sulfuric acid and 35% hydrochloric acid, respectively. After exposure to the fumes from these reagents for 150 hours, the fitting shall show no discoloration, disintegration or other effects.
19. Cycle test (fittings)
    a. Valves shall be subjected to a life test for 500,000 cycles of operation. After completion of the life test, the valve shall control the flow of water at test pressure with an application of force or torque to the lever or handle not to exceed 22.5 lb for linear motion force or 22.5 in-lb for rotary motion force.
20. Bend Test (finishes)
    a. An 18 gauge steel strip, finished as specified, when bent 180° over a 1/2" diameter mandrel, shall show no peeling or flaking off of the finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of reinforcements, and other conditions affecting performance of laboratory casework.

B. Proceed with installation only after unsatisfactory conditions have been corrected

3.2 INSTALLATION

A. Erect casework straight, level and plumb and securely anchor in place. Scribe and closely fit to adjacent work. Cut and fit work around pipes, and ducts.

B. Install all items complete and adjust all moving parts to operate properly.

C. Leave surface clean and free from defects at time of final acceptance.

3.3 CLEANING AND PROTECTING

A. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.

B. Protect countertop surfaces during construction with 6-mil (0.15-mm) plastic or other suitable water-resistant covering. Tape to underside of countertop at a minimum of 48 inches (1200 mm) on center.

END OF SECTION

SECTION 12 35 53.13
METAL LABORATORY CASEWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install:

1. Laboratory Casework;
   a. Base cabinets, full height cabinets, wall cabinets, and movable cabinets wherever indicated.
      1) Including wiring troughs, filler panels, back panels, adjustable or fixed shelves, doors, drawers, rigid insulation, grommets, cabinet hardware, hangers, shims and supports and other accessories as needed for a complete and proper installation.
   b. Suitable to receive and support epoxy or engineered stone tops and epoxy drop in sinks as specified in related section 12 36 53.
   c. Suitable to receive other types of tops including solid surface, butcherblock, and stainless steel as specified in related sections 12 36 16 and 12 36 19 and included in drawings or schedules.
2. Shelving systems
   a. Complete shelving systems including standards, brackets, braces as well as all metal shelves and shelf accessories such as earthquake rails.
3. Moveable lab tables
   a. Provide table frames complete with all required wiring troughs, service lines and service fixtures, aprons, levelers, feet and other accessories for complete and proper installation. Provide units pre-piped and prewired for services as indicated in drawings
   b. Suitable to receive and support epoxy or engineered tops as specified in related section 12 36 53.
   c. Suitable to receive other types of tops including solid surface, butcherblock, and stainless steel as specified in related sections 12 36 16 and 12 36 19 and included in drawings or schedules.
4. Modular lab bench systems:
   a. Provide table and shelf frames complete with all required wiring troughs, service lines and service fixtures, aprons, levelers, feet and other accessories for complete and proper installation.
   b. Provide units pre-piped and prewired for services as indicated in drawings
   c. Suitable to receive and support epoxy or engineered stone tops as specified in related section 12 36 53.
   d. Suitable to receive other types of tops including solid surface, butcherblock, and stainless steel as specified in related sections 12 36 16, and 12 36 19 and included in drawings or schedules.
   e. Provide indicated manufacturer standard accessories such as modesty panels, power bars, tack boards, and monitor arms as shown.
   f. Provide complete shelving systems including standards, brackets, braces as well as all metal shelves and shelf accessories such as earthquake rails.

5. Preparation of all casework for service fittings and accessories as specified in Section 11 53 43, and for controls, lighting, and fixtures and fittings specified for attachment to casework in Divisions 22, 23, and 26.
6. Coordination of the work of this Section with the work of other Division 12 Casework sections to provide a complete laboratory casework package inclusive of all elements needed for proper installation and operation.
7. Coordination of all substrate requirements for installation, including blocking, nailers, grounds, and strapping provided under Division 6 for a secure installation of all work.
8. All submittals, coordination and other requirements of this section and related Specification section 12 35 52 COMMON WORK RESULTS FOR LABORATORY FURNITURE AND CASEWORK.

1.2 RELATED SECTIONS

A. General Conditions and General Requirements of the Contract for Construction are applicable to the work of this section. Attention is to be given to related work sections, including but not limited to:

B. Section 06 10 00 – ROUGH CARPENTRY: Nailers, blocking and in-wall supports for items of this Section and related work.

C. Section 09 65 00 – RESILIENT FLOORING AND ACCESSORIES: Wall base to be installed at casework toe kicks.

D. Section 10 10 00 – VISUAL DISPLAY UNITS: Visual display units including markerboards, sliding markerboards, and other types of writeable surface incorporated into casework of this section.

E. Section 11 53 43 – SERVICE FITTINGS AND ACCESSORIES: Requirements for service outlets and accessory fittings.

F. Section 12 35 52 – COMMON WORK RESULTS FOR LABORATORY FURNITURE AND CASEWORK: Performance, fabrication, installation, and cleaning requirements for work of this Section 12 35 53.

G. Section 12 36 53 – LABORATORY COUNTERTOPS: Laboratory epoxy countertops to be installed in conjunction with the work of this Section

H. Division 22 –PLUMBING: Piped services connections for work of this section and Section 11 53 13.

I. Division 23 – HEATING, VENTILATING AND AIR CONDITIONING: Ductwork connections for vented cabinets or other work of this and related sections.

J. Division 25 – INTEGRATED AUTOMATION: All fittings, equipment, coordination and controls for integration of laboratory furniture and casework elements with building controls.

K. Division 26 – ELECTRICAL: All electrical fittings, wiring and components, related to work of this and related sections.

L. Division 27 – COMMUNICATIONS: All electrical fittings, wiring and components for IT and low voltage communications connections to work of this section.

1.3 REFERENCES

A. Comply with applicable requirements of the standards listed in specification section 12 35 52, and those others referenced in this Section, under the provisions of Division 1 – GENERAL REQUIREMENTS. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.

1. California Department of Health Services Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers, including 2004 Addenda.

B. Definitions:

1. CDHS : California Department of Health Services
2. VOC: Volatile Organic Compound(s)

1.4 QUALITY ASSURANCE

A. Refer to Section 12 35 52 for quality assurance requirements of this and related sections.

1.5 SUBMITTALS

A. Lab casework elements are included under multiple specification sections. It is the responsibility of the contractor to assemble a complete submittal package cross-referencing all specification sections and requirements and showing a complete casework package.

B. Submit the following under provisions of Division 1 – GENERAL REQUIREMENTS:

1. Literature: Manufacturer's product data sheets, specifications, performance data, physical properties for items included in the work.
2. Sustainable Materials Literature
   a. b. Adhesives and Sealants: Include certification of data indicating Volatile Organic Compound (VOC) content of all field-applied adhesives and sealants and compliance with California Department of Health Services Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers, including addenda. Submit MSDS highlighting VOC limits.
   b. Metal components and products: Include certification indicating recycled content of all metal components.
3. Materials schedule: A complete schedule of casework components, coordinated with the Contract Drawings.
4. Manufacturer’s instructions: Manufacturer’s installation instructions indicating special procedures, requirements for anchoring and supporting work, and perimeter conditions requiring special attention.
5. Warranty: Sample warranty for approval, and executed warranty as part of closeout documents.
6. Quality Assurance reports: Literature from fabricators, suppliers, and installers showing compliance with Quality Assurance requirements of Section 12 35 52
   a. Submit test data showing compliance with required finish and function tests included in Section 12 35 52, as appropriate for the type of product supplied
   b. Where other tests are prescribed by the requirements of SEFA 8 for specific casework types and configurations shown (including torsion tests, pull tests, or other types of finish tests) submit all test data in accordance with SEFA standards.

7. Shop Drawings in sufficient detail to show fabrication, installation, anchorage, and interface of the work of this Section with the work of adjacent trades.
   a. Include detailed shop drawings for overhead service panels showing configuration of service fixtures and service fittings, and clearances for maintenance and operation of all fittings
   b. Components shall be identified on shop drawings via manufacturer's part numbers, correlated with Materials schedule.
8. Selection samples:
   a. Manufacturer's full line of standard colors for powder coated finishes.
9. Verification samples:
   a. Complete powder coat finished sample base cabinet unit as part of the complete mockup specified in SECTION 12 35 52 – COMMON WORK RESULTS FOR LABORATORY FURNITURE AND CASEWORK.
   b. Sample of each type of cabinet hardware in specified finish.
10. Operations and maintenance materials and manuals for all installed work.

1.6 SEQUENCING AND SCHEDULING

A. Provide shop drawings and submittals in a timely fashion to permit fabrication of long-lead casework items and maintain overall construction schedule.

1.7 PRODUCT HANDLING

A. Comply with requirements of Section 12 35 52 for delivery, storage, and handling, and for acceptable site conditions for receiving and installing casework.

1.8 WARRANTY

A. Provide manufacturer's two year warranty against all defects in material or workmanship. Warranty for any element of the work shall not commence prior to the date of Owner's beneficial occupancy of the space in which the work is installed.

B. Provide longer specific warranties for particular components of casework, as indicated.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design (Specified Manufacturer): To establish a standard of quality, design and function desired, Drawings and specifications have been based on Mott Manufacturing Ltd. Brantford ON, Canada

B. Acceptable Manufacturers: Subject to compliance with the requirements specified herein, manufacturers offering products which may be incorporated in the work include the following,
   1. Mott Manufacturing Ltd., Brantford ON, Canada
   2. Bedcolab, Laval Quebec, Canada.
   3. Kewaunee Scientific Inc., Statesville, NC.
   4. LabCrafters, Ronkonkoma, NY.

2.2 SYSTEM DESCRIPTION

A. Casework finishes

1. For casework identified as “painted” or not identified as being of stainless steel, finish to be powder coated epoxy; Basis of Design color to selected from manufacturer’s full line of colors.
2. For casework identified as stainless steel, provide 316 steel, satin finish. Exposed faces shall be free of discolorations from welding or finishing.
3. At all exposed and semi exposed surfaces, applied metal finishes shall meet the requirements of Section 12 35 52 – Part 2.1-A, Tests 1, 12, 13, 15 and 16. Stainless steel casework shall provide finish test results for Test 1.

B. Powder Coated Metal Casework Systems

1. Cabinets to be all metal body construction including door and drawer fronts, full overlay.
   a. Construction of metal casework is to meet technical requirements of SEFA 8 and Section 12 35 52 of this specification..
2. Provide fixed casework at walls and islands where indicated. Provide all necessary fillers and closure panels at corners, end conditions, and knee spaces to close off all concealed space.
   a. Provide mix of base cabinets of types indicated, including drawer bases, door bases, sink bases, and specialty bases at conditions such as teaching walls. Provide heights as indicated at base cabinets, including standing and sitting height bases. Where knee spaces exceed 48” length, provide supplemental supports for countertops incorporated into casework.
3. Provide a mixture of wall cabinets with glass or solid doors and open shelving as indicated.
4. Provide movable and suspended cabinets where indicated
   a. Lab tops for movable cabinets to be provided to match lab tops at fixed casework.
   b. Provide glides at all movable casework units.
   c. Mobile cabinets shall be short enough to permit them to be placed under lab tables when those tables are at 30” elevation. Suspended cabinets shall be short enough to retain a 4” toe space below the suspended cabinet when the work station or table it is attached to is lowered to 30”.
   d. Hardware, color and finish to match fixed casework.
   e. Hanging rail details for suspended cabinets to match movable table and modular workstation hanging rails.
   f. Provide set screws for all suspended cabinets to prevent movement once installed.
5. Provide full height storage cabinets with solid or glass swing door fronts as indicated.
   a. Special attention is directed to cabinets identified for “microscope storage” with specific load and spacing requirements for shelves that may exceed typical requirements.
   b. Special attention is directed to cabinets identified as “teaching wall” units to receive sliding markerboard fronts or types shown, including sliding markerboard provided under other sections

6. Provide custom cabinet fabrications for student cubbies, microscope storage, and other uses as indicated in details.
7. Coordinate installation of blocking and nailers for all casework to ensure adequate anchorage and support for all elements of work.
8. Coordinate installation of epoxy or other types of tops and counters, as well as service fixtures, fittings, and sinks specified under related sections.
9. Fixed metal casework shall meet the requirements of Section 12 35 52, Part 2.1-A, tests 2, 3, 4, 6, 8, 9, 10, and 11 as applicable to the specific casework elements. Test 3 applies to shelves installed in base or wall cabinets or on independent standards. Test 8 and 9 apply to base, tall, and wall cabinets.
10. Movable casework shall meet the requirements of Section 12 35 52, Part 2.1-A, tests 2, 3, 6, 8, 9, 10, and 11 as applicable to the specific casework elements.

C. Stainless Steel Casework Systems

1. Cabinets to be all metal body construction including door and drawer fronts, full overlay.
   a. Construction of metal casework is to meet technical requirements of SEFA 8 and Section 12 35 52 of this specification..
2. Provide fixed casework at walls and islands where indicated. Provide all necessary fillers and closure panels at corners, end conditions, and knee spaces to close off all concealed space.
   a. Provide mix of base cabinets of types indicated, including drawer bases, door bases, sink bases, and specialty bases at conditions such as teaching walls. Provide heights as indicated at base cabinets, including standing and sitting height bases. Where knee spaces exceed 48” length, provide supplemental supports for countertops incorporated into casework.
3. Provide a mixture of wall cabinets with glass or solid doors and open shelving as indicated.
4. Provide movable and suspended cabinets where indicated
   a. Lab tops for movable cabinets to be provided to match lab tops at fixed casework.
   b. Provide glides at all movable casework units.
   c. Mobile cabinets shall be short enough to permit them to be placed under lab tables when those tables are at 30” elevation. Suspended cabinets shall be short enough to retain a 4” toe space below the suspended cabinet when the work station or table it is attached to is lowered to 30”.
   d. Hardware, color and finish to match fixed casework.
   e. Hanging rail details for suspended cabinets to match movable table and modular workstation hanging rails.
   f. Provide set screws for all suspended cabinets to prevent movement once installed.
5. Provide full height storage cabinets with solid or glass swing door fronts as indicated.
6. Coordinate installation of blocking and nailers for all casework to ensure adequate anchorage and support for all elements of work.
7. Coordinate installation of epoxy or other types of tops and counters, as well as service fixtures, fittings, and sinks specified under related sections.
8. Fixed metal casework shall meet the requirements of Section 12 35 52, Part 2.1-A, tests 2, 3, 4, 6, 8, 9, 10, and 11 as applicable to the specific casework elements. Test

3 applies to shelves installed in base or wall cabinets or on independent standards. Test 8 and 9 apply to base, tall, and wall cabinets.

9. Movable casework shall meet the requirements of Section 12 35 52, Part 2.1-A, tests 2, 3, 6, 8, 9, 10, and 11 as applicable to the specific casework elements. .

D. Adjustable Shelving systems

1. Provide stainless steel brackets and standards in all spaces with stainless steel casework. Shelf standards and brackets elsewhere shall be powder coated.
   a. Basis of design product for standards is Mott WRV10xx and WRV11xx series for double and single slotted units. Provide heights indicated.
   b. Basis of design product for brackets is Mott FSB40xx and FIB40xx series, sized for depth of shelves indicated
2. Shelves to be
   a. “Standard Metal Shelves” as specified herein
3. Adjustable shelves, when assembled, shall meet the requirements of Section 12 35 52, Part 2.1-A, test 3.
4. Metal finishes for shelf supports shall meet the requirements of Part 2.2-A of this section.

E. Lab Tables (without services)

1. Table frames to be powder coated steel construction, full welded with all exposed faces fully finished.
2. Coordinate installation of epoxy or other types of tops and counters, as well as service fixtures, fittings, and sinks specified under related sections.
3. Include hanging rails for suspended bases at all tables.
4. Tables to be height adjustable from 30” to 36” (measured at top of surface. Provide inserts for bolt- or pin-adjustable legs to match. Cotter pins are not acceptable.
5. Provide leveling feet and glides at all lab tables except at Field Gear Room, where locking casters shall be provided.
6. Basis of Design is Mott Cambridge (with C, H, or rail-less configuration as shown), of length and depth indicated.
7. Tables shall meet the requirements of Section 12 35 52, Part 2.1-A, test 5. Tables with drawers integral to them shall meet tests 9, 10, and 11.

F. Modular lab bench systems

1. Basis of design is Mott Optima 2100 Series bench, modular single and double sided benches.
2. With integral shelving, and with movable or suspended base cabinets below where shown. Tops to be adjustable between 30 and 36”. Legs, table frames, and accessories to be powder coated steel construction with finished top and backs
3. Typical configuration - provide 30” deep modular units, length as indicated, each with three 12” deep shelves above. Provide one 18" wide drawer base cabinet on glides below each modular unit. Set initial top height at 36”.
4. Lab tops for modular lab benches to be provided to match lab tops at fixed casework within each room.
5. Provide clamps, bolts or anchors as required to temporarily secure adjacent units (back to back or side to side) to one another to prevent gaps opening between tops. Fixing systems must be removable without special tools.

6. Provide leveling feet and glides at all modular bench units.
7. Modular bench units shall meet the requirements of Section 12 35 52, Part 2.1-A, test 5, and all shelves shall meet the requirements of test 3. Units with drawers integral to them shall meet tests 9, 10, and 11.

2.3 MATERIALS

A. Steel:

1. Painted or Powder Coated Metal: Includes base and tall cabinetry, support framing, shelf support brackets, shelving wall standards, filler and closure panels, and fittings needed to assemble casework and assemblies as noted on drawings.
   a. Cold-rolled commercial steel sheet, complying with ASTM A 1008/A 1008M; matte finish; suitable for exposed applications.
2. Stainless steel: Includes base and tall cabinetry, support framing, shelf support brackets, shelving wall standards, filler and closure panels, and fittings needed to assemble casework and assemblies as noted on drawings as stainless steel.
   a. Cold-rolled commercial steel sheet, complying with ASTM A240; satin finish; suitable for exposed applications.
   b. Stainless steel for laboratory casework shall be 316.
3. Minimum Metal Thickness:
   a. Sides, Ends, Fixed Backs, Bottoms, Tops, Soffits, and Item Not Otherwise Indicated: 18 Gauge. Except for flammable liquid-storage cabinets, bottoms may be 20 gauge if reinforced.
   b. Back Panels, Drawer Bodies, and Shelving: 20 Gauge except for back panels and doors of flammable liquid storage cabinets and for un-reinforced shelves more than 36 inches long shall be 18 Gauge.
   c. Intermediate Horizontal Rails, Table Aprons and Cross Rails, Center Posts, and Top Gussets: 16 Gauge.
   d. Drawer Runners, Sink Supports, and Hinge Reinforcements: 15 Gauge.
   e. Leveling and Corner Gussets: 12 Gauge

B. Metal Finish:

1. Thermosetting powder coat finish, in color selected,, complying with FGIA 621.
2. All coated metal parts shall be pre-treated with iron phosphate

C. Glass:

1. Tempered and clear float, 3mm thick, conforming to ANSI Z97.1 Class A, glazing quality.
2. Laminated glass: ANSI Z97.1 Class A, Type 1 with clear PVB interlayer. Total nominal thickness of laminated glass: 6 mm.

D. Sealant:

1. One component, RTV silicone sealant. Color to suit application.

E. Resilient Base and Adhesive:

1. Base cabinets to be designed to work with 4” high base molding provided by others. Metal fillers for non-level floors shall be provided as required after installation.

2.4 HARDWARE

A. Hinges:

1. Heavy-duty five (5) knuckle hinges of all-metal construction, permitting 165 degree swing; accommodate door thicknesses specified. Fully adjustable for clockwise, counter-clockwise, toe in and out door alignment.
2. Base plates for maintaining 1/8" reveals between door/drawers within the same cabinet, and between doors of adjoining cabinets.
3. One pair of hinges per door to 48 inch height. One and one-half pair of hinges per door over 48 inches in height.
4. Hinge mounting: Flathead screws so applied to door and cabinet as to withstand a weight load of 150 pounds minimum.

B. Pulls: Staple-shape wire pull, 4 inches long, 3/8 inch diameter, stainless steel with brushed finish, with one-inch finger clearance.

C. Monitor Arms: Single monitor arm with 3 axis movement

1. Minimum adjustment = 12” vertical, 12” lateral, 18” front-to back.
2. Pivot / tilt = 360 pivot at base and monitor attachment, min 120 degree tilt.
3. Center back attachment to monitor
4. Capable of supporting up to 15 lb monitor without sag, creep or failure.
5. Fixed mount (table, clamp, or beam mount as indicated)
6. Finish to be bright white unless otherwise indicated.
7. Products: To establish a standard of quality, fabrication and finish, the basis of design product is Flo Single, as manufactured by Hermann Miller
   a. Alternate product/manufacturers : Sapper XYZ 30 by Knoll. CF Series Single Adjustable Monitor Arm by Steelcase

D. Catches:

1. Base and wall cabinets: Spring-tension nylon roller catch with steel strike plate; one catch for each door required at double doors without locks.
2. Tall cases: One pair of heavy-duty spring tension rubber roller catches for each door; positive catch and lever type latch installed on left hand door.

E. Locks: Heavy duty, cylinder-type lock with 7 pin BEST keyway M. Positive tumbler operations shall be accomplished by cam action without the aid of springs.

1. Locations: All drawers and hinged doors on casework.
2. Three point locks shall be provided at full height doors.
3. Keying: All casework locks keyed alike within each room; Masterkey all casework in Project. No two rooms shall be keyed alike unless otherwise directed by Owner’s Representative. Provide 4 keys for each room, and 6 masterkeys (total).
4. The lock system shall guarantee security which restricts the duplicating of keys to registered locksmiths.

F. Drawer Slides: Side-mounted, clear zinc finish, full-extension, self-closing design with positive in-stop. Out-stops designed to permit easy removal of drawer, but to prevent inadvertent drawer removal. Captive nylon rollers, both front and rear, with adjuster cam to regulate body side sway.

1. Standard Drawers: Equal to Accuride model 3832, Minimum 100 pound capacity, with clear zinc finish.
2. File Drawers and Deep Drawers (greater than 12 inches deep): Equal to Accuride model 4034, Minimum 150 pound capacity, with clear zinc finish.

G. Label Holders: Self adhesive type, stainless steel with satin finish, designed for 2 1/2 inch by 1 1/8 inch cards, unless otherwise indicated. At all drawer fronts (upper left corner) all doors in base cabinets (upper right or left corner, depending on hand) and all wall cabinets (lower right or left corner depending on hand.)

H. Number Plates: Not Required

I. Adjustable shelf supports: Manufacturer's standard adjustable shelf supports. Flush cabinet interior sides, without permanent projection into shelf area.
1. Shelf supports: BHMA B84072, wrought steel, mortise mounted.
2. Shelf support clips: Pin type, corrosion resistant coated finish.
3. Shelf adjustment on 1 inch centers.

J. Leveling Devices:
1. Leveling devices furnished at all corners, adaptable to table legs or the bottom corners of base cabinets.
2. Device construction: 1/2 inch diameter bolt threaded through a 1/2 inch tee nut securely screwed to bottom of leg, or to 1-5/8 inch U-shaped 12 gauge metal bracket with leveling bolts mounted at the four bottom corners of a base cabinet.
3. Bolts: cadmium plated steel with a hexagonal head to provide bearing against a 12 gauge flat steel floor plate, installed so as to be accessible for adjustment through cupboard bottoms and drawer openings when installed on base cabinets.

K. Floor Glides:
1. Locations: Open-leg and pedestal tables. Movable casework units.
2. Construction: Non-marring material at least 1-1/2 inch diameter to prevent indenting composition flooring: with at least a 5/8 inch height adjustment.
3. Use of metal buttons is unacceptable.

L. Casters:
1. Locations Open-leg and pedestal tables. Movable casework units.
2. Heavy- duty locking 3-1/2" twin wheel casters. Provide a total load rating (including mobile cabinet and work top) of 500lb

M. Auxiliary Support Struts:
1. Locations and function: support drain troughs and fume hood superstructures, or other abnormal loads.
2. Construction: two 16 gauge channel uprights fastened top and bottom by two adjustable "U" shaped spreaders, each 1/8 inch by 1-1/2 inch by length required, with hangers to support mechanical service piping and drain lines as required.

N. Install hardware uniformly and precisely after final finishing is complete. Set hinges snug and flat in mortises for leaf concealment. Turn screws to flat seat. Adjust and align hardware so that moving parts operate freely and contact points meet accurately. Allow for final field adjustment after installation.

O. Hardware Finish: Satin finish stainless steel US32D, unless otherwise noted.

2.5 CASEWORK CONSTRUCTION

A. General Requirements, Metal casework: All components are to be die formed, notched, keyed and tightly fitted. All components spot-welded as part of assembly – cabinets assembled purely with mechanical fasteners are not acceptable.

1. Quantities, sizes and configurations as shown on Drawings. Frameless cabinets are not considered equal to those specified.
2. Joint construction:
   a. Blind, not extended to faces of cabinets.
   b. All component edges hemmed, backfolded, or lock seamed.
   c. Reinforcement: screws, cleats, and spanning elements shall not be lesser gauge than the components being reinforced.
3. Provide leveling devices for all cabinets and open framed tables.
4. Provide base and tall floor-standing cabinets, unless otherwise shown with fully enclosed 4” tall toe kick and with base moulding at the floor on all front faces and exposed sides.
5. Drawer fronts and hinged doors are to overlay the cabinet body. Maintain a maximum 1/8" reveal between pairs of doors, between door and drawer front, or between multiple drawer fronts within the cabinet.
6. There shall be a one inch clear dimension from the bottom of the countertop to the door or drawer below.
7. Dimensions: Manufacturer’s standard sizes unless otherwise indicated on Drawings.
   a. Heights of base cabinets are indicated on Drawings as height to finished countertop. Fabricator is responsible to coordinate fabrication height of base cabinets with thickness of the various countertop types.
   b. Depth of base cabinets as required to provide 6 inch clear utility space below counter, between base cabinet back and wall as shown on Drawings.

B. Metal Base Cabinets.

1. Totally enclosed cabinet constructed from integrally joined parts; solid ends and backs; flush interior for ease of cleaning; casework toe space 2-1/2 inches deep x 4 inches high, fully enclosed and integral to base cabinet construction.
2. Minimum Metal Thickness:
   a. Sides, Ends, Fixed Backs, Bottoms, Tops, Soffits, and Item Not Otherwise Indicated: 18 Gauge. Except for flammable liquid-storage cabinets, bottoms may be 20 gauge if reinforced.
   b. Back Panels, Drawer Bodies, and Shelving: 20 Gauge except for back panels and doors of flammable liquid storage cabinets and for un-reinforced shelves more than 36 inches long shall be 18 Gauge.
   c. Intermediate Horizontal Rails, Table Aprons and Cross Rails, Center Posts, and Top Gussets: 16 Gauge.
   d. Drawer Runners, Sink Supports, and Hinge Reinforcements: 15 Gauge.
   e. Leveling and Corner Gussets: 12 Gauge
3. Basic construction requirements for frame sizes as follows:
   a. Intermediate rails 3/4 x 1-3/4 inches minimum. Intermediate rail mounted at the front between the drawers and between all drawers and doors.

b. Top Horizontal:
   1) Min 16 gauge
c. Bottom Horizontal:
   1) Min 16 gauge

4. Cupboard bottom: Continuous with no openings or seams, 18 gauge or 20 gauge if reinforced.
5. Cabinet end panels: Minimum 18 gauge, reinforced where necessary to prevent visible oilcanning of exposed faces.
6. Cabinet backs:
   a. Standard cabinet back: 20 gauge, continuous. Provide removable back panels for access to service chases at fixed casework.
   b. Exposed exterior backs: 16 gauge minimum face panel.
7. Door/Drawer Spreaders: Provide minimum 16 gauge ¾” tall cabinet body spreaders immediately behind all door/drawer and multiple drawer horizontal joints to maintain exact body dimensions, and close off reveal..
8. Sink cabinets Provide with supplementary sink mount supports.
9. Provide standard doors and drawers as indicated on drawings and specified herein.

C. Metal Wall Cabinets:
1. Totally enclosed cabinet constructed from integrally joined parts; solid ends and backs; flush interior for ease of cleaning.
2. Construction and materials as for base cabinets with the following exception:
   a. 18 gauge min top, sloped or flat, as indicated on drawings.
   b. 18 gauge minimum non-removable bottom panel with integral lip.
   c. Access panels in cabinet backs not required.
3. Dimensions: Manufacturer’s standard sizes as given below unless otherwise indicated on Drawings.
   a. Heights of wall cabinets; nominal 42” inches typical, and 24 inches where indicated.
4. Door types for wall cabinets: Solid doors or glass-front doors as indicated in drawings and schedules. Standard construction as specified herein.

D. Metal Tall Cabinets:
1. Totally enclosed cabinet constructed from integrally joined parts; solid ends and backs; flush interior for ease of cleaning.
2. Construction and materials as for base cabinets with the following exceptions:
   a. 18 gauge min top, sloped or flat, as indicated on drawings.
   b. Access panels in cabinet backs not required.
3. Dimensions: Manufacturer’s standard sizes as given below unless otherwise indicated on Drawings.
4. Door types for tall cabinets. Solid doors or glass-front doors as indicated in drawings and schedules. Standard construction as specified herein.

E. Metal Movable Cabinets:
1. Totally enclosed cabinet constructed from integrally joined parts; solid ends and backs; flush interior for ease of cleaning.

2. Construction and materials as for base cabinets with the following exceptions:
   a. Access panels in cabinet backs not required.
   b. At units with casters, toe kick not required. At units with glides, provide shortened toe kick to accommodate glide height. In all cases, the bottom elevation of the interior of mobile cabinets shall match that of fixed cabinets.
   c. Provide anti-tip counterweights at all movable units.
   d. Movable units shall receive tops as indicated in drawings or schedules
3. Provide standard doors or drawers as indicated and as specified herein.

F. Metal Suspended Cabinets:
1. Totally enclosed cabinet constructed from integrally joined parts; solid ends and backs; flush interior for ease of cleaning.
2. Construction and materials as for base cabinets with the following exceptions:
   a. Access panels in cabinet backs not required.
   b. Toe kick not required.
   c. Provide 20 gauge min bottom panel at underside of unit.
   d. Suspension rails to match rail detail of tables and modular casework units.
   e. Provide set screw for all suspended units to restrict movement once installed.
3. Provide standard doors or drawers as indicated and as specified herein.

G. Standard Metal Cabinet Doors:
1. Swinging doors: 3/4 inch thick double pan construction, Min 18 gauge face / 20 gauge back.
   a. Provide acoustically dampening core at all swinging doors, full width and depth of door, and continuously bonded to metal faces to produce a smoother surface free of oilcanning.
   b. Provide 12ga reinforcing for hinges, pulls and locks as necessary to meet performance criteria.
2. Swinging doors for tall cabinets (minimum 76 inches high): 1 inch thick double pan construction as above.
3. Glass doors: Double pan construction as above with manufacturer's standard detail glass retainer. Non-glass areas of glass doors to include acoustical core.
4. Door edges: Back fold all panels – no seams shall be visible on cabinet fronts.

H. Standard Metal Drawers: One piece, fully coved bottom pan.
1. Drawer fronts: 3/4 inch thick double pan construction, Min 18 gauge face / 20 gauge back.
   a. Provide acoustically dampening core at all drawer fronts, full width and depth of unit, and continuously bonded to metal faces to produce a smooth surface free of oilcanning.
   b. Provide 12ga reinforcing for hinges, pulls and locks as necessary to meet performance criteria.
2. Drawer sides and back: 18 gauge minimum, with reinforcing U bend at all edges, integral with bottom pan, with vertical joints welded at corners.
3. Drawer Bottom: 18 gauge minimum. Reinforce drawer bottoms as required with intermediate spreaders.

4. Drawer Suspension: All drawer suspension assemblies shall be rated at 100 pounds minimum, and 150 pounds for file drawers. They shall consist of two sections providing a quiet, smooth operation on nylon rollers. Case channels shall maintain alignment of drawer and the drawer shall be removable without the use of tools.

I. Standard metal shelving: Full-width adjustable shelves in all base, wall and tall cabinets where shown on Drawings

1. Thickness: 3/4 inch thickness, all edges folded down and back, and corners welded. Reinforce shelf bottoms with spreaders as required to meet loading criteria and prevent deformation or oilcanning of shelf surface.

J. Standard Metal Filler Panels: Flush panels fabricated to match adjacent casework; sizes as determined in field. Back bend all edges and provide concealed fasteners.

K. Metal specialty cabinet fabrications:

1. Custom cabinets as indicated, including but not limited to:
   a. Storage cubbies, with or without adjustable dividers
   b. Specially sized or shaped cabinets to accommodate equipment. Indicated.
   c. Specially vented, piped, or plumbed cabinets.
   d. Cabinets intended to support specific and unusual loads or to withstand specific and unusual conditions.
2. Fabricate specialty cabinets in accordance with requirements for standard base cabinets, and in accordance with the following:
   a. Increase gauge and size of members where required by unusual loadings, spans, supports, or other conditions.
   b. Pressed metal louvers for ventilation may be integral to cabinet construction. Attached louvers shall be stainless steel, lightproof louvers equal to Dayton, Canarm or Ruskin.
      1) Size louver free are for ventilation requirements indicated.
   c. For storage cubbies and units, provide double pan construction with sound deadening core construction.
   d. For cabinets with piping, electrical, or vent connections, provide all necessary collars, grommets, escutcheons and other accessories for final connections. At all penetrations for loose cords and cables provide grommets with screw on or snap in covers.

L. Open frame tables for lab stations (with services):

1. Legs: 2 inch square with all corners radiused, 4-piece construction, fully welded.
   a. Legs and table frames to be full welded.
   b. Provide adjustable height legs where indicated
2. Mobility: Provide adjustable height glides, or locking casters, where indicated. Table legs shall be shortened an amount equal to the added height of the mobility device, to maintain the same range of adjustment.
3. Apron size and configuration as shown in drawings, powder coated steel, full welded.
   a. C-channel apron frames where indicated on drawings for aprons to receive outlets or utilities. Full welded and powder coated to match remainder of frame.
4. Provide standard metal drawers as shown on drawings. Finish to match casework finish.

5. Provide 12 ga bent metal plate computer holder as shown on drawings. Bolted to table leg. Finish to match casework finish.
6. Concealed utility spaces: Fabricate with exposed face not less than 16 ga steel, powder coated.
7. Provide built-into tables, pre-piped and pre-wired for service fixtures and service fittings as scheduled in Section 11 53 43 - SERVICE FITTINGS AND ACCESSORIES. Prepiping and pre-wiring shall meet requirements of Divisions 22, 26, and 27 of this specification.
   a. Outlets and fittings shall be shop installed wherever possible.
   b. Provide monitor arms as specified herein where indicated on drawings.
8. Leg braces
   a. Provide “C” or “H” pattern bottom frames to maintain accessible clearances at tables used for seating.

M. Open frame modular lab bench units:
1. Legs and uprights: 2 inch square with all corners radiused, 4-piece construction, fully welded.
   a. Legs and table frames to be full welded. .
   b. Provide floor leveling glides for tables designated as movable.
   c. Provide adjustable height legs where indicated.
   d. Uprights to be slotted to receive shelf brackets from the top of the unit down to not more than 8” above the finished desk top.
2. Mobility: Provide adjustable height glides, or locking casters, where indicated. Table legs shall be shortened an amount equal to the added height of the mobility device, to maintain the same range of adjustment.
3. All apron frames shall be 2” square to match leg construction unless otherwise noted, powder coated steel, full welded.
   a. Provide 3”, 4”, or other depth C-channel apron frames where indicated on drawings for aprons to receive outlets or utilities. Full welded and powder coated to match remainder of frame.
4. Concealed utility spaces: Fabricate with exposed face not less than 16 ga steel, powder coated.
   a. Provide with removable “false-back” access for wiring.
5. Provide, modular lab benches pre-piped and pre-wired for service fixtures and service fittings as scheduled in Section 11 53 43 - SERVICE FITTINGS AND ACCESSORIES. Prepiping and pre-wiring shall meet requirements of Divisions 22, 26, and 27 of this specification.
   a. Outlets and fittings shall be shop installed wherever possible.
   b. Provide 2 circuits to each unit, with one circuit serving one NEMA 5-20R duplex outlet per 2’ of bench length, in factory-installed wireway above work top, and one circuit serving a duplex NEMA 5-20R at the bottom support leg.
   c. Provide up to 3 service turrets per unit – refer to drawings and schedules for piped service to be provided.
   d. Provide each unit with NEMA L14-20P plug for connection to overhead power, and provide each unit with flexible braided hose connections as specified in section 11 53 43, suitable for types of piped service indicated with quick connect for attachment to ceiling panels.

e. Provide monitor arms as specified herein where indicated on drawings.

6. Leg braces

a. Provide bottom leg braces where required to meet loading and other performance tests. Leg braces, where needed, shall be “C” or “H” configuration to avoid interfering with seating clearance.

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL

A. Install all casework plumb, level, true and straight with no distortions. Cabinets at right angles to each other shall be erected at 90 degrees to each other unless otherwise indicated. Shim as required, using concealed shims. Where cabinets abut other finished work, scribe and apply filler strips, filler panels and fascias for accurate fit with fasteners concealed where practical and flush with cabinets alongside.

B. Base Cabinets: Set cabinets straight, plumb and level. Adjust sub-tops within 1/16 inch of a single plane.

1. Fasten each individual cabinet to wall, with stainless steel or chrome finished oval head screws with grommets spaced 24 inches on center.

2. Bolt continuous cabinets together. Secure individual cabinets with not less than two fasteners into floor, where they do not adjoin other cabinets.

a. Where required, assemble units into one integral unit with joints flush, tight, and uniform. Align similar adjoining doors and drawers to a tolerance of 1/16 inch.

C. Wall Cabinets: Securely fasten to solid supporting material, not plaster, lath, or wall board. Anchor, adjust, and align wall cabinets as specified for base cabinets.

1. Reinforcement of stud walls to support wall-mounted cabinets will be done during wall erection by trade involved, but responsibility for accurate location and sizing of reinforcement is part of this work.

D. Adjust casework and hardware so that doors and drawers operate smoothly without wrap or bind. Lubricate operating hardware as recommended by manufacturer.

E. Install countertops and sinks in accordance with manufacturers' instructions; set plumb, square and true, securely anchored to cabinet framing or supporting legs as appropriate.

F. Coordinate installation of work of this section with casework and tops provided under other sections for a complete and properly functioning package.

3.2 MOBILE UNITS INSTALLATION

A. Install all modular lab benches, tables and mobile casework as indicated. Ensure shelving, casework and work surfaces plumb, level, true and straight with no distortions. Cabinets at right angles to each other shall be erected at 90 degrees to each other unless otherwise indicated. Shim as required, using concealed shims.

B. Fasten adjacent modular bench units to one another. Tie in all quick connects and power at modular benches.

C. Adjust casework and hardware so that doors and drawers operate smoothly without wrap or bind. Lubricate operating hardware as recommended by manufacturer.

3.3 INSTALLATION OF TOPS AND SHELVES

A. Workmanship: Abut top and edge surfaces in one true plane, with internal supports placed to prevent any deflection. Provide flush hairline joints in shelves and tops exceeding 10 feet in length.

B. Provide scribe molding for closures at junctures of top and splash with walls and with units alongside as recommended by manufacture for materials involved.

C. Where counter top backs and end splashes abut drywall partitions, seal joints with clear silicone sealant.

END OF SECTION

SECTION 12 36 52
LABORATORY TOP REPAIR

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Refinish and repair lab tops at all locations indicated on documents. .

1. Provide all necessary material, labor, and equipment. Provide adequate temporary protection to all adjacent surfaces that may be damaged by the work of this section.

1.2 RELATED SECTIONS

A. General Conditions and General Requirements of the Contract for Construction are applicable to the work of this section. Attention is to be given to related work sections, including but not limited to:

B. Section 12 35 52 – COMMON WORK RESULTS FOR LABORATORY FURNITURE AND CASEWORK: Performance, fabrication, installation, and cleaning requirements for work of this Section.

C. Section 12 36 53 – LABORATORY COUNTERTOPS: Laboratory epoxy countertops to be installed in conjunction with the work of this Section

1.3 REFERENCES

A. Comply with applicable requirements of the following standards and those others referenced in this Section, under the provisions of Division 1 – GENERAL REQUIREMENTS. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.

1. American Society for Testing and Materials (ASTM):
   a. ASTM D570 – Standard Test Method for Water Absorption of Plastics.
   b. ASTM D635 – Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.1
   c. ASTM D638 – Standard Test Method for Tensile Properties of Plastics.
   d. ASTM D648 – Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position.
   e. ASTM D695 – Standard Test Method for Compressive Properties of Rigid Plastics.
   f. ASTM D785 – Standard Test Method for Rockwell Hardness of Plastics and Electrical Insulating Materials
   g. ASTM D790 – Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
   h. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials
   i. ASTM G22-76(1996) – Determining Resistance of Plastics to Bacteria (a withdrawn standard).
2. National Sanitation Foundation (NSF/ANSI): Standard 51 – Food Equipment Materials.
3. Scientific Equipment and Furniture Association (SEFA): SEFA-3 Laboratory Work Surfaces
4. California Department of Health Services Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers, including 2004 Addenda.

1.4 QUALITY ASSURANCE

A. Refer to Section 12 35 52 for quality assurance requirements for work of this and related sections.

1.5 SUBMITTALS

A. Lab casework elements are included under multiple specification sections. It is the responsibility of the contractor to assemble a complete submittal package cross-referencing all specification sections and requirements and showing a complete casework package.

B. Submit the following under provisions of Division 1 – GENERAL REQUIREMENTS:
   1. Literature: Manufacturer's product data sheets, specifications, performance data, physical properties for items included in the work.
   2. Materials schedule: A complete schedule of components, coordinated with the Contract Drawings.
   3. Manufacturer’s instructions: Manufacturer’s installation instructions indicating special procedures, requirements for anchoring and supporting work, and perimeter conditions requiring special attention.
   4. Warranty: Sample warranty for approval, and executed warranty as part of closeout documents.
   5. Operations and maintenance materials and manuals for all installed work

1.6 SEQUENCING AND SCHEDULING

A. Provide shop drawings and submittals in a timely fashion to permit fabrication of long-lead items and maintain overall construction schedule.

B. Coordinate repair and refurbishment of lab tops with work of other laboratory casework components.

1.7 PRODUCT HANDLING

A. Comply with requirements of Section 12 35 52 for delivery, storage, and handling, and for acceptable site conditions for receiving and installing work of this section and of casework supporting work of this section.

1.8 WARRANTY

A. Provide manufacturer’s one-year warranty against all defects in material or workmanship. Warranty for any element of the work shall not commence prior to the date of Owner’s beneficial occupancy of the space in which the work is installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design (Specified Manufacturer): To establish a standard of quality, design and function desired, Drawings and specifications have been based on Durcon.

B. Alternate Acceptable Manufacturers: Subject to compliance with performance and function requirements products from alternate manufacturers may be provided

2.2 PRODUCTS

A. Top covers
   1. New epoxy tops, cut to fit over existing tops.
   2. 3/8” min thickness, rounded edge.
   3. Set fully in epoxy adhesive compatible with material
   4. Pre-cut and pre-drill for all existing benchtop utilities.

5. New epoxy top covers shall be the same products and finishes specified under division 12 36 53

B. Epoxy adhesive

1. Manufacturer's standard single component.

2.3 PERFORMANCE REQUIREMENTS

A. Top covers

1. Top covers shall meet the chemical resistance requirements for new tops as specified in section 12 36 53.
2. Refinished tops shall show no bubbling, delamination or uneven color.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation requirements at ACM counters

1. Some tops to be refurbished by be asbestos containing. **Asbestos-containing tops shall not be subjected to abrasion, sawing, or other activities that risk the release of asbestos materials.**

B. Repair

1. Field measure all utilities, sizes, and penetrations.
2. Shop cut top covers for all utility and sink penetrations.
3. Install atop covers aligned to top below, and tight to all edges.
4. Full bed new top covers in epoxy adhesive.
5. Provide epoxy adhesive joints at any seams between panels, and between new top covers and existing backsplashes and side splashes.

3.2 ADJUSTMENT, PROTECTION, AND CLEANING

A. General: Do not permit debris or rubbish to accumulate inside on finished tops – promptly remove all rubbish and debris from work area.

B. After installation, protect all exposed finishes or components until final cleaning and acceptance.

C. Damaged Work: Repair equal to new undamaged work, as acceptable to Architect.

END OF SECTION

SECTION 12 36 53
LABORATORY COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install 1" epoxy resin laboratory countertops, backsplashes and accessories.
   1. Provide tall backsplash (up to 15" as shown on drawings) behind all sinks.
   2. Provide matching counters at fixed and mobile casework.
   3. Provide side splashes, fillers, and closure panels where indicated and where required for a complete installation.

B. Furnish and install 1" nominal engineered quartz laboratory countertops, backsplashes, and accessories
   1. Provide tall backsplash (up to 15" as shown on drawings) behind all sinks.
   2. Provide matching counters at fixed and mobile casework.
   3. Provide side splashes, fillers, and closure panels where indicated and where required for a complete installation.

C. Provide epoxy resin drop-in or undermount sinks of types indicated, where indicated.

1.2 RELATED SECTIONS

A. General Conditions and General Requirements of the Contract for Construction are applicable to the work of this section. Attention is to be given to related work sections, including but not limited to:

B. Section 10 10 00 – VISUAL DISPLAY UNITS: Visual display units including markerboards, sliding markerboards, and other types of writeable surface incorporated into casework and countertops of this section.

C. SECTION 11 53 00 – LABORATORY EQUIPMENT: Requirements for equipment supporting or supported by countertops of this section.

D. Section 11 53 43 – SERVICE FITTINGS AND ACCESSORIES: Requirements for service outlets and accessory fittings.

E. Section 12 35 52 – COMMON WORK RESULTS FOR LABORATORY FURNITURE AND CASEWORK: Performance, fabrication, installation, and cleaning requirements for work of this Section 12 35 53.

F. Section 12 35 53.13 – METAL LABORATORY CASEWORK: Casework to receive tops provided in this section.

G. Division 22 –PLUMBING: Piped services connections for work of this section and Section 11 53 13.

H. Division 26 – ELECTRICAL: All electrical fittings, wiring and components, related to work of this and related sections.

I. Division 27 – COMMUNICATIONS: All electrical fittings, wiring and components for IT and low voltage communications connections to work of this section.

1.3 REFERENCES

A. Comply with applicable requirements of the following standards and those others referenced in this Section, under the provisions of Division 1 – GENERAL REQUIREMENTS. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.

1. American Society for Testing and Materials (ASTM):
   a. ASTM D570 – Standard Test Method for Water Absorption of Plastics.
   b. ASTM D635 – Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.1
   c. ASTM D638 – Standard Test Method for Tensile Properties of Plastics.
   d. ASTM D648 – Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position.
   e. ASTM D695 – Standard Test Method for Compressive Properties of Rigid Plastics.
   f. ASTM D785 – Standard Test Method for Rockwell Hardness of Plastics and Electrical Insulating Materials
   g. ASTM D790 – Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
   h. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials
   i. ASTM G22-76(1996) – Determining Resistance of Plastics to Bacteria (a withdrawn standard).
2. National Sanitation Foundation (NSF/ANSI): Standard 51 – Food Equipment Materials.
3. Scientific Equipment and Furniture Association (SEFA): SEFA-3 Laboratory Work Surfaces
4. California Department of Health Services Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers, including 2004 Addenda.

1.4 QUALITY ASSURANCE

A. Refer to Section 12 35 52 for quality assurance requirements for work of this and related sections.

1.5 SUBMITTALS

A. Lab casework elements are included under multiple specification sections. It is the responsibility of the contractor to assemble a complete submittal package cross-referencing all specification sections and requirements and showing a complete casework package.

B. Submit the following under provisions of Division 1 – GENERAL REQUIREMENTS:

1. Literature: Manufacturer's product data sheets, specifications, performance data, physical properties for items included in the work.
2. Sustainable Materials Literature:
   a. Adhesives and Sealants: Include certification of data indicating Volatile Organic Compound (VOC) content of all field-applied adhesives and sealants and compliance with California Department of Health Services Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers, including addenda. Submit MSDS highlighting VOC limits..
3. Materials schedule: A complete schedule of casework components, coordinated with the Contract Drawings.
4. Manufacturer’s instructions: Manufacturer’s installation instructions indicating special procedures, requirements for anchoring and supporting work, and perimeter conditions requiring special attention.

5. Warranty: Sample warranty for approval, and executed warranty as part of closeout documents.
6. Quality Assurance reports: Literature from fabricators, suppliers, and installers showing compliance with Quality Assurance requirements of Section 12 35 52
   a. Submit test data showing compliance with required finish and function tests included in this Section and Section 12 35 52. As appropriate for the type of product supplied
   b. Where other tests are prescribed by the requirements of SEFA 3 for specific product types and configurations shown, submit all tests in accordance with SEFA standards
7. Shop Drawings in sufficient detail to show fabrication, installation, anchorage, and interface of the work of this Section with the work of adjacent trades.
   a. Indicate locations of all proposed seams.
8. Selection samples:
   a. 6 inch by 6 inch **minimum** samples of specified finishes and products including top and sink materials, and showing range of available colors and finishes.
9. Verification samples:
   a. Complete epoxy top with joint and backsplash as part of the complete mockup specified in SECTION 12 35 52 – COMMON WORK RESULTS FOR LABORATORY FURNITURE AND CASEWORK
   b. For each engineered quartz color and pattern selected, provide samples not less than 12” by 12” showing full extent of variations in appearance characteristics expected in the completed work.
10. Operations and maintenance materials and manuals for all installed work
11. Compatibility report showing Division 7 joint sealant products are compatible with, and will not stain or damage engineered quartz products.

1.6 FIELD MEASUREMENTS

A. Provide all field measurements, and coordinate all established dimensions required for the work of this section in accordance with requirements of SECTION 12 35 52 – COMMON WORK RESULTS FOR LABORATORY FURNITURE AND CASEWORK.

1.7 SEQUENCING AND SCHEDULING

A. A. Coordinate the work of this Section with the respective trades responsible for installing inter-facing work, and ensure that the work performed hereunder is acceptable to such trades for the installation of their work

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle all elements of work required for this section in accordance with requirements of SECTION 12 35 52 – COMMON WORK RESULTS FOR LABORATORY FURNITURE AND CASEWORK.

B. Store engineered quartz tops on wood A-frames or pallets with non-staining separating separators and non-staining waterproof covers. Ventilate to prevent condensation.

1.9 WARRANTY

A. Provide manufacturer’s two year warranty against all defects in material or workmanship. Warranty for any element of the work shall not commence prior to the date of Owner’s beneficial occupancy of the space in which the work is installed.

B. Provide longer warranties for any element of the work where manufacturer’s warranty exceeds two years.

PART 2 - PRODUCTS

2.1 EPOXY PRODUCTS

A. Basis of Design: To establish a standard of quality, design and function desired, Drawings and specifications have been based on: The Durcon Company, Inc., Taylor Texas.
   1. Basis of design color - Durcon Epoxy “Graphite”

B. Alternate Manufacturers: Subject to conformance with requirements, products by the following manufacturers may be accepted:
   1. The Durcon Company, Inc. Taylor, Texas
   2. Kewaunee Scientific, Statesville, NC.
   3. LabTech Supply. Santa Ana, CA.

2.2 ENGINEERED STONE (QUARTZ) PRODUCTS

A. Basis of Design: To establish a standard of quality, design, and function desired, drawings and specifications have been based on Silestone, Cosentino Industrial, Cantoria Spain
   1. Basis of design color “Stellar Night”

B. Alternate Manufacturers: Subject to conformance with requirements, products by the following manufacturers may be accepted
   1. MSI, Orange, CA
   2. Ceasarstone, Charlotte, NC
   3. Wilsonart Quartz

2.3 PERFROMANCE CRITERIA

A. Epoxy Sheet product for countertops, shelves and backsplashes, minimum tested physical performance criteria:
   1. Flexural Strength (tested per ASTM D790): 14,500 To 14,900 PSI.
   2. Modulus of Elasticity (tested per ASTM D790): 2,000,000 PSI.
   3. Compressive Strength (tested per ASTM D695): 33,500 To 38,100 PSI
   4. Tensile Strength (tested per ASTM D638/D651): 6,400+ PSI.
   5. Hardness, Rockwell "M" Scale (tested per ASTM D785): Values Of 105 To 113, Over 5 Samples - Average 109.
   6. Water Absorption (tested per ASTM D570): 0.008 To 0.02% After 24 Hours.
   7. Heat Distortion (tested per ASTM D648): 380 F (193 C).
   8. Flammability or Fire Resistance (tested per ASTM D635) did not ignite or self-extinguishing.
   9. Temperature Use Limit: 331 degrees F. (166 degrees C.).
   10. Fungai and Bacterial Growth Resistance (tested per ASTM G22): Approved.
   11. Food and Splash Zone (tested per NSF/ANSI Standard 51): Approved.
   12. Fire Resistance - Smoke Developed Index (tested per ASTM E84): 8.71 (In) / 221.2 (Mm).

B. Sheet product for countertops shelves and backsplashes, chemical resistance:
   1. Tested in accordance with 12 35 52-Part 2.1-A Test 1.

C. Engineered stone Sheet product for countertops and backsplashes, minimum tested physical performance criteria:
   1. Flexural Strength (tested per ASTM D790): 14,500 To 14,900 PSI.
   2. Modulus of Elasticity (tested per ASTM D790): 2,000,000 PSI.
   3. Compressive Strength (tested per ASTM D695): 33,500 To 38,100 PSI
   4. Tensile Strength (tested per ASTM D638/D651): 5,600+ PSI.

5. Hardness, (ASTM D2583) – 60-65
6. Water Absorption (tested per ASTM D570): 0.008% To 0.04% After 24 Hours.
7. Heat Distortion (tested per ASTM C484) – No effect
8. Flammability or Fire Resistance (tested per ASTM D635) did not ignite or self-extinguishing.
9. Boiling water test (NEMA LD3-3.5) – No effect
10. Fungai and Bacterial Growth Resistance (tested per ASTM G22): Approved.
11. Food and Splash Zone (tested per NSF/ANSI Standard 51): Approved.
12. Fire Resistance - Smoke Developed Index (tested per ASTM E84): Class I

D. Sheet product for countertops shelves and backsplashes, chemical resistance:
1. Tested in accordance with 12 35 52-Part 2.1-A Test 1.

2.4 SHEET PRODUCTS

A. Epoxy Countertops:
1. 1 inch thick molded modified epoxy resin. Colors as selected above.
2. Tops shall be a uniform mixture throughout their full thickness and not depend upon a surface coating for chemical or stain resistance.
3. Backsplashes and sidesplashes- 4 inches high at typical counters. Taller backsplashes as shown at sinks and other locations. All back and sidesplashes to be 1 inch thick. End curbs shall be provided at end of runs to maintain continuity of the integral curb.
4. Countertops 10 feet or less in length shall be seamless. When length of top exceeds 10 feet, seams may be provided parallel to the short dimension (Locate as shown on reviewed and accepted shop drawings). Limit seams to absolute minimum number.
5. Edge detail: 1/8” standard 45 degree bevel at all exposed edges. Drip groove at all exposed edges.

B. Epoxy Shelves
1. 1 inch thick molded modified epoxy resin. Colors as selected above.
2. Provide lengths and depths as indicated. Coordinate fabrication with approved shelf supports to receive epoxy shelves.
3. Edge Detail: 1/8” standard 45 degree bevel at all exposed edges. Drip groove at all exposed edges.

C. Fillers, Closure Plates, Cover Plates
1. Fabricate from same material as adjacent tops.
2. Install flush, with hairline seams sealed tight at all fixed locations.
3. Provide concealed fasteners to substrates.

D. Engineered Stone (Quartz) Countertops
1. 30mm / 1 1/8” nominal molded engineered stone consisting of up to 90% pulverized quartz and other minerals with resin binder and pigments.
2. Tops shall be a uniform mixture throughout their full thickness and not depend upon a surface coating for chemical or stain resistance.
3. Backsplashes and sidesplashes- 4 inches high at typical counters. Taller backsplashes as shown at sinks and other locations. All back and sidesplashes to be 1 inch thick. End curbs shall be provided at end of runs to maintain continuity of the integral curb.
4. Countertops 10 feet or less in length shall be seamless. When length of top exceeds 10 feet, seams may be provided parallel to the short dimension (Locate as shown on reviewed and accepted shop drawings). Limit seams to absolute minimum number.
5. Edge detail: 1/8” standard 45 degree bevel at all exposed edges. Drip groove at all exposed edges.

2.5 MOULDED PRODUCTS

A. Sinks: Basis of Design: To establish a standard of quality, design and function desired, Drawings and specifications have been based on: The Durcon Company, Inc., Taylor Texas.
   1. Sink Models: As indicated in drawings

B. Sinks, General: Molded of same material as countertops, size as indicated on Drawings, with all inside corners coved and bottom pitched to drain outlet.
   1. Construction: Drop-in or undermount type sink, as indicated. with tapered side of sink and inside corners radiused. Pitch bottom of sink to drain. Provide undermount for sinks that exceed constraints for drop-in sinks and as otherwise indicated on Drawings.
   2. Provide modified epoxy resin outlets. Seal around drain with epoxy sealant as recommended by the sink manufacturer.
   3. Apply sink basins to countertops and ship as integral one piece unit.
   4. Provide sink supports as required for specified sinks.
   5. Provide one overflow for each sink.

2.6 SOURCE CONTROL

A. Provide all epoxy material specified under this section from a single manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Carefully examine the installed work of others and verify that such work is complete to the point where this installation may properly commence. Coordinate with the General Contractor/Construction Manager to verify that required backing and reinforcements are in place, secure, and accurately located and that project is ready for the installation of the laboratory casework.

B. Proceed with work when conditions permit Work to be installed in complete accordance with the original design, accepted submittals, and the manufacturer's written instructions.

C. In the event of discrepancy, immediately notify the Architect in writing. Do not proceed with the installation in areas of discrepancy until issues have been resolved.

3.2 INSTALLATION

A. Counter top lengths shall be fabricated as specified with ends abutting tightly in a hairline joints, single true plane, smooth and level with no raised edges at the joints with supports place to prevent deflection. All joints are to be sealed with corrosion resistant sealants.

B. Make field jointing in same manner as factory jointing using dowels, splines, adhesives, and fasteners recommended by manufacturer. Locate field joints as shown on accepted submittal drawings. Joints shall be factory prepared requiring no job site processing of top and edge surfaces.

C. Tops shall be anchored to base cabinets. Secure tops to cabinets/supports with concealed "Z" type angles or equal fastening devices spaced no more that 24 inches on center, with one located within 6 inches of front and back edge. Tighten according to manufacturer's written instructions to exert a uniform heavy pressure at joints. Countersink exposed heads approximately 1/8 inch and plug flush with material equal in chemical resistant, color, harshness and texture to adjoining surface. Where work surface in intended to be

moveable use a clamping device that is removable. Counter tops to be installed with a maximum 1/8” gap. Secure epoxy countertops to cabinets with epoxy cement, applied at each corner and along perimeter edges at not more than 48 inches o.c.

D. Provide holes and cutouts as required for equipment and service fittings and fixtures. Verify size of opening with actual size of item to be used, prior to making openings. Form inside corners to a radius of not less than 1/8”. After cutting, rout and file cutouts to ensure smooth, crack-free edges. Seal exposed edges after cutting with a chemical resistant sealer recommended by the manufacturer.

E. Provide scribe moldings for closures at junctures of countertop, curb and splash with walls as recommended by manufacturer for materials involved. Match materials and finish to adjacent laboratory casework. Use chemical-resistant, permanently elastic sealing compound where recommended by manufacturer.

F. Wall-to-wall counter tops are to be installed with a maximum 1/4" gap

G. Carefully dress joints smooth, remove surface scratches and clean entire surface.

3.3 INSTALLATION - SHELVES

A. Install shelves on approved shelf supports, with concealed fasteners.

B. Shelves to be monolithic, without joints.

3.4 CLEANING

A. Repair or remove and replace defective, damaged or soiled work to match original factory finish.

B. Clean finished surfaces, including wiping of drawers and cabinet shelves, touch up as required.

C. Clean counter tops leaving tops free of grease and streaks. Use no wax or oils.

3.5 PROTECTION

A. Protect against soiling and deterioration during remainder of construction period.

B. Protect counter tops and ledges for the remainder of the construction period with 1/4” corrugated cardboard or equal completely covering the top and securely taped to edges. Mark cardboard in large lettering “No Standing”.

END OF SECTION

SECTION 200000 - COMMON MECHANICAL/ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. This section of the specifications covers additional general requirements for Division 21 - 28.

B. The basic general requirements for these Divisions are specified in Division 01, the entirety of which is applicable to the MEP Divisions.

1.2 SUPPLEMENTARY MEP DEFINITIONS

A. “Architect means the “Prime Design Consultant.” If R.G. Vanderweil Engineers, LLP is not the Prime Design Consultant, the Architect may authorize R.G. Vanderweil Engineers, LLP to act on the Architect's behalf in matters concerning the systems Vanderweil has designed.

B. The words “Architect” and “Engineer” may be used interchangeably in the mechanical and electrical Division specifications.

C. The terms “Contractor,” “General Contractor,” “Construction Manager,” and “Design-Builder,” may appear in the mechanical and electrical Divisions. Wherever such a term is used, it shall mean the entity that is directing all the construction.

D. “AHJ” means “Authorities Having Jurisdiction.”

E. “MEP” as used herein means the work specified in Divisions 20 through 28, as follows:

1. 23 (HVAC), 26 (Electrical), 27 (Communications)

1.3 ADDITIONAL PROVISIONS RELATING TO THE MEP DOCUMENTS

A. The two-dimensional drawings govern the construction. They show the design intent and are part of the Contract Documents. BIM models are not part of contract documents. They are developed for convenience only.

B. In spaces used by building occupants, but not in mechanical rooms, the architectural drawings shall govern the location of visible mechanical and electrical components. In order to obtain the intended aesthetics in such spaces, prior to installation of visible material and equipment (including access panels), review Architectural Drawings for desired locations and where not definitively indicated, request information from Architect.

C. Maintain maximum headroom at all locations. All piping, duct, conduit, and associated components to be as tight to underside of structure as possible.

D. Systems shall be run in a rectilinear fashion.

E. Requirement for complete MEP systems and coordination adjustments:

1. The two-dimensional drawings and the BIM model are diagrammatic, whether furnished electronically or in hard copy. They indicate general arrangements of mechanical systems and other work, and are intended to convey sufficient information for skilled contractors and tradesmen to furnish and install complete

systems. They are not intended to be absolutely precise or at the level of detail of coordination or shop drawings. They are not intended to show every offset, fitting, and component. The purpose of the drawings and BIM model is to indicate a systems concept, the main components of the systems, and the approximate geometrical relationships. Based on this information Contractor shall provide all other components and materials to make the systems fully complete, coordinated with other systems, the structure and space available, and operational.

1.4 ADDITIONAL REQUIREMENTS FOR MEP DISCREPANCIES

A. Provide systems and components that are fully complete and operational and fully suitable for the intended use.

B. Where Drawings or Specifications conflict or are unclear, or do not coincide with manufacturers' recommendations or with applicable codes and standards, submit clarification request in form of an RFI before installation. Otherwise, make changes in installed work required for compliance with manufacturer instructions or codes and standards within Contract Price. Similarly, where insufficient information exists in the documents to precisely describe a certain component or subsystem, or the routing of a component or its coordination with other building elements submit clarification request in the form of an RFI before installation.

C. If the required material, installation, or work can be interpreted differently from drawing to drawing, or between drawings and specs, provide material, installation or work that is of the higher standard.

D. Where discrepancies exist between the mechanical, plumbing, fire protection, and electrical drawings in regards to what trade owns disconnects or starters, the discrepancy shall be brought to the Architect’s attention in accordance with paragraph (b) above. If the scope is not resolved prior to the Award of Contract, Division 26 shall provide such items.

1.5 MEP DIGITAL DATA TRANSFER REQUIREMENT

A. Electronic BIM files for HVAC, Electrical, or Electronic Safety and Security systems will be furnished by Engineer at contractor’s request. These files will be provided on Engineer’s FTP site in the software release used by the Engineer. If other media or software version is requested, Engineer will require advance reimbursement of processing costs. Requests for electronic files will be honored after receipt of a signed licensing agreement acceptable to Vanderweil.

1.6 MEP CODES, STANDARDS, AUTHORITIES AND PERMITS

A. Perform MEP work in accordance with rules, regulations, standards, codes, ordinances, and laws of local, state, and Federal governments, and other authorities that have legal jurisdiction over the site.

B. Prior to beginning work, secure and pay for all permits and inspections required by the AHJ.

C. Materials and equipment shall be manufactured, installed and tested as specified in latest editions of applicable publications, standards, rulings and determinations of:

Applicable local and state codes, NFPA, OSHA, UL, FM, American Insurance Association (AIA) (formerly National Board of Fire Underwriters), Owner's Insurance Underwriter.

D. Specific reference is made to the following NFPA standards which contain an exceptionally high quantity of mechanical, electrical, and fire protection requirements. These standards as referenced by the applicable building, fire, and mechanical codes shall apply: No. 13 - Installation of Sprinkler Systems, No. 14 - Installation of Standpipe and Hose Systems, No. 20 - Installation of Centrifugal Fire Pumps, No. 30 - Combustible Liquids, No. 37 - Installation of Use of Stationary Combustion Engines and Gas Turbines, No. 45 - Fire Protection for Laboratories Using Chemicals, No. 70 - National Electric Code, No. 72 - National Fire Alarm Code, No. 101 - Life Safety Code

E. Material and equipment shall be listed by UL.

F. When requirements cited in the various parts of the Contract Documents conflict with each other, most stringent shall govern work. Architect may relax this requirement when relaxation does not violate ruling of AHJ. Approval for relaxation shall be obtained from AHJ in writing.

G. Unless indicated otherwise, the most recent editions of applicable specifications and publications of the following organizations form part of these Contract Documents. Material and Equipment shall be approved by the relevant organizations for intended service: AGI, ANSI, ASME, NEMA, ASTM, AWWA, ASHRAE, AMCA, SMACNA, ARI, IEEE, Thermal Insulation Manufacturers Association (TIMA), Insulated Cable Engineers Association (ICEA), Manufacturer's Standardization Society of the Valve & Fittings Industry (MSS)

1.7 SUBMITTALS - SUPPLEMENTARY REQUIREMENTS FOR MEP SYSTEMS

A. These supplemental requirements apply only to the MEP systems and are in addition to the requirements in Division 01.

B. Besides shop drawings, which are submitted relatively early in the project, code-required information on life safety and other systems is required to be submitted prior to claiming construction completion and filing for an occupancy permit. Refer to the specification section covering "Closeout Procedures."

C. Contractor review of MEP submittals shall confirm that the submittal item physically fits into the space available.

D. On the submittal cover sheet, provide the following additional information: (a) Contract Drawing Reference Number, (b) Equipment Tag (from Schedules on drawings), (c) Identify Submission Number (first, second, third, fourth).

E. Also on the submittal cover sheet provide the following: (a) Product representative's contact information, (b) Do all submitted items exactly match scheduled/specified items (Yes, No)?, (c) Is this item a substitution or deviation from the contract documents (Yes, No)?, (d) Does equipment fit space on construction documents, coordination drawings, and actual field conditions (Yes, No)?, (e) Does this material/equipment add expense to other trades or project costs?, (f) Is control interface coordinated (Yes, No)?, (g) List electrical characteristics (Voltage/Phase/Hz/Amps).

F. Provide shop drawings showing details of piping connections to ALL equipment.

G. Division 23 shop drawings and installation layout drawings for heating, pumping, process piping, and refrigeration systems prepared by the Installer shall note name(s), license number(s), and license expiration dates of the installing firm.

H. Sheet metal shop drawings shall show the same content as coordination drawings, but without the fire protection, plumbing and electrical layers superimposed.

I. Engineer will return MEP submittals notated as follows:

"APPROVED AS NOTED"
"Reviewed and found generally acceptable. Minor deviations may be noted. Contractor shall submit:"

- ☐ o further submittal required if notations are complied with.
- ☐ ine-item confirmation of compliance with notations

"PROVISIONALLY APPROVED - CONFIRMATORY RESUBMITTAL REQUIRED"
Submittal shall be considered approved when notations have been incorporated and a resubmittal with explanatory cover letter has been made.

"REJECTED; REVISE AND RESUBMIT"
"Submittal contains deviations which shall be corrected and confirmed by a new submittal."

"REJECTED"
Submittal is incorrect to such an extent that material is unacceptable or is incomplete to such an extent that a complete review cannot be made. Resubmit in accordance with requirements of the Contract Documents."

"NO ACTION"
Submittal not reviewed.

"REVIEWED FOR INFORMATION"
This Submittal is for information only.

1.8 ADDITIONAL REQUIREMENTS FOR MEP PHOTOGRAPHIC DOCUMENTATION

A. The MEP record photos are specifically for the mechanical and electrical trades in concealed areas.

B. Take photographs of all concealed systems and equipment in inaccessible ceilings, shafts, underground (buried) piping routes and other concealed, not readily-accessible areas. At completion of work, submit digitally, with explanatory information for each. These are information submittals.

1.9 SUPPLEMENTARY REQUIREMENTS FOR MEP OPERATION AND MAINTENANCE MANUALS

A. Provide lubrication instructions for each item that requires lubrication.

B. Incorporate system one-line and flow diagrams, to indicate how each component relates to the whole.

C. Include valve directory showing each valve with I.D., and show I.D.'s on respective one line or flow diagrams.

D. Include copy of HVAC balancing report.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 LIFE SAFETY SYSTEMS - REQUIREMENTS FOR CERTIFICATE OF OCCUPANCY

A. Scheduling Life Safety Work

1. Schedule work so life safety systems are complete in advance of other systems. This requirement is to allow the Engineer to conduct a final project visit and correction of issues found without affecting issuance of a Substantial Completion Certificate or a Certificate of Occupancy.

B. Life Safety Systems Include

1. Fire Suppression Systems
2. Fire Notification (Alarm) and Detection Systems
3. Smoke Control Systems and Special Inspections
4. Egress Signage and Lighting Systems
5. Emergency Power Systems

C. Engineering Certification

1. Contractor shall ascertain from the AHJ whether Engineer must certify completion as a prerequisite for the Occupancy Permit. If so, confirm all systems are complete and notify Engineer in writing at least 10 working days before the Occupancy Certificate is requested.

D. Meaning Of “Complete” for a Life Safety System

1. No further work is required to satisfy the requirements of the drawings, specifications and applicable codes and standards.
2. Systems are fully operational with power to components, valves open, status indicators in "normal" condition and otherwise ready "as-is" to perform required functions.
3. Required product data and shop drawing submittals have been submitted and returned with a "Reviewed" status.
4. Test certificates have been submitted and returned with an ”Approved as Noted” status.
5. Project visit report observations and "punch list" items have been addressed and/or corrected.
6. "O&M" documentation and "as-built" plans have been submitted and returned with a "Reviewed" status.

3.2 MEP CONTRACTORS’ SPECIAL RESPONSIBILITIES

A. Cooperate and coordinate with work of other Sections in executing work of this Section.

1. For equipment provided under any division or section which has connections made under the mechanical or electrical sections, obtain detailed installation and hookup information from the equipment manufacturers.
2. Obtain final roughing dimensions or other information needed for complete installation of items furnished under other Sections or by Owner.
3. Keep fully informed as to shape, size and position of openings required for material or equipment to be provided under all Sections. Give full information so that openings required by work of this Section may be coordinated with other work and other openings and may be provided for in advance.
4. Provide information requested as to sizes, number and locations of concrete housekeeping pads necessary for floor-mounted vibrating and rotating equipment.
5. Notify Architect of location and extent of existing piping, conduit, ductwork and equipment that interferes with new construction. In coordination with and with approval of Architect, relocate piping, ductwork and equipment to permit new work to be provided. Remove non-functioning and abandoned piping, ductwork and equipment. Dispose of or store items.

B. Building Expansion Joints and Firewalls

1. Ductwork, conduit, cable tray, piping, and other horizontal distribution systems shall be provided with expansion provisions when passing across building expansion joints. Provide copper ground jumper across expansion joints for electrical components. Systems shall be run through rated walls, partitions, and floors via approved fireproofed sleeves.

C. Installation Shall Provide Access to Systems

1. Installation shall allow clearances for easy access to systems for routine maintenance, for repairs, and for installing new cable in conduit and cable trays.
2. Access panels shall be installed in ceilings that are not composed of removable tiles. These shall be located where system components exist that have moving parts, motors, or other components requiring periodic maintenance, adjustment, or replacement. Access panels shall be shown on Coordination Drawings and shall be of the type and finish approved by the Architect.

D. Installation Only Items

1. Where a Contractor is required to install items that it does not purchase, coordinate the delivery and be responsible for their unloading from delivery vehicles and for safe handling and field storage up to the time of installation.
   a. Provide field assembly and internal connections, as well as mounting in place of the items, including the purchase and installation of dunnage supporting members and fastenings to adapt them to architectural and structural conditions.
   b. Provide connection to building systems including the purchase and installation of terminating fittings necessary to adapt and connect them to the building systems.

2. Carefully examine items upon delivery. Claims that items have been received in a condition that their installation will require procedures beyond the scope of work of this contract will be considered only if presented in writing within one week of their date of delivery. Unless claims have been submitted, fully recondition or replace damaged items.

E. Surveys and Measurements

1. Base measurements, both horizontal and vertical, on reference points established by Contractor and be responsible for correct layout of work.

2. In event of discrepancy between actual measurements and those indicated, notify Architect in writing and do not proceed with work until written instructions have been issued.

F. Fireproofing

1. Clips, hangers, clamps, supports and other attachments to surfaces to be fireproofed shall be installed, insofar as possible, prior to start of spray fiber work.

2. Ducts, piping and other items that would interfere with proper application of fireproofing shall be installed after completion of spray fiber work.

3. Patching and repairing of fireproofing due to cutting or damaging to fireproofing during course of work shall be performed by installer of fireproofing and paid for by trade responsible for damage and shall not constitute grounds for an extra to Owner.

G. Air Bound Systems

1. If, after systems are operational, piping systems, coils or other apparatus are stratified or air bound (by vacuum or pressure), they shall be repiped with new fittings, air vents, or vacuum breakers at no extra cost. If connections are concealed in furring, floors, or ceilings, installing trade shall bear all expenses of tearing up and refinishing construction and finish, leaving same in as good condition as before it was disturbed.

H. Site Logistics

1. Unload materials and equipment delivered to site. Pay costs for rigging, hoisting, lowering and moving equipment on and around site, in building or on roof.

I. Continuity of Services

1. Do not interrupt existing services without Owner's approval.

2. Schedule interruptions in advance, according to Owner's instructions.

3. Interruptions shall be scheduled at times of day and work so that they have minimal impact on Owner's operations.

4. Include premium time work associated with interruptions of services and/or shutdowns to avoid disruption to Owner's operations.

3.3 MEP - CLEANING OF PIPING

A. Furnish pipe cleaning chemicals, chemical feed equipment, materials and labor necessary to clean piping.

B. Chemicals shall conform to LEED standards for environmental compatibility.

C. Permanently install necessary chemical injection fittings complete with stop valves.

D. After piping systems have been pressure tested and approved for tightness, clean and flush piping as specified and in accordance with applicable codes.

E. Maintain continuous blowdown and make-up during flushing operation.

3.4 MEP AND FIRE PROTECTION COMPLETION REQUIREMENTS

A. Special Provisions for MEP Completion Punchlists

1. When the contract work is substantially complete, if requested by the Contractor, the Engineer will inspect the relevant work to confirm completion status. Prior to the inspection, the Contractor shall submit a punch list of remaining items to be completed as well as the Testing, Adjustment, and Balance report. In the course of the review the Engineer will add a supplement to the Contractor's punch list with any observed remaining work that is not already on the list and provide the modified punch list, in a medium selected at the Engineer's discretion, for the Contractor's convenience in closing out the work.

2. Regardless of what the Engineer observes and does not observe in the inspection, the responsibility for successful completion of the contract in all of its details remains with the Contractor.

3. If, when the Engineer arrives at the site certain areas are not complete and ready for review at the substantial completion stage, the Engineer will not review these areas.

4. Confirmation of Punch List Remediation. Once the engineer has submitted the supplement to the Contractor punch list, it shall be the responsibility of the Contractor to confirm that all the listed items have been correctly remedied. Upon receipt of such confirmation, and at the request of the Contractor, the engineer will perform an additional inspection to confirm completion.

B. Supplementary MEP Provisions for Obtaining Occupancy Permit

1. Contractor shall coordinate with the approved agency (commissioning agent) and owner regarding the preliminary commissioning report and acknowledgement letter, as required by the IBC and IECC as a condition for final inspection.

2. Contractor shall prepare and submit the below life-safety related items as a prerequisite for construction completion and occupancy. These shall be submitted to the Engineer prior to filing for the occupancy permit so that the Engineer can provide the completion documentation to the AHJ in a timely fashion. Provide a copy of all documents to Architect and to Owner. The required Contractor submittals include:

a. Contractor certification that MEP systems have been installed in compliance with the Permit Documents

b. Contractor statement of compliance of (a) the fire protection and fire alarm installation with the contract documents, and (b) testing of the fire alarm in accordance with the manufacturer's specifications.

c. Contractor certification that acceptance tests of the fire protection and life safety systems have been successfully completed.

d. Contractor Test and Material Certificates (per NFPA) for fire protection, fire alarm, smoke control and emergency power systems.

e. As-builts of the fire protection system.

f. Special Inspector Reports (smoke control system testing).

g. HVAC Air and Water Balancing Reports.

h. Contractor certification of successful emergency and standby power test and inclusion of NFPA 110 test report.

i. Contractor certification of successful functional testing of lighting controls system.

j. Contractor certification of successful emergency egress lighting test.

k. Domestic water systems testing, chlorination and water quality documentation.

l. Contractor certification of completion of code-related items on contractor's punch list and supplemental architectural and engineering punch lists.

m. List of remaining punch list items for 100 percent MEP completion.

n. Final as-built drawings, operations and maintenance manuals, final system balancing report and final commissioning reports must be provided to the Owner within 90 days of the receipt of the Certificate of Occupancy.

END OF SECTION

SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Sleeves.
2. Stack-sleeve fittings.
3. Sleeve-seal systems.
4. Sleeve-seal fittings.
5. Grout.
6. Silicone sealants.

B. Related Work:

1. Section 017419 – Construction and Demolition Waste Management Disposal.
2. Section 018113 – Sustainable Design Requirements.
3. Section 018119 – Construction Indoor Air Quality Requirements.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop collar.

B. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, anticorrosion coated or galvanized, with plain ends and integral welded waterstop collar.

C. Galvanized-Steel Sheet Sleeves: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

D. PVC Pipe Sleeves: ASTM D1785, Schedule 40.

E. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

F. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

2.2 STACK-SLEEVE FITTINGS

A. Description: Manufactured, Dura-coated or Duco-coated or galvanized cast-iron sleeve with integral clamping flange for use in waterproof floors and roofs. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

A. Description:

1. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
2. Designed to form a hydrostatic seal of 20 psig (137 kPa) minimum.
3. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
4. Pressure Plates: Carbon steel.
5. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, ASTM B633 of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.

B. Plastic or rubber waterstop collar with center opening to match piping OD.

2.5 GROUT

A. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.6 SILICONE SEALANTS

A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant, ASTM C920, Type S, Grade NS, Class 25, Use NT.

B. Silicone, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade P, Class 25, Uses T and NT. Grade P Pourable (self-leveling) formulation is for opening in floors and other horizontal surfaces that are not fire rated.

C. Silicone Foam: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch (25-mm) annular clear space between piping and concrete slabs and walls.

1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
2. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level.

3. Using grout or silicone sealant, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint.

E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

3.2 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in new slabs as slabs are constructed.

1. Install fittings that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.
2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
3. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level.
4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Use silicone sealant to seal the space around outside of stack-sleeve fittings.

B. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Use grout or silicone sealant to seal the space around outside of sleeve-seal fittings.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.

B. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.6 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:

a. Piping Smaller Than NPS 6 (DN 150): Cast-iron pipe sleeves.
b. Piping NPS 6 (DN 150) and Larger: Cast-iron pipe sleeves.

2. Exterior Concrete Walls below Grade:

a. Piping Smaller Than NPS 6 (DN 150): Cast-iron pipe sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.

b. Piping NPS 6 (DN 150) and Larger: Cast-iron pipe sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs-on-Grade:

a. Piping Smaller Than NPS 6 (DN 150): Cast-iron pipe sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.

b. Piping NPS 6 (DN 150) and Larger: Cast-iron pipe sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.

4. Concrete Slabs above Grade:

   a. Piping Smaller Than NPS 6 (DN 150): Steel pipe sleeves.
   b. Piping NPS 6 (DN 150) and Larger: Steel pipe sleeves.

5. Interior Partitions:

   a. Piping Smaller Than NPS 6 (DN 150): Steel pipe sleeves.
   b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel sheet sleeves.

END OF SECTION 220517

SECTION 220518 - ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Escutcheons.
2. Floor plates.

B. Related Work:

1. Section 017419 – Construction and Demolition Waste Management Disposal.
2. Section 018113 – Sustainable Design Requirements.
3. Section 018119 – Construction Indoor Air Quality Requirements.

1.3 DEFINITIONS

A. Existing Piping to Remain: Existing piping that is not to be removed and that is not otherwise indicated to be removed and salvaged, or removed and reinstalled.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

A. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.

B. One-Piece, Stainless-Steel Type: With polished stainless-steel finish.

C. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

D. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel with polished, chrome-plated finish and spring-clip fasteners.

E. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.

F. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed hinge; and spring-clip fasteners.

2.2 FLOOR PLATES

A. Split Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.

1. Escutcheons for New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.
b. Chrome-Plated Piping: One-piece steel with polished, chrome-plated finish.
c. Insulated Piping: One-piece steel with polished, chrome-plated finish.
d. Insulated Piping: One-piece stainless steel with polished stainless-steel finish.
e. Insulated Piping: One-piece cast brass with polished, chrome-plated finish.
f. Insulated Piping: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
g. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.
h. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece stainless steel with polished stainless-steel finish.
i. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece cast brass with polished, chrome-plated finish.
j. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
k. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.
l. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece stainless steel with polished stainless-steel finish.
m. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece cast brass with polished, chrome-plated finish.
n. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece stamped

steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.

o. Bare Piping in Unfinished Service Spaces: One-piece steel with polished, chrome- plated finish.

p. Bare Piping in Unfinished Service Spaces: One-piece cast brass with polished, chrome-plated finish.

q. Bare Piping in Unfinished Service Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.

r. Bare Piping in Equipment Rooms: One-piece steel with polished, chrome-plated finish.

s. Bare Piping in Equipment Rooms: One-piece cast brass with polished, chrome- plated finish.

t. Bare Piping in Equipment Rooms: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. New Piping: One-piece, floor plate.

3.2 FIELD QUALITY CONTROL

A. Using new materials, replace broken and damaged escutcheons and floor plates.

END OF SECTION 220518

SECTION 220523.12 - BALL VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Bronze ball valves.
2. Steel ball valves.

B. Related Work:

1. Section 017419 – Construction and Demolition Waste Management Disposal.
2. Section 018113 – Sustainable Design Requirements.
3. Section 018119 – Construction Indoor Air Quality Requirements.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1. Certification that products comply with NSF 61and NSF 372.
2. For all interior, wet-applied adhesives, sealants, paints, and coatings related to the work of this Section, submit product and material documentation as outlined in the Submittals article of Section 018113 “Sustainable Design Requirements.”

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, and soldered ends.
3. Set ball valves open to minimize exposure of functional surfaces.

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 operating handles or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer. Acceptable models:
1. Apollo:
   a. 70LF-140
   b. 70LF-240
2. Nibco:
   a. T-580-66-LF
   b. S-580-66-LF
3. Watts:
   a. LFB6000-SS
   b. LFB6001-SS

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B16.5 for flanges on steel valves.
4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
5. ASME B16.18 for solder-joint connections.
6. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 and NSF 372 for valve materials for potable-water service.

D. 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.

E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 4 (DN 100) and larger.
2. Handlever: For quarter-turn valves smaller than NPS 4 (DN 100).

H. Valves in Insulated Piping:

1. Include 2-inch (50-mm) stem extensions.
2. Extended operating handles of nonthermal-conductive material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
3. Memory stops that are fully adjustable after insulation is applied.

2.2 BRONZE BALL VALVES

A. Bronze Ball Valves, Two-Piece with Regular Port and Bronze or Brass Trim:

1. Description:

a. Standard: NSF/ANSI-61-8 Certified
b. 15% glass filled double seal
c. Body Design: Two piece.
d. Body Material: Bronze.
e. Ends: Threaded.
f. Seats: RTFE.
g. Stem: Stainless Steel.
h. Ball: Stainless Steel.
i. Port: Regular.
j. Seat working P/T rating 300 psig @ 250 ºF minimum
k. Body working P/T rating 300 psig @ 300 ºF minimum
l. WOG rating 300 psig minimum
m. Saturated Steam rating 150 psig minimum.
n. Lever Handle Actuator

B. Hose Connection Ball Valves; Bronze Body, Full Port; Two-Piece; 316 Stainless Steel Ball and Stem; PTFE or TFE seat, Seat working P/T rating 300 psig @ 250 ˚F minimum; Body working P/T rating 300 psig @ 300 ˚F minimum; WOG rating 300 psig minimum; saturated steam rating 150 psig minimum; Lever Handle Actuator; NSF/ANSI-61 Certified.
   1. Acceptable Models:
      a. Apollo: 70LF-140-HC, 70LF-240-HC
      b. Nibco: T-585-66-LF-HC, S-585-66-LF-HC
      a. Watts: LFB6000-SS

PART 3 - EXECUTION

3.1 EXAMINATION

A. 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.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. 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.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install valve tags. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

B. Select valves with the following end connections:

1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded ends except where solder- joint valve-end option or press-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Copper Tubing, NPS 5 (DN 125) and Larger: Flanged ends.
4. For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 (DN 125) and Larger: Flanged ends.

3.4 LOW-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 PSIG OR LESS)

A. Pipe NPS 2 (DN 50) and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Bronze ball valves, two-piece with regular port and bronze or brass trim.
3. Bronze ball valves, two-piece with regular port and bronze or stainless steel trim.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Steel and Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.
2. Steel ball valves, Class 150 with regular port.
3. Iron ball valves, Class 150.

3.5 HIGH-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 TO 200 PSIG)

A. Pipe NPS 2 (DN 50) and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Brass ball valve, two-piece with regular port and brass or stainless steel trim.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Steel and Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.
2. Steel ball valves, Class 150 with regular port.

3.5 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) and Smaller:

1. Bronze ball valves, two-piece with regular port and bronze or brass or stainless steel trim. Provide with threaded or solder or press connection-joint ends.
2. Bronze ball valves, two-piece with regular port and bronze or stainless-steel trim.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Steel and Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.
2. Steel ball valves, Class 150 with regular port.
3. Iron ball valves, Class 150.

END OF SECTION 220523.12

SECTION 220523.13 - BUTTERFLY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Iron, single-flange butterfly valves.
2. Iron, flanged-end butterfly valves.
3. CPVC butterfly valves.
4. PVC butterfly valves.
5. Chainwheels.

B. Related Work:

1. Section 017419 – Construction and Demolition Waste Management Disposal.
2. Section 018113 – Sustainable Design Requirements.
3. Section 018119 – Construction Indoor Air Quality Requirements.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene-diene terpolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1. Certification that products comply with NSF 61 Annex G.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set butterfly valves closed or slightly open.

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 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer. Acceptable manufacturers:
1. Apollo
2. Nibco
3. Watts
4. Mueller Co.
5. Kitz Corporation of America 4200 Series.

B. ASME Compliance:

1. ASME B16.1 for flanges on iron valves.
2. ASME B16.5 for flanges on steel valves.
3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
4. ASME B31.9 for building service piping valves.

C. AWWA Compliance: Comply with AWWA C207 for flanged-end connections.

D. NSF Compliance: NSF 61 Annex G for valve materials for potable-water service.

E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valve Actuator Types:

1. Gear Actuator: For valves NPS 8 (DN 200) and larger.
2. Handlever: For valves NPS 6 (DN 150) and smaller.

3. Chainwheel: Device for attachment to gear, handlever, or stem; of size and with chain for mounting height, according to "Valve Installation" Article.

H. Valves in Insulated Piping: With 2-inch (50-mm) stem extensions.

2.2 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. Iron, Single-Flange Butterfly Valves with Aluminum-Bronze Disc:
1. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: ASTM A126, cast iron or ASTM A536, ductile iron.
e. Seat: EPDM.
f. Stem: One- or two-piece stainless steel.
g. Disc: Aluminum bronze.

B. Iron, Single-Flange Butterfly Valves with Ductile-Iron Disc:
1. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: ASTM A126, cast iron or ASTM A536, ductile iron.
e. Seat: EPDM.
f. Stem: One- or two-piece stainless steel.
g. Disc: Nickel-plated ductile iron.

C. Iron, Single-Flange Butterfly Valves with Stainless-Steel Disc:
1. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating, NPS 12 (DN 300) and Smaller: 200 psig (1380 kPa).
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: ASTM A126, cast iron or ASTM A536, ductile iron.
e. Seat: EPDM.
f. Stem: One- or two-piece stainless steel.
g. Disc: Stainless steel.

2.3 DUCTILE-IRON, FLANGED-END BUTTERFLY VALVES

A. Ductile Iron, Flanged-End Butterfly Valves, 175 CWP:
   1. Description:
      a. Standard: MSS SP-67, Flanged Type.
      b. CWP Rating: 175 psig (1200 kPa).
      c. Body Material: fusion-bonded epoxy coated, ductile iron, ANSI class 125/150 flanged ends, drilled per ASME B16.1/B16.5.
      d. Stem: Two-piece stainless steel, per MSS SP-67.
      e. Disc: Epoxy-coated or nickel-plated, ductile iron.
      f. Seal: EPDM.

B. Ductile Iron, flanged-End Butterfly Valves, 300 CWP:
   1. Description:
      a. Standard: MSS SP-67, Flanged Type.
      b. CWP Rating: 300 psig (2070 kPa).
      c. Body Material: Fusion-bonded epoxy coated ductile iron, ANSI Class 300 flanged ends, drilled per ASME B16.1.
      d. Stem: Two-piece stainless steel, per MSS SP-67.
      e. Disc: Epoxy-coated or nickel-plated, ductile iron.
      f. Seal: EPDM.

2.4 CHAINWHEELS

A. Description: Valve actuation assembly with sprocket rim, chain guides, chain, and attachment brackets for mounting chainwheels directly to handwheels.

   1. Sprocket Rim with Chain Guides: Ductile or cast iron, of type and size required for valve.
   2. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.1 EXAMINATION

A. 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.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine mating flange faces for damage. 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.

D. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install chainwheels on operators for butterfly valves NPS 4 (DN 100) and larger and more than 96 inches (2400 mm) above floor. Extend chains to 60 inches (1520 mm) above finished floor.

F. Install valve tags. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

3.3 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.

3.4 LOW-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 PSIG (1035 kPa) OR LESS)

A. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Iron, Single-Flange Butterfly Valves: 200 CWP, NBR seat, stainless-steel disc.

3.5 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM seat, stainless-steel disc.

END OF SECTION 220523.13

SECTION 220523.14 - CHECK VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Bronze lift check valves.
2. Bronze swing check valves.
3. Bronze swing check valves, press ends.

B. Related Work:

1. Section 017419 – Construction and Demolition Waste Management Disposal.
2. Section 018113 – Sustainable Design Requirements.
3. Section 018119 – Construction Indoor Air Quality Requirements.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene-diene terpolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1. Certification that products comply with NSF 61.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set 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 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer. Acceptable manufacturers:
1. Apollo
2. Nibco
3. Watts

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
4. ASME B16.18 for solder joint.
5. ASME B31.9 for building services piping valves.

C. AWWA Compliance: Comply with AWWA C207 for flanged-end connections.

D. Drinking Water System Components - Health Effects and Drinking Water System Components - Lead Content Compliance: NSF 61 and NSF 372.

E. 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.

F. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

G. Valve Sizes: Same as upstream piping unless otherwise indicated.

H. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE LIFT CHECK VALVES

A. Bronze Lift Check Valves with Bronze Disc, Class 125:
   1. Description:

      a. Standard: MSS SP-80, Type 1.
      b. CWP Rating: 200 psig (1380 kPa).
      c. Body Design: Vertical flow.
      d. Body Material: ASTM B61 or ASTM B62, bronze.
      e. Ends: Threaded or soldered. See valve schedule articles.
      f. Disc: Bronze.

B. Bronze Lift Check Valves with Nonmetallic Disc, Class 125:
   1. Description:

      a. Standard: MSS SP-80, Type 2.
      b. CWP Rating: 200 psig (1380 kPa).
      c. Body Design: Vertical flow.
      d. Body Material: ASTM B61 or ASTM B62, bronze.
      e. Ends: Threaded or soldered. See valve schedule articles.
      f. Disc: NBR, PTFE.

2.3 BRONZE SWING CHECK VALVES

A. Bronze Swing Check Valves with Bronze Disc, Class 125:
   1. Description:

      a. Standard: MSS SP-80, Type 3.
      b. CWP Rating: 200 psig (1380 kPa).
      c. Body Design: Horizontal flow.
      d. Body Material: ASTM B62, bronze.
      e. Ends: Threaded or soldered. See valve schedule articles.
      f. Disc: Bronze.

B. Bronze Swing Check Valves with Nonmetallic Disc, Class 125:
   1. Description:

      a. Standard: MSS SP-80, Type 4.
      b. CWP Rating: 200 psig (1380 kPa).
      c. Body Design: Horizontal flow.
      d. Body Material: ASTM B62, bronze.
      e. Ends: Threaded or soldered. See valve schedule articles.
      f. Disc: PTFE.

C. Bronze Swing Check Valves with Bronze Disc, Class 150:
   1. Description:
      a. Standard: MSS SP-80, Type 3.
      b. CWP Rating: 300 psig (2070 kPa).
      c. Body Design: Horizontal flow.
      d. Body Material: ASTM B62, bronze.
      e. Ends: Threaded or soldered. See valve schedule articles.
      f. Disc: Bronze.

D. Bronze Swing Check Valves with Nonmetallic Disc, Class 150:
   1. Description:
      a. Standard: MSS SP-80, Type 4.
      b. CWP Rating: 300 psig (2070 kPa).
      c. Body Design: Horizontal flow.
      d. Body Material: ASTM B62, bronze.
      e. Ends: Threaded or soldered. See valve schedule articles.
      f. Disc: PTFE.

E. Bronze Swing Check Valves, Press Ends:
   1. Description:
      a. Standard: MSS SP-80 and MSS SP-139.
      b. CWP Rating: Minimum 200 psig (1380 kPa).
      c. Body Design: Horizontal flow.
      d. Body Material: ASTM B584, bronze.
      e. Ends: Press.
      f. Press Ends Connection Rating: Minimum 200 psig (1380 kPa).
      g. Disc: Brass or bronze.

PART 3 - EXECUTION

3.1 EXAMINATION

A. 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.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. 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.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Check Valves: Install check valves for proper direction of flow.

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Center-Guided and Plate-Type Check Valves: In horizontal or vertical position, between flanges.
3. Lift Check Valves: With stem upright and plumb.

F. Install valve tags. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

3.3 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.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Pump-Discharge Check Valves:

a. NPS 2 (DN 50) and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
b. NPS 2-1/2 (DN 65) and Larger for Domestic Water: Iron swing check valves with lever and weight or spring; or iron, center-guided, metal-seat or resilient-seat check valves.
c. NPS 2-1/2 (DN 65) and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.

B. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

C. End Connections:

1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded or soldered or press-ends.
2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged or threaded.
3. For Copper Tubing, NPS 5 (DN 125) and Larger: Flanged.
4. For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded.
5. For Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged or threaded.
6. For Steel Piping, NPS 5 (DN 125) and Larger: Flanged.

3.5 LOW-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 PSIG (1035 kPa) OR LESS)

A. Pipe NPS 2 (DN 50) and Smaller:

1. Vertical, Upflow Applications Only: Bronze lift check valves with bronze disc, Class 125, with soldered or threaded end connections.
2. Horizontal and Vertical Applications: Bronze swing check valves with bronze disc, Class 125, with soldered or threaded end connections.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Iron swing check valves with metal seats, Class 125, with threaded or flanged end connections.
2. Iron, single-plate check valves with resilient seat, Class 125, with threaded or flanged end connections.

3.6 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) and Smaller:

1. Bronze swing check valves with bronze disc, Class 125, with soldered or

threaded end connections.

2. Bronze swing check valves with press-end connections.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Ductile Iron, flanged-end swing check valves, 300 CWP.
2. Ductile Iron, flanged-end center-guided wafer check valves, Class 125.
3. Ductile Iron, center-guided check valves with globe, metal seat, Class 125, with threaded or flanged end connections.
4. Ductile Iron, single-plate check valves with resilient seat, Class 125, with threaded or flanged end connections.

END OF SECTION 220523.14

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Fiberglass pipe hangers.
4. Metal framing systems.
5. Fiberglass strut systems.
6. Thermal hanger-shield inserts.
7. Fastener systems.
8. Pipe stands.
9. Pipe-positioning systems.
10. Equipment supports.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 220516 "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.

C. Related Work:

1. Section 017419 – Construction and Demolition Waste Management Disposal.
2. Section 018113 – Sustainable Design Requirements.
3. Section 018119 – Construction Indoor Air Quality Requirements.

1.3 ACTION SUBMITTALS

A. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Fiberglass strut systems.
4. Pipe stands.
5. Equipment supports.

B. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of trapeze hangers.
2. Include design calculations for designing trapeze hangers.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.6 QUALITY ASSURANCE

A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.

B. Pipe Welding Qualifications: Qualify procedures and operators according to 2015 ASME Boiler and Pressure Vessel Code, Section IX.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design trapeze pipe hangers and equipment supports.

B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

2.2 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized, hot-dip galvanized, or electro-galvanized.
3. Nonmetallic Coatings: Plastic coated or epoxy powder coated.
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.

B. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

C. Copper Pipe and Tube Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-58, 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 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:
1. Description: Shop- or field-fabricated pipe-support assembly, made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
2. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.

3. Channels: Continuous slotted carbon-steel or stainless-steel, Type 304 channel with inturned lips.
4. Channel Width: Selected for applicable load criteria.
5. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel or stainless steel.
7. Metallic Coating: Hot-dip galvanized.
8. Paint Coating: Green epoxy, acrylic, or urethane.
9. Plastic Coating: PVC.

B. Non-MFMA Manufacturer Metal Framing Systems:

1. Description: Shop- or field-fabricated pipe-support assembly, made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
2. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.
3. Channels: Continuous slotted carbon-steel or stainless-steel channel with inturned lips.
4. Channel Width: Select for applicable load criteria.
5. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel or stainless steel.
7. Metallic Coating: Hot-dip galvanized
8. Paint Coating: Green epoxy, acrylic, or urethane.
9. Plastic Coating: PVC.

2.5 THERMAL HANGER-SHIELD INSERTS

A. Insulation-Insert Material for Cold Piping: 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 Hot Piping: 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.

2.6 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 anchors, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
   1. Indoor Applications: Zinc-coated or stainless steel.
   2. Outdoor Applications: Stainless steel.

2.7 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:
   1. Description: Single base unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
   2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
   3. Hardware: Galvanized steel or polycarbonate.
   4. Accessories: Protection pads.

C. Low-Profile, Single-Base, Single-Pipe Stand:
   1. Description: Single base with vertical and horizontal members, and pipe support, for roof installation without membrane protection.
   2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
   3. Vertical Members: Two galvanized or stainless-steel, continuous-thread, 1/2-inch (12- mm) rods.
   4. Horizontal Member: Adjustable horizontal, galvanized or stainless-steel pipe support channels.
   5. Pipe Supports: Roller.
   6. Hardware: Galvanized or Stainless steel.
   7. Accessories: Protection pads.

8. Height: 12 inches (300 mm) above roof.

D. 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.

2.8 PIPE-POSITIONING SYSTEMS

A. Description: IAPMO PS 42 positioning system composed of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.9 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-carbon- steel shapes.

2.10 MATERIALS

A. Aluminum: ASTM B221 (ASTM B221M).

B. Carbon Steel: ASTM A1011/A1011M.

C. Structural Steel: ASTM A36/A36M carbon-steel plates, shapes, and bars; black and galvanized.

D. Stainless Steel: ASTM A240/A240M.

E. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.

B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

3.2 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. 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. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-58. Install hangers and attachments as required to properly support piping from building structure.

D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

E. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.

F. 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.

G. Pipe Stand Installation:

1. Pipe Stand Types, except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.

H. Pipe-Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

I. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

J. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

K. Install lateral bracing with pipe hangers and supports to prevent swaying.

L. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 (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.

M. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

N. 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.

O. Insulated Piping:

1. Attach clamps and spacers to piping.

   a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.
   b. Piping Operating Below Ambient Air Temperature: Use thermal hanger-shield insert with clamp sized to match OD of insert.
   c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39 protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

   a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

   a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
   b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
   c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 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.

5. Pipes NPS 8 (DN 200) and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal Hanger Shields: Install with insulation of same thickness as piping insulation.

3.3 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.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and

equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/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.

3.5 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 1-1/2 inches (40 mm).

3.6 PAINTING

A. Touchup: Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05 mm).

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded, shop- painted areas on miscellaneous metal are specified in Section 099123 "Interior Painting."

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.7 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-58 for pipe-hanger 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 finishes.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports and attachments for general service applications.

F. Use stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for hostile environment applications.

G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Use thermal hanger-shield inserts for insulated piping and tubing.

J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F (566 deg C) pipes NPS 4 to NPS 24 (DN 100 to DN 600), requiring up to 4 inches (100 mm) of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36 (DN 20 to DN 900), requiring clamp flexibility and up to 4 inches (100 mm) of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 (DN 15 to DN 600) if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4 (DN 15 to DN 100), to allow off-center closure for hanger installation before pipe

erection.

6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8 (DN 20 to DN 200).
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8 (DN 10 to DN 200).
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3 (DN 10 to DN 80).
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon- steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 (DN 65 to DN 900) if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30 (DN 25 to DN 750), from two rods if longitudinal movement caused by expansion and contraction occurs.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24 (DN 65 to DN 600), from single rod if horizontal movement caused by expansion and contraction occurs.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 (DN 50 to DN 1050) if longitudinal movement caused by expansion and contraction occurs but vertical adjustment is unnecessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 (DN 50 to DN 600) if small horizontal movement caused by expansion and contraction occurs and vertical adjustment is unnecessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 (DN 50 to DN 750) if vertical and lateral adjustment during installation, in addition to expansion and contraction, is required.

K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping

system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24 (DN 24 to DN 600).
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) if longer ends are required for riser clamps.

L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment of up to 6 inches (150 mm) for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11 split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F (49 to 232 deg C) piping installations.

M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I- beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I- beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from

above by using clip and rod. Use one of the following for indicated loads:

a. Light (MSS Type 31): 750 lb (340 kg).
b. Medium (MSS Type 32): 1500 lb (680 kg).
c. Heavy (MSS Type 33): 3000 lb (1360 kg).

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal Hanger-Shield Inserts: For supporting insulated pipe.

O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1- 1/4 inches (32 mm).
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected

equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

a. Horizontal (MSS Type 54): Mounted horizontally.
b. Vertical (MSS Type 55): Mounted vertically.
c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

P. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

R. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

S. Use pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

SECTION 220548 - VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Elastomeric isolation pads.
2. Elastomeric isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Open-spring isolators.
5. Housed-spring isolators.
6. Restrained-spring isolators.
7. Housed-restrained-spring isolators.
8. Pipe-riser resilient support.
9. Resilient pipe guides.
10. Air-spring isolators.
11. Restrained-air-spring isolators.
12. Elastomeric hangers.
13. Spring hangers.
14. Snubbers.
15. Restraints - rigid type.
16. Restraint accessories.
17. Post-installed concrete anchors.
18. Concrete inserts.
19. Vibration isolation equipment bases.

B. Related Work:

1. Section 017419 – Construction and Demolition Waste Management Disposal.
2. Section 018113 – Sustainable Design Requirements.
3. Section 018119 – Construction Indoor Air Quality Requirements.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
   2. Include load rating for each wind-force-restraint fitting and assembly.
   3. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device restraint component.
   4. Annotate to indicate application of each product submitted and compliance with requirements.
   5. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Shop Drawings:
   1. Detail fabrication and assembly of equipment bases.
   2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

C. Delegated-Design Submittal:
   1. Product Listing, Preapproval, and Evaluation Documentation: By UL, showing maximum ratings of restraint items and the basis for approval (tests or calculations).
   2. Design Calculations for Vibration Isolation Devices: Calculate static and dynamic loading due to equipment weight and operating forces required to select proper vibration isolators, and to design vibration isolation bases.
   3. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, and spring deflection changes. Include certification that riser system was examined for excessive stress and that none exists.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of vibration isolation device installation for plumbing piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.

B. Qualification Data: For professional engineer.

C. Welding certificates.

D. Air-Spring Mounting System Performance Certification: Include natural frequency, load, and damping test data performed by an independent agency.

E. Field quality-control reports:

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air-spring isolators to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, be an NRTL as defined by OSHA in 29 CFR 1910.7, and be acceptable to authorities having jurisdiction.

B. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Component Supports:
1. Load Ratings, features, and applications of all reinforcement components must be based on testing standards of a nationally recognized testing agency.
2. All component support attachments must comply with force and displacement resistance requirements of ASCE/SEI 7-16 Section 13.6.

2.2 ELASTOMERIC ISOLATION PADS

A. Elastomeric Isolation Pads:
1. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
2. Size: Factory or field cut to match requirements of supported equipment.
3. Pad Material: Oil and water resistant with elastomeric properties. Neoprene rubber, silicone rubber, or other elastomeric material.
4. Surface Pattern: Smooth, ribbed, or waffle pattern.
5. Infused nonwoven cotton or synthetic fibers.
6. Load-bearing metal plates adhered to pads.
7. Sandwich-Core Material: Resilient and elastomeric.

a. Surface Pattern: Smooth, ribbed, or waffle pattern.
b. Infused nonwoven cotton or synthetic fibers.

2.3 ELASTOMERIC ISOLATION MOUNTS

A. Double-Deflection, Elastomeric Isolation Mounts:
1. Mounting Plates:
   a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.
   b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.
2. Elastomeric Material: Molded, oil- and water-resistant neoprene rubber, silicone rubber, or other elastomeric material.

2.4 OPEN-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators:
1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig (3447 kPa).
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

2.5 HOUSED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators in Two-Part Telescoping Housing:
1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators.

a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig (3447 kPa).
b. Top housing with attachment and leveling bolt

2.6 RESTRAINED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint:
1. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.
   a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig (3447 kPa).
   b. Top plate with threaded mounting holes.
   c. Internal leveling bolt that acts as blocking during installation.
2. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.7 HOUSED-RESTRAINED-SPRING ISOLATORS

A. Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing:
1. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with adjustable snubbers to limit vertical movement.
   a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig (3447 kPa).
   b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without

deformation or failure.

2.8 PIPE-RISER RESILIENT SUPPORT

A. All-Directional, Acoustical Pipe Anchor Consisting of Two Steel Tubes Separated by a Minimum 1/2-inch- (13-mm-) Thick Neoprene:

1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
2. Maximum Load Per Support: 500 psig (3447 KPa) on isolation material providing equal isolation in all directions.

2.9 RESILIENT PIPE GUIDES

A. Telescopic Arrangement of Two Steel Tubes or Post and Sleeve Arrangement Separated by a Minimum 1/2-inch- (13-mm-) Thick Neoprene:
1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.10 AIR-SPRING ISOLATORS

A. Freestanding, Single or Multiple, Compressed-Air Bellows:
1. Bellows Assembly: Upper and lower powder-coated steel sections connected by a replaceable, flexible, nylon-reinforced neoprene bellows or similar elastomeric material.
2. Maximum Natural Frequency: 3 Hz.
3. Operating Pressure Range: 25 to 100 psig (172 to 690 kPa).
4. Burst Pressure: At least three times manufacturer's published maximum operating pressure.
5. Automatic leveling valve.

2.11 RESTRAINED-AIR-SPRING ISOLATORS

A. Freestanding, Single or Multiple, Compressed-Air Bellows with Vertical-Limit Stop Restraint:
1. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.

a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig (3447 kPa).
b. Top plate with threaded mounting holes
c. Internal leveling bolt that acts as blocking during installation.

2. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Bellows Assembly: Upper and lower powder-coated steel sections connected by a replaceable, flexible, nylon-reinforced neoprene bellows or similar elastomeric material.
7. Maximum Natural Frequency: 3 Hz
8. Operating Pressure Range: 25 to 100 psig (172 to 690 kPa).
9. Burst Pressure: At least three times manufacturer's published maximum operating pressure.
10. Automatic leveling valve.

2.12 ELASTOMERIC HANGERS

A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods:
1. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger- rod misalignment without binding or reducing isolation efficiency.
2. Damping Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel-to-steel contact.

2.13 SPRING HANGERS

A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:
1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without

deformation or failure.

6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
8. Self-centering hanger-rod cap to ensure concentricity between hanger rod and support spring coil.

2.14 SNUBBERS

A. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.

1. Post-installed Concrete Anchor Bolts: Secure to concrete surface with post-installed concrete anchors.
2. Anchors in Masonry: Design in accordance with TMS 402.
3. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
4. Resilient Cushion: Maximum 1/4-inch (6-mm) air gap, and minimum 1/4 inch (6mm) thick.

2.15 RESTRAINTS - RIGID TYPE

A. Description: Shop- or field-fabricated bracing assembly made of ANSI/AISI S110-07-S1 slotted steel channels, ANSI/ASTM A53/A53M steel pipe as per NFPA 13, or other rigid steel brace member. Includes accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.16 RESTRAINTS - CABLE TYPE

A. Restraint cable assembly and cable fittings must comply with ASCE/SEI 19. All cable fittings and complete cable assembly must maintain the minimum cable breaking force. U-shaped cable clips and wedge type end fittings do not comply and are unacceptable.

2.17 RESTRAINT ACCESSORIES

A. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod. Non-metallic stiffeners are unacceptable.

B. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings.

C. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

D. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

E. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.18 POST-INSTALLED CONCRETE ANCHORS

A. Mechanical Anchor Bolts:

1. Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488/E488M.

B. Adhesive Anchor Bolts:

1. Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488/E488M.

2.19 CONCRETE INSERTS

A. Comply with ANSI/MSS 58.

2.20 VIBRATION ISOLATION EQUIPMENT BASES

A. Steel Rails: Factory-fabricated, welded, structural-steel rails.
1. Design Requirements: Lowest possible mounting height with not less than 1-inch (25- mm) clearance above the floor. Include equipment anchor bolts and auxiliary motor slide rails.

a. Include supports for suction and discharge elbows for pumps.
2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A36/A36M. Rails shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

B. Steel Bases: Factory-fabricated, welded, structural-steel bases and rails.
1. Design Requirements: Lowest possible mounting height with not less than 1-inch (25- mm) clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
a. Include supports for suction and discharge elbows for pumps.
2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A36/A36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

C. Concrete Inertia Base: Factory-fabricated or field-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch (25- mm) clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
a. Include supports for suction and discharge elbows for pumps.
2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A36/A36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength is adequate to carry static load within specified loading limits.

3.3 INSTALLATION OF VIBRATION CONTROL DEVICES

A. Provide vibration-control devices for systems where indicated on Drawings, or where the Specifications indicate.

B. Coordinate location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."

C. Installation of vibration isolators must not cause any stresses, misalignment, or change of position of equipment or piping.

D. Comply with requirements in Section 077200 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.

E. Equipment Restraints:
   1. Install snubbers on plumbing equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
   2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).

F. Piping Restraints:
   1. Comply with requirements in MSS SP-127.
   2. Space lateral supports a maximum of 40 feet (12 m) o.c., and longitudinal supports a maximum of 80 feet (24 m) o.c.
   3. Brace a change of direction longer than 12 feet (3.7 m).

G. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

H. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

I. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

J. Post-Installed Concrete Anchors:
   1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify Project structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
   2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
   3. Mechanical-Type Anchor Bolts: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
   4. Adhesive-Type Anchor Bolts: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
   5. Set anchors to manufacturer's recommended torque, using a torque wrench.
   6. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.

3.4 INSTALLATION OF AIR-SPRING ISOLATORS

A. Independent Isolator Installation:
   1. Install automatic leveling valve into each air isolator.
   2. Inflate each isolator to height and pressure specified on Drawings.

B. Pressure-Regulated Isolator Installation:
   1. Coordinate the constant pressure-regulated air supply to air springs with the requirements for piping and connections specified in Section 221513 "General-Service Compressed-Air Piping."
   2. Connect all pressure regulators to a single dry, filtered facility air supply.

3. Inflate isolators to height and pressure specified on Drawings.

3.5 INSTALLATION OF VIBRATION ISOLATION EQUIPMENT BASES

A. Coordinate location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."

B. Coordinate dimensions of steel equipment rails, bases, and concrete inertia bases, with requirements of isolated equipment specified in this and other Sections. Where dimensions of bases are indicated on Drawings, they may require adjustment to accommodate actual isolated equipment.

3.6 ADJUSTING

A. Adjust isolators after system is at operating weight.

B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Tests and Inspections:
1. Perform tests and inspections with the assistance of a factory-authorized service representative.
2. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
3. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
4. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
5. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
6. Test to 90 percent of rated proof load of device.
7. Measure isolator restraint clearance.
8. Measure isolator deflection.
9. Verify snubber minimum clearances.
10. Test and adjust restrained-air-spring isolator controls and safeties.

D. Remove and replace malfunctioning units and retest as specified above.

E. Units will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

END OF SECTION 220548

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Stencils.
5. Valve tags.
6. Warning tags.

B. Related Work:

1. Section 017419 – Construction and Demolition Waste Management Disposal.
2. Section 018113 – Sustainable Design Requirements.
3. Section 018119 – Construction Indoor Air Quality Requirements.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
3. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:
1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.
2. Letter Color: White
3. Background Color: Black
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
6. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.

B. Letter Color: White

C. Background Color: Red.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).

F. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two- thirds to three-quarters the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full 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; also include 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.

2.4 STENCILS

A. Stencils for Piping:

1. Lettering Size: Size letters according to ASME A13.1 for piping.
2. Stencil Material: Fiberboard or metal.
3. Stencil Paint: Exterior, gloss, alkyd enamel in colors complying with recommendations in ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.
4. Identification Paint: Exterior, alkyd enamel in colors according to ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.

2.5 VALVE TAGS

A. Valve Tags: 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) minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link chain or beaded chain or S-hook.

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.

2.6 WARNING TAGS

A. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches (75 by 133 mm) minimum.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."

4. Color: Safety yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

A. Piping Color Coding: Painting of piping is specified in Section 099123 "Interior Painting."

B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

C. 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 for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet (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.

D. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

E. Pipe Label Color Schedule:

1. Low-Pressure Compressed Air Piping:

a. Background: Safety blue
b. Letter Colors: White

2. High-Pressure Compressed Air Piping:

   a. Background: Safety blue
   b. Letter Colors: White

3. Domestic Water Piping

   a. Background: Safety green
   b. Letter Colors: White

4. Sanitary Waste and Storm Drainage Piping:

   a. Background Color: Safety black
   b. Letter Color: White

5. Natural Gas Piping:

   a. Background Color: Safety yellow
   b. Letter Color: Black

6. Reverse Osmosis Water Piping:

   a. Background Color: Safety green
   b. Letter Color: White

7. Tempered Water Piping:

   a. Background Color: Safety green
   b. Letter Color: White

3.5 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

   1. Valve-Tag Size and Shape:

a. Cold Water: 1-1/2 inches (38 mm), round
b. Hot Water: 1-1/2 inches (38 mm) round
c. Low-Pressure Compressed Air: 1-1/2 inches (38 mm), round

2. Valve-Tag Colors:

a. Cold Water: Natural
b. Hot Water: Natural
c. Low-Pressure Compressed Air: Natural

3. Letter Colors:

a. Cold Water: White
b. Hot Water: White
c. Low-Pressure Compressed Air: White

3.6 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 220553

SECTION 220593 - TESTING, ADJUSTING AND BALANCING FOR PLUMBING SYSTEMS

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

A. Every new plumbing system and every part of an existing plumbing system that has been altered or repaired shall be inspected and tested. Inspections and tests shall comply with the requirements of this Section. All testing is to be performed by the Contractor unless specifically indicated otherwise.

B. Defects disclosed by tests shall be repaired, or, if required by the Owner, defective work shall be replaced with new work. Tests shall be repeated after defects have been repaired or replaced and shall be repeated as often as necessary until all work passes the required tests.

C. All inactive portions of the potable water system(s) shall be flushed and tested as per Article 3.04 prior to placing in service.

1.02 SUBMITTALS

A. Disinfection and Water Quality Testing Plan (DWQTP), as described in Article 3.03.

B. Tests

1. Manufacturer’s pump tests with curves

C. Reports

1. Disinfection Completion Package, as described in Article 3.03.

2. Lead Remediation Documentation, as described in Article 3.20 (if applicable).

D. Qualifications

1. DWQTP preparer, as described in Article 3.03, paragraph F.13.

2. Water Disinfection and Sampling Company, as described in Article 3.03, paragraph F.14.

3. Laboratory performing water testing, as described in Article 3.03, paragraph F.15.

E. Informational submittals

1. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

2. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

3. Strategies and Procedures Plan: Within 60 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures.

4. Certified TAB reports.

5. Sample report forms.

6. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

F. Quality Assurance

1. Persons performing the Work of this Section shall be certified by NEBB or TABB and shall have experience on at least 2 projects involving same complexities to those required under this Contract. The testing, adjusting and balancing firm shall have a Professional Engineer registered in the State of NY (on staff or a sub-consultant of the testing, adjusting and balancing firm) who shall sign and seal all the reports.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Provide all materials, equipment and other items required for tests, retests, repairs and replacements that are required to complete the Work of this Section.

B. All gauges, instruments and test devices shall be provided with a certificate of calibration and calibration curve or letter indicating that a minimum of five (5) test points have been calibrated. The certificate and letter must show the date of last calibration. The calibration date must be within a year of the testing date.

C. If necessary, provide new (factory wrapped) hose for use during disinfection procedures.

PART 3 - EXECUTION

3.01 PIPING SYSTEM TESTS - GENERAL

A. All new piping and equipment shall be tested prior to application of insulation, painting, concealing or placing of backfill. Testing as stipulated herein shall be considered minimum, and where tests stipulated by authorities having legal jurisdiction exceed these requirements, such more stringent tests shall be performed.

B. The work of the Contractor shall include the furnishing of all labor, testing instruments, gauges, pumps, smoke machines, and other equipment required or necessary for tests, required by law, rules, and regulations and as specified.

C. Provide all other tests required by local inspectors and all other authorities having jurisdiction.

D. All appurtenances shall be operated after installation to determine whether or not they meet the requirements of the Specifications.

E. Where controls and accessories are not designed to withstand pipe test pressures, they shall be removed or otherwise properly protected against damage during such test. After approval of such tests, controls and accessories shall be installed and tested with operating medium to operating pressures.

F. If leaks are observed during any tests the defective work or material shall be replaced. No caulking of screwed joints or holes will be acceptable. Peening of welds is prohibited. Repetition of the entire test will be required as many times as leaks can be observed from the tests, until no leak results in successful completion of the test.

G. All tests shall be made in the presence and to the satisfaction of a representative of the Owner, or their representatives, and the local authorities having legal jurisdiction over the work to be tested, and as may be directed; and at least 72 hours notice shall be given to all parties in advance of all tests.

H. All piping which is to be enclosed in partitions or hung ceilings shall be tested and made tight when directed by the Construction Supervisor representative of the Owner and in adequate time to permit the installation of partitions and ceilings. When necessary, the Contractor shall drain the piping and/or take such precautions as required to prevent damage by freezing.

3.02 TESTING OF AUTOMATIC CONTROLS

A. In cooperation with control manufacturer's representative, adjust controls to operate as specified. Testing personnel shall check all controls for proper calibrations and list all controls requiring adjustment by control installers.

3.03 DRAINAGE AND VENT PIPING INSIDE BUILDING

A. Rough Plumbing: The piping of plumbing drainage and venting system shall be verified as to material and shall be tested upon completion of the rough piping installation and proven to be watertight. The representative of the local agency having jurisdiction may require the removal of any cleanout plugs to ascertain that the prescribed pressure has been reached in all parts of the system.

1. Water Test

A water test shall be applied to the drainage system which includes soil, waste, leader and vent piping either in its entirety or in sections after rough piping has been installed. If applied to the entire system, all openings in the piping, except the highest opening, shall be tightly closed and the system filled with water to the point of overflow. If the system is tested in section, each opening, except the highest opening of the sections under test, shall be tightly plugged and each section filled with water. No section shall be tested with less than a 10 ft., head of water. In testing successive sections, at least the upper 10 ft., of the following section shall be tested, so that no joint or pipe in the building (except the uppermost 10 ft., of the system) shall have been submitted to a test of less than 10 ft., head of water. The water shall be kept in the system or in the portion under the test for at least 15 minutes before inspection starts; the system shall then be tight at all points.

B. Finished Plumbing: After the plumbing fixtures have been set and their traps filled with water the entire drainage system shall be verified as to materials and shall be tested and proven gas tight by smoke test.

1. Final Drainage and vent test:

A smoke test, if deemed necessary by the Plumbing Inspector, shall be performed when the visual final test of the completed drainage and vent system is not in sufficient detail to determine that testing and inspection are in compliance with the NYS Plumbing Code. When the smoke test is utilized, it shall be made by filling all traps with water and then introducing into the entire system a pungent thick smoke produced by one or more smoke machines. When the smoke appears at stack openings of the roof, these openings shall be closed and a pressure equivalent to a 1" water column shall be maintained for the period of inspection.

3.04 POTABLE WATER SUPPLY TEST

A. When the water supply pipes are in place and the branches for the fixtures roughed in, the Contractor shall close all openings and test entire system under a pressure of 150 pounds per square inch for at least one hour as shown upon an approved test gage.

3.05 ADJUSTMENTS

A. During the preliminary operation, the manufacturers of the different apparatus installed, including the starting and stopping devices, shall make adjustments as may be necessary.
B. Contractor shall set all manual balancing valves to design flow rates as shown on drawings. All balancing valve positions shall be marked upon final system testing and verification.

3.06 FIXTURE TEST

A. Fixtures shall be tested for soundness, stability of support, and satisfactory operation of all parts. All water-closet floor flanges must be tested.

3.07 PUMP TESTS

A. All pumps shall be tested by the manufacturers prior to shipment of the pump. The test shall show the characteristic curves, indicating the relations of capacity, head, efficiency and H.P. throughout the pump's entire range. For each pump three certified copies of the tests shall be delivered to the Owner before the pumps are set in position.

3.08 FINAL OPERATING TEST

A. After the completion of the entire work, the Contractor shall operate the entire

installation of plumbing and drainage in the presence of the Owner's Representative and of the representatives of the manufacturers of the different apparatus and appliances installed.

3.09 NOTIFICATION OF OFFICIALS, ETC.

A. The Contractor shall provide written notification to the Owner and all department agencies and bureaus with jurisdiction required to witness any tests falling within their jurisdiction.

In addition, the manufacturers of the apparatus to be tested must have qualified representation at all tests of apparatus supplied by them.

3.10 FUEL, MATERIAL, AND LABOR FOR TESTS, ETC.

A. The Contractor shall furnish all fuel, apparatus, material and labor required for preliminary and final operations, cleaning, testing and adjusting, including the necessary oil, electric current and the services of competent mechanics.

3.11 GAS PIPING SYSTEM

A. Purge all piping before demolition work.

B. Purge all equipment after piping has been purged.

3.12 FINAL TEST OF FIXTURES

A. After all the fixtures are set and connected, Contractor shall turn water on at all fixtures, traps, etc., and the proper working of all shall be demonstrated by him to the satisfaction of the Owner.

3.13 INSPECTION

A. The Owner reserves the right to order the Contractor to disassemble or take apart any or all material and equipment called for in order that it may be inspected to see that it has been constructed in strict accordance with the plans, specifications and details. If after inspection, it is found to fully comply, then the Contractor shall properly reassemble all such material and equipment.

Any material or equipment that does not fully comply with the requirements of the plans, details and specifications will be rejected and shall be at once removed from the premises and shall be replaced with new material and equipment that complies fully with the requirements of the plans, details and specifications.

3.14 PROCEDURE FOR DIRECT REPLACMENT OF POTABLE WATER SYSTEM FIXTURES, FITTINGS AND APPLIANCES

A. When approved in the DWQTP, in lieu of full system disinfection the following procedures may be implemented when potable water system components (e.g., fixtures, fitting, faucets, bubblers, valves, hose bibs, temperature or flow gauges, appliances etc.) are installed or replaced at a school as part of work that does not involve the replacement or installation of associated potable water piping.

B. The procedures indicated apply to both the hot and cold water systems.

1. Potable water system components shall be delivered to the school new and in intact factory-wrapped packaging. Components not in intact factory-wrapped packaging will not be accepted for use. All components shall be maintained in a clean area prior to installation.

2. Prior to installation, turn the water on to flush out any residual sediment or debris from within the piping.

3. Install all components in accordance with applicable codes and regulations.

4. Only remove components from the factory-wrapped packaging at the installation location.

5. Immediately install the components after they are removed from the factory packaging.

6. Tools used for installation shall be disinfected clean and free of deleterious material

7. During installation, the plumber shall handle components in a sanitary manner to avoid contamination of waterside surfaces.

8. Following installation of fixtures or faucets, turn on the hot and cold water valves separately and then simultaneously to confirm proper operation and water flow.

C. After completing the procedure, a letter must be provided which certifies all steps were completed.

D. Assist and coordinate lead testing in accordance with Article 3.20 of this Section, which is required regardless of disinfection or special installation procedure.

3.15 LEAD TESTING OF POTABLE WATER FIXTURES AND FAUCETS FOR CONTRUCTION QA/QC

A. All new pipe, solder, flux, fittings, fixtures, and other appurtenances shall comply with the federally mandated Reduction of Lead in Drinking Water Act of 2011 (Lead-Free Act). In addition, all these components must be “lead-free” as defined in the act. A representative of the Owner’s IEH Division will perform sampling for lead at faucets and fixtures to assure compliance.

B. The Contractor shall provide access, means and otherwise facilitate the collection of water samples from the potable water fixtures (within the scope of contract work) by a representative of the Owner’s IEH Division.

C. All lead results will be reviewed and a determination made by the Owner’s IEH Division as to the suitability of the water for drinking purposes. This determination will be made upon verification that results are below the NYSDOH Action Level for lead in drinking water.

D. If the sample results are deemed unacceptable by the Owner, the Contractor shall be responsible for all actions required to remedy the issue including, but not limited to, pipe system flushing and/or pipe/fixture replacement. Attachment E of Template shall be used for system flushing unless otherwise directed by the Owner.

E. Sampling procedures shall be repeated until acceptable water quality is demonstrated. Potable water system shall not be put into service until successful completion of the lead sampling and written acceptance by the IEH Division.

F. The Contractor shall provide Lead Remediation Documentation to the Owner’s IEH Division, including all documentation related to remedial activities, including flushing logs, replacement fixture model information, etc. Attachment E of Template shall be used for system flushing unless otherwise directed by the Owner.

3.16 PROGRESS REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems balancing devices. Recommend changes and additions to systems balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: Prepare biweekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.17 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
   1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
   2. Include a list of instruments used for procedures, along with proof of calibration.
   3. Certify validity and accuracy of field data.

B. Final Report Contents: In addition to certified field-report data, include the following:
   1. Pump curves.
   2. Manufacturers' test data.
   3. Field test reports prepared by system and equipment installers.
   4. Other information relative to equipment performance; do not include Shop Drawings and Product Data.

C. General Report Data: In addition to form titles and entries, include the following data:
   1. Title page.
   2. Name and address of the TAB specialist.
   3. Project name.
   4. Project location.
   5. Architect's name and address.
   6. Engineer's name and address.
   7. Contractor's name and address.
   8. Report date.
   9. Signature of TAB supervisor who certifies the report.
   10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
   11. Summary of contents including the following:
      a. Indicated versus final performance.
      b. Notable characteristics of systems.
      c. Description of system operation sequence if it varies from the Contract Documents.
   12. Nomenclature sheets for each item of equipment.

13. Notes to explain why certain final data in the body of reports vary from indicated values.

END OF SECTION 220593

SECTION 220716 - PLUMBING EQUIPMENT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes insulating the following plumbing equipment that is not factory insulated:
   1. Domestic water heat exchangers.
   2. Domestic water, hot-water and cold-water pumps.

B. Related Sections:

   1. Section 220719 "Plumbing Piping Insulation."

C. Related Work:

   1. Section 017419 – Construction and Demolition Waste Management Disposal.
   2. Section 018113 – Sustainable Design Requirements.
   3. Section 018119 – Construction Indoor Air Quality Requirements.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied, if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

   1. Detail removable insulation at equipment connections.
   2. Detail application of field-applied jackets.
   3. Detail application at linkages of control devices.
   4. Detail field application for each equipment type.

C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:

1. Sheet Form Insulation Materials: 12 inches (300 mm) square.
2. Sheet Jacket Materials: 12 inches (300 mm) square.
3. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.6 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. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less and smoke-developed index of 150 or less.

1.7 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.

1.8 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with equipment Installer for equipment insulation application.

C. Coordinate installation and testing of heat tracing.

1.9 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 INSULATION MATERIALS

A. Comply with requirements in "Domestic Water Boiler Breeching Insulation Schedule" and "Indoor Equipment Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come into contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable in accordance with ASTM C795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Calcium Silicate: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C533, Type I or Type II.

G. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Comply with ASTM C552.
   1. Block Insulation: Type I.
   2. Special-Shaped Insulation: Type III.
   3. Board Insulation: Type IV.
   4. Factory fabricate shapes in accordance with ASTM C450 and ASTM C585.
   5. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

H. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C534/C534M, Type II for sheet materials.

I. Mineral-Fiber Blanket: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C553, Type II, and ASTM C1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

J. High-Temperature, Mineral-Fiber Blanket: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C553, Type V, without factory-applied jacket.

K. Mineral-Fiber, Pipe and Tank: Mineral or glass fibers bonded with a thermosetting resin. Comply
with ASTM C1393.
1. Semirigid board material with factory-applied ASJ jacket.
2. Nominal density is 2.5 lb/cu. ft. (40 kg/cu. m) or more.
3. Thermal conductivity (k-value) at 100 deg F (55 deg C) is 0.29 Btu x in./h x sq. ft. x deg F (0.042 W/m x K) or less.
4. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C195.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C196.

C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C449.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F (10 to 427 deg C).

C. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F (minus 73 to plus 93 deg C).

D. Flexible Elastomeric and Polyolefin Adhesive: Solvent-based adhesive.
1. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less as tested in accordance with ASTM E84.
2. Wet Flash Point: Below 0 deg F (minus 18 deg C)
3. Service Temperature Range: 40 to 200 deg F (4 to plus 93 deg C).

4. Color: Black.

E. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

F. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

G. PVC Jacket Adhesive: Compatible with PVC jacket.

2.4 MASTICS AND COATINGS

A. Materials shall be compatible with insulation materials, jackets, and substrates.

B. Vapor-Retarder Mastic, Water Based: Suitable for indoor use on below-ambient services.
   1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
   2. Service Temperature Range: 0 to plus 180 deg F (Minus 18 to plus 82 deg C).
   3. Comply with MIL-PRF-19565C, Type II, for permeance requirements
   4. Color: White

C. Vapor-Retarder Mastic, Solvent Based, Indoor Use: Suitable for indoor use on below-ambient services.
   1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
   2. Service Temperature Range: 0 to 180 deg F (Minus 18 to plus 82 deg C).
   3. Color: White

D. Vapor-Retarder Mastic, Solvent Based, Outdoor Use: Suitable for outdoor use on below- ambient services.
   1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
   2. Service Temperature Range: Minus 50 to plus 220 deg F (Minus 46 to plus 104 deg C).
   3. Color: White

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
   1. Water-Vapor Permeance: ASTM E96/E96M, greater than 1.0 perm (0.66 metric perms) at manufacturer's recommended dry film thickness.
   2. Service Temperature Range: 0 to plus 180 deg F (Minus 18 to plus 82 deg C)
   3. Color: White

2.5 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.
   1. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire- resistant lagging cloths over insulation.
   2. Service Temperature Range: 20 to plus 180 deg F (Minus 6 to plus 82 deg C)
   3. Color: White.

2.6 SEALANTS

A. Materials shall be as recommended by the insulation manufacturer and shall be compatible with insulation materials, jackets, and substrates.

B. Joint Sealants:
   1. Permanently flexible, elastomeric sealant.
   2. Service Temperature Range: Minus 150 to plus 250 deg F (Minus 101 to plus 121 deg C)
   3. Color: White or gray.

C. FSK and Metal Jacket Flashing Sealants:
   1. Fire- and water-resistant, flexible, elastomeric sealant.
   2. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
   3. Color: Aluminum.

D. ASJ Flashing Sealants and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
   1. Fire- and water-resistant, flexible, elastomeric sealant.
   2. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
   3. Color: White.

2.7 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

   1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
   2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
   3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.

2.8 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric: Approximately 4 oz./sq. yd. (114 g/sq. m) with a thread count of 5 strands by 5 strands/sq. in. (2 strands by 2 strands/sq. mm) for covering equipment.

B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. (34 g/sq. m) with a thread count of 10 strands by 10 strands/sq. in. (4 strands by 4 strands/sq. mm), in a Leno weave, for equipment.

2.9 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd. (271 g/sq. m).

2.10 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C1136, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
   1. Adhesive: As recommended by jacket material manufacturer.
   2. Color: White.
   3. Factory-fabricated tank heads and tank side panels.

D. Metal Jacket:
   1. Aluminum Jacket: Comply with ASTM B209 (ASTM B209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.

      a. Sheet and roll stock ready for shop or field sizing
      b. Finish and thickness are indicated in field-applied jacket schedules.
      c. Moisture Barrier for Indoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
      d. Moisture Barrier for Outdoor Applications: 2.5-mil- (0.063-mm-) thick polysurlyn.
      e. Factory-Fabricated Fitting Covers:

1) Same material, finish, and thickness as jacket.
2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
3) Tee covers.
4) Flange and union covers.
5) End caps.
6) Beveled collars.
7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2. Stainless-Steel Jacket (Mechanical rooms and Service areas): ASTM A240/A240M.

a. Sheet and roll stock ready for shop or field sizing
b. Material, finish, and thickness are indicated in field-applied jacket schedules.
c. Moisture Barrier for Indoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper
d. Moisture Barrier for Outdoor Applications: 2.5-mil- (0.063-mm-) thick polysurlyn.
e. Factory-Fabricated Fitting Covers:

1) Same material, finish, and thickness as jacket.
2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
3) Tee covers.
4) Flange and union covers.
5) End caps.
6) Beveled collars.
7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

E. Self-Adhesive Outdoor Jacket: 60-mil- (1.5-mm-) thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with white aluminum-foil facing.

F. PVDC Jacket for Indoor Applications: 4-mil- (0.10-mm-) thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perm (0.013 metric perm) when tested in accordance with ASTM E96/E96M and with a flame-spread index of 10 and a smoke-developed index of 20 when tested in accordance with ASTM E84.

G. PVDC Jacket for Outdoor Applications: 6-mil- (0.15-mm-) thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perm (0.007 metric perm) when tested in accordance with ASTM E96/E96M and with a flame-spread index of 25 and a smoke-developed index of 50 when tested in accordance with ASTM E84.

H. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.

2.11 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
   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.
   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.
   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.

E. PVDC Tape for Indoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.
   1. Width: 3 inches (75 mm).
   2. Film Thickness: 2 mils (0.05 mm).
   3. Adhesive Thickness: 1.5 mils (0.04 mm).
   4. Elongation at Break: 145 percent.
   5. Tensile Strength: 20 psi (138 kPa).

2.12 SECUREMENTS

A. Bands:
   1. Stainless Steel: ASTM A240/A240M, Type 304 or Type 316; 0.015 inch (0.38 mm) thick, 1/2 inch (13 mm) wide with wing seal.
   2. Aluminum: ASTM B209 (ASTM B209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 1/2 inch (13 mm) wide with wing seal.

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 1-1/2-inch (38-mm) galvanized carbon- steel washer.

   3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.
      a. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
      b. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch- (2.6- mm-) diameter shank; length to suit depth of insulation indicated.
      c. Adhesive: Recommended by hanger manufacturer. Use product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

   4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.
      a. Baseplate: Perforated, nylon sheet, 0.030 inch (0.76 mm) thick by 1-1/2 inches (38 mm) in diameter.

b. Spindle: Nylon, 0.106-inch- (2.6-mm-) diameter shank; length to suit depth of insulation indicated, up to 2-1/2 inches (63 mm).
c. Adhesive: Recommended by hanger manufacturer. Use product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.
   a. Baseplate: Galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
   b. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed; 0.106-inch- (2.6- mm-) diameter shank, length to suit depth of insulation indicated.
   c. Adhesive-backed base with a peel-off protective cover.

6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.
   a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

D. Wire: 0.062-inch (1.6-mm) soft-annealed, stainless steel.

2.13 CORNER ANGLES

A. PVC Corner Angles: 30-mils (0.8-mm-) thick, minimum 1- by 1-inch (25- by 25-mm) PVC in accordance with ASTM D1784, Class 16354-C, white or color-coded to match adjacent surface.

B. Aluminum Corner Angles: 0.040-inch (1.0-mm-) thick, minimum 1- by 1-inch (25- by 25-mm), aluminum in accordance with ASTM B209 (ASTM B209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14.

C. Stainless Steel Corner Angles: 0.024-inch (0.61-mm-) thick, minimum 1- by 1-inch (25- by 25- mm) stainless steel in accordance with ASTM A240/A240M, Type 304 or Type 316.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances 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.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils (0.127 mm) thick and an epoxy finish 5 mils (0.127 mm) thick if operating in a temperature range between 140 and 300 deg F (60 and 149 deg C). Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F (0 and 149 deg C) with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of equipment, 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. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. 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 attached to structure with vapor-barrier mastic.
3. Install insert materials and 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 insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

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 1-1/2 inches (38 mm). Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 4 inches (100 mm) o.c.

    a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints.

L. Cut insulation in a manner to avoid compressing insulation more than 25 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 in similar fashion to butt joints.

O. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.4 INSTALLATION OF EQUIPMENT, TANK, AND VESSEL INSULATION

A. Mineral-Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives in accordance with manufacturer's recommended coverage rates per unit area, for 50 percent coverage of tank and vessel surfaces.
2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints.

Stagger end joints.

3. Protect exposed corners with secured corner angles.
4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:

    a. Do not weld anchor pins to ASME-labeled pressure vessels.
    b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
    c. On tanks and vessels, maximum anchor-pin spacing is 3 inches (75 mm) from insulation end joints and 16 inches (400 mm) o.c. in both directions.
    d. Do not over-compress insulation during installation.
    e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
    f. Impale insulation over anchor pins, and attach speed washers.
    g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

5. Secure each layer of insulation with stainless steel or aluminum bands. Select band material compatible with insulation materials.
6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches (150 mm) from each end. Install wire or cable between two circumferential girdles 12 inches (300 mm) o.c. Install a wire ring around each end and around outer periphery of center openings and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches (1200 mm) o.c. Use this network for securing insulation with tie wire or bands.
7. Stagger joints between insulation layers at least 3 inches (75 mm).
8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.

1. Apply 100 percent coverage of adhesive to surface with manufacturer's

recommended adhesive.
2. Seal longitudinal seams and end joints.

C. Insulation Installation on Pumps:

1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch (150-mm) centers, starting at corners. Install 3/8-inch- (10-mm-) diameter fasteners with wing nuts. Alternatively, secure the box sections together using a field-adjustable latching mechanism.
2. Fabricate boxes from galvanized steel, aluminum or stainless steel, at least 0.040 inch (1.0 mm) thick.
3. For below-ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.6 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. 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.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. 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.

E. Where PVDC jackets are indicated, install as follows:

1. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches (850 mm) or less. 33-1/2-inch- (850-mm-) circumference limit allows for 2-inch- (50-mm-) overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
2. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.7 FINISHES

A. Equipment Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

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.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

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.

3.8 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections.

B. Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections with the assistance of a factory-authorized service representative.

E. Tests and Inspections: Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Indoor Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.

F. All insulation applications will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports.

3.9 INDOOR EQUIPMENT INSULATION SCHEDULE

A. Insulate indoor and outdoor equipment that is not factory insulated.

B. Domestic water pump insulation shall match adjoining piping insulation.

3.10 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field- applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Equipment, Concealed:
   1. PVC: 20 mils (0.5 mm) thick.
   2. Aluminum, Smooth: 0.016 inch (0.41 mm) thick.

END OF SECTION 220716

SECTION 220719 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes insulating the following plumbing piping services:

1. Domestic cold-water piping.
2. Domestic hot-water piping.
3. Domestic recirculating hot- and tempered-water piping.
4. Domestic chilled-water piping for drinking fountains.
5. Sanitary waste piping exposed to freezing conditions.
6. Storm-water piping exposed to freezing conditions.
7. Roof drains and rainwater leaders.
8. Supplies and drains for handicap-accessible lavatories and sinks.

B. Related Sections:

1. Section 220716 "Plumbing Equipment Insulation" for equipment insulation.

C. Related Work:

1. Section 017419 – Construction and Demolition Waste Management Disposal.
2. Section 018113 – Sustainable Design Requirements.
3. Section 018119 – Construction Indoor Air Quality Requirements.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each

type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties, equipment connections, and access panels.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.

C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:

1. Preformed Pipe Insulation Materials: 12 inches (300 mm) long by NPS 2 (DN 50).
2. Jacket Materials for Pipe: 12 inches (300 mm) long by NPS 2 (DN 50).
3. Sheet Jacket Materials: 12 inches (300 mm) square.
4. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less and smoke-

developed index of 50 or less.

2. Insulation Installed Outdoors: Flame-spread index of 75 or less and smoke-developed index of 150 or less.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
5. Demolish and remove mockups when directed.

C. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.7 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.

1.8 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.9 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 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come into contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable in accordance with ASTM C795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Preformed Pipe: Glass fibers bonded with a thermosetting resin. Comply with ASTM C547.
   1. Preformed Pipe Insulation: Type I, Grade A with factory-applied
   ASJ-SSL. 2. 850 deg F (454 deg C).
   3. Factory fabricate shapes in accordance with ASTM C450 and ASTM C585.
   4. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C195.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C196.

C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C449.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

C. ASJ Adhesive and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A, for bonding insulation jacket lap seams and joints.

D. PVC Jacket Adhesive: Compatible with PVC jacket.

2.4 MASTICS AND COATINGS

A. Materials shall be compatible with insulation materials, jackets, and substrates.

B. Vapor-Retarder Mastic, Water Based: Suitable for indoor use on below-ambient services.
   1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
   2. Service Temperature Range: 0 to plus 180 deg F (Minus 18 to plus 82 deg C).
   3. Comply with MIL-PRF-19565C, Type II, for permeance requirements, with supplier listing on DOD QPD - Qualified Products Database.
   4. Color: White.

C. Vapor-Retarder Mastic, Solvent Based, Indoor Use: Suitable for indoor use on below-ambient services.
   1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
   2. Service Temperature Range: 0 to 180 deg F (Minus 18 to plus 82 deg C).
   3. Color: White.

D. Vapor-Retarder Mastic, Solvent Based, Outdoor Use: Suitable for outdoor use on below- ambient services.
   1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
   2. Service Temperature Range: Minus 50 to plus 220 deg F (Minus 46 to plus 104 deg C).
   3. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
   1. Water-Vapor Permeance: ASTM E96/E96M, greater than 1.0 perm (0.66 metric perms) at manufacturer's recommended dry film thickness.
   2. Service Temperature Range: 0 to plus 180 deg F (Minus 18 to plus 82 deg C).
   3. Color: White.

2.5 LAGGING ADHESIVES

A. Adhesives shall comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.
   1. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire- resistant lagging cloths over pipe insulation.
   2. Service Temperature Range: 20 to plus 180 deg F (Minus 6 to plus 82 deg C).
   3. Color: White.

2.6 SEALANTS

A. Materials shall be as recommended by the insulation manufacturer and shall be compatible with insulation materials, jackets, and substrates.

B. Joint Sealants:
1. Permanently flexible, elastomeric sealant.
2. Service Temperature Range: Minus 58 to plus 176 deg F (Minus 50 to plus 80 deg C).
3. Color: White or gray.

C. FSK and Metal Jacket Flashing Sealants:
1. Fire- and water-resistant, flexible, elastomeric sealant.
2. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
3. Color: Aluminum.

D. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:
1. Fire- and water-resistant, flexible, elastomeric sealant.
2. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
3. Color: White.

2.7 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.

2.8 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric: Approximately 2 oz./sq. yd. (68 g/sq. m) with a thread count of 10 strands by 10 strands/sq. in. (4 strands by 4 strands/sq. mm) for covering pipe and pipe fittings.

B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. (34 g/sq. m) with a thread count of 10 strands by 10 strands/sq. in. (4 strands by 4 strands/sq. mm), in a Leno weave,

for pipe.

2.9 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd. (271 g/sq. m).

2.10 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C1136, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
   1. Adhesive: As recommended by jacket material manufacturer.
   2. Color: White.
   3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

      a. 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.

D. Metal Jacket:
   1. Aluminum Jacket: Comply with ASTM B209 (ASTM B209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.

      a. Sheet and roll stock ready for shop or field sizing.
      b. Finish and thickness are indicated in field-applied jacket schedules.
      c. Moisture Barrier for Indoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper
      d. Moisture Barrier for Outdoor Applications: 2.5-mil- (0.063-mm-) thick polysurlyn.
      e. Factory-Fabricated Fitting Covers:

         1) Same material, finish, and thickness as jacket.
         2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
         3) Tee covers.
         4) Flange and union covers.
         5) End caps.

6) Beveled collars.
7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2. Stainless-Steel Jacket: ASTM A240/A240M.

a. Sheet and roll stock ready for shop or field sizing
b. Material, finish, and thickness are indicated in field-applied jacket schedules.
c. Moisture Barrier for Indoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper
d. Moisture Barrier for Outdoor Applications: 2.5-mil- (0.063-mm-) thick polysurlyn.
e. Factory-Fabricated Fitting Covers:

1) Same material, finish, and thickness as jacket.
2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
3) Tee covers.
4) Flange and union covers.
5) End caps.
6) Beveled collars.
7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

E. Self-Adhesive Outdoor Jacket: 60-mil- (1.5-mm-) thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a cross-laminated polyethylene film covered with [white] [stucco-embossed] aluminum-foil facing.

2.11 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
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.
   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.
   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.

2.12 SECUREMENTS

A. Bands:
   1. Stainless Steel: ASTM A240/A240M, Type 304 or Type 316; 0.015 inch (0.38 mm) thick, 1/2 inch (13 mm) wide with wing seal.
   2. Aluminum: ASTM B209 (ASTM B209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14,
      0.020 inch (0.51 mm) thick, 1/2 inch (13 mm) wide with wing seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

C. Wire: 0.062-inch (1.6-mm) soft-annealed, stainless steel.

2.13 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:
   1. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with

Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures:
   1. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold- water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

   1. Verify that systems to be insulated have been tested and are free of defects.
   2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of 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 storage, application, and finishing. Replace insulation materials that get wet.

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 attached to structure with vapor-barrier mastic.
3. Install insert materials and 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. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. 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 1-1/2 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 4 inches (100 mm) o.c.

a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 25 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. 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 in similar fashion to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. 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 Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. 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.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 GENERAL 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 Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or sectional pipe insulation made from same material and density as that of adjacent pipe insulation. 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.

3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as that used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 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.
5. 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 2 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.
6. Insulate flanges, mechanical couplings, and unions, using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.
7. 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.
8. For services not specified to receive a field-applied jacket, except for flexible elastomeric and polyolefin, 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.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. 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.

D. 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 that of adjoining pipe insulation.

2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least 2 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.

3.6 INSTALLATION OF GLASS-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches (150 mm) o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.

4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as that of straight segments of pipe insulation when available.
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.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as that of straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.7 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal

seams and end joints. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. 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. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

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.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

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.

3.9 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections.

B. Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections with the assistance of a factory-authorized service representative.

E. Tests and Inspections: Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

F. All insulation applications will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports.

3.10 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.11 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

1. NPS 1 (DN 25) and Smaller: Insulation shall be the following:

a. Fiberglass with all service jacket and vapor barrier.

2. NPS 1-1/2 (DN 32) and Larger: Insulation shall be the following:

a. Fiberglass with all service jacket and vapor barrier.

B. Domestic Hot and Recirculated Tempered and Hot Water:

1. NPS 1-1/4 (DN 32) and Smaller: Insulation shall be the following:

a. Fiberglass with all service jacket.

2. NPS 1-1/2 (DN 40) and Larger: Insulation shall be the following:
   a. Fiberglass with all service jacket.

C. Stormwater and Overflow:

1. All Pipe Sizes: Insulation shall be the following:

   a. Fiberglass with all service jacket.

D. Roof Drain and Overflow Drain Bodies:

1. All Pipe Sizes: Insulation shall be the following:

   a. Fiberglass with all service jacket.

E. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:

1. All Pipe Sizes: Insulation shall be the following:

   a. Fiberglass with all service jacket.

F. Hot Service Drains:
1. All Pipe Sizes: Insulation shall be the following:

   a. Fiberglass with all service jacket.

3.12 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field- applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:
1. Jackets for hot piping shall be factory applied, white, all service jackets composed of reinforced kraft paper and a self-sealing, pressure sensitive longitudinal lap seal.
2. Jackets for cold piping shall be the same as for hot piping with the addition of a vapor barrier. Seal all butt joints with 4" wide strips of vapor barrier sealed with vapor barrier adhesive. This requirement exceeds the typical industry standard of

using 3" wide strips.

END OF SECTION 220719

SECTION 22 08 00 COMMISSIONING OF PLUMBING

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. This section includes commissioning process requirements for Plumbing systems, assemblies, and equipment.

B. Related Sections:

1. Division 01 Section "General Commissioning Requirements" for general commissioning process requirements.

1.3 DESCRIPTION

A. Refer to Division 01 Section “General Commissioning Requirements” for the description of commissioning.

1.4 DEFINITIONS

A. Refer to Division 01 Section “General Commissioning Requirements” for definitions.

1.5 SUBMITTALS

A. Refer to Division 01 Section “General Commissioning Requirements” for CxA’s role.

B. Refer to Division 01 Section “Submittals” for specific requirements. In addition, provide the following:

C. Certificates of readiness

D. Certificates of completion of installation, prestart, and startup activities.

E. O&M manuals

F. Test reports

1.6 QUALITY ASSURANCE

A. Test Equipment Calibration Requirements: Contractors will comply with test manufacturer's calibration procedures and intervals. Recalibrate test instruments immediately after instruments have been repaired resulting from being dropped or damaged. Affix calibration tags to test instruments. Furnish calibration records to CxA upon request.

1.7 COORDINATION

A. Refer to Division 01 Section "General Commissioning Requirements" for requirements pertaining to coordination during the commissioning process.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. All standard testing equipment required to perform startup, initial checkout and functional perfor- mance testing shall be provided by the contractor for the equipment being tested. For example, the plumbing contractor of Division 22 shall ultimately be responsible for all standard testing equipment for the plumbing system in Division 22, except for equipment specific to and used by TAB in their commissioning responsibilities. A sufficient quantity of two-way radios shall be pro- vided by each subcontractor.

B. Special equipment, tools and instruments (specific to a piece of equipment and only available from vendor) required for testing shall be included in the base bid price to the Owner and left on site, except for stand-alone data logging equipment that may be used by the CxA.

C. Proprietary test equipment and software required by any equipment manufacturer for program- ming and/or start-up, whether specified or not, shall be provided by the manufacturer of the equip- ment. Manufacturer shall provide the test equipment, demonstrate its use, and assist in the commissioning process as needed. Proprietary test equipment (and software) shall become the property of the Owner upon completion of the commissioning process.

D. Data logging equipment and software required to test equipment will be provided by the CxA but shall **not** become the property of the Owner.

E. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Specifications. If not otherwise noted, the fol- lowing minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration within the past year to an accuracy of 0.5□F and a resolution of + or - 0.1□F. Pressure sensors shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year.

PART 3 - EXECUTION

3.1 GENERAL DOCUMENTATION REQUIREMENTS

A. With assistance from the installing contractors, the CxA will prepare Pre-Functional/Functional Test Checklists for all commissioned components, equipment, and systems

B. Red-lined Drawings: The contractor will verify all equipment, systems, instrumentation, wiring and components are shown correctly on red-lined drawings. Preliminary red-lined drawings must be made available to the Commissioning Team for use prior to the start of Functional Performance Testing. Changes, as a result of Functional Testing, must be incorporated into the final as-built drawings, which will be created from the red-lined drawings. The contracted party, as defined in the Contract Documents will create the as-built drawings.

C. Operation and Maintenance Data: Contractor will provide a copy of O&M literature within 45 days of each submittal acceptance for use during the commissioning process for all commissioned equipment and systems. The CxA will review the O&M literature once for conformance to project requirements. The CxA will receive a copy of the final approved O&M literature once corrections have been made by the contractor.

D. Demonstration and Training: Contractor will provide demonstration and training as required by the specifications. A complete training plan and schedule must be submitted by the contractor to the CxA four weeks (4) prior to any training. A training agenda for each training session must be submitted to the CxA one (1) week prior the training session

3.2 CONTRACTOR'S RESPONSIBILITIES

A. Perform commissioning tests at the direction of the CxA.

B. Attend construction phase controls coordination meetings.

C. Attend domestic water balancing review and coordination meetings.

D. Participate in Plumbing systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.

E. Provide information requested by the CxA for final commissioning documentation.

F. Include requirements for submittal data, operation and maintenance data, and training in each purchase order or sub-contract written.

G. Prepare preliminary schedule for Plumbing system orientations and inspections, operation and maintenance manual submissions, training sessions, pipe and duct system testing, flushing and cleaning, equipment start-up, testing and balancing and task completion for owner. Distribute preliminary schedule to commissioning team members.

H. Update schedule as required throughout the construction period.

I. Assist the CxA in all verification and functional performance tests.

J. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

K. Gather operation and maintenance literature on all equipment, and assemble in binders as required by the specifications. Submit to CxA 45 days after submittal acceptance.

L. Coordinate with the CxA to provide 48-hour advance notice so that the witnessing of equipment and system start-up and testing can begin.

M. Notify the CxA a minimum of two weeks in advance of the time for start of the balancing work. Attend the initial balancing meeting for review of the balancing procedures.

N. Participate in, and schedule vendors and contractors to participate in the training sessions.

O. Provide written notification to the CM/GC and CxA that the following work has been completed in accordance with the contract documents, and that the equipment, systems, and sub-system are operating as required.

P. The equipment supplier shall document the performance of his equipment.

Q. Provide a complete set of red-lined drawings to the CxA prior to the start of Functional Performance Testing.

R. Balance Contractor
1. Attend initial commissioning coordination meeting scheduled by the CxA.
2. Submit the site-specific balancing plan to the CxA and Design Professional for review and acceptance.
3. Attend the balancing review meeting scheduled by the CxA. Be prepared to discuss the procedures that shall be followed in balancing the Plumbing system.
4. At the completion of the balancing work, and the submittal of the final balancing report, notify the Plumbing contractor and the CM/GC.
5. At the completion of balancing work, and the submittal of the final balancing report, notify the Plumbing Contractor and the CM/GC.
6. Participate in verification of the balancing report, which will consist of repeating measurements contained in the balancing reports. Assist in diagnostic purposes when directed.

S. Equipment Suppliers
1. Provide all requested submittal data, including detailed start-up procedures and specific responsibilities of the Owner, to keep warranties in force.
2. Assist in equipment testing per agreements with contractors.
3. Provide information requested by CxA regarding equipment sequence of operation and testing procedures.

T. Refer to Division 01 Section “General Commissioning Requirements” for additional contractor responsibilities.

3.3 OWNER’S RESPONSIBILITIES

A. Refer to Division 01 Section “General Commissioning Requirements” for Owner’s Responsibilities.

3.4 DESIGN PROFESSIONAL'S RESPONSIBILITIES

A. Refer to Division 01 Section “General Commissioning Requirements” for Design Professional’s Responsibilities.

3.5 CxA'S RESPONSIBILITIES

A. Refer to Division 01 Section “General Commissioning Requirements” for CxA’s Responsibilities.

3.6 TESTING PREPARATION

A. Certify in writing to the CxA that Plumbing systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.

B. Certify in writing to the CxA that Plumbing instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.

C. Certify in writing that balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.

D. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

E. Inspect and verify the position of each device and interlock identified on checklists.

F. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.

G. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

3.7 DOMESTIC WATER BALANCING VERIFICATION

A. Prior to performance of Domestic Water Balancing work, provide copies of reports, sample forms, checklists, and certificates to the CxA.

B. Notify the CxA at least ten (10) days in advance of testing and balancing Work, and provide access for the CxA to witness balancing Work.

C. Provide technicians, instrumentation, and tools to verify testing and balancing of Plumbing systems at the direction of the CxA.

1. The CxA will notify testing and balancing subcontractor ten (10) days in advance of the date of field verification. Notice will not include data points to be verified.
2. The balancing subcontractor shall use the same instruments (by model and serial number) that were used when original data were collected.
3. Failure of an item includes a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final balancing report.
4. Remedy the deficiency and notify the CxA so verification of failed portions can be performed.

3.8 GENERAL TESTING REQUIREMENTS

A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.

B. Scope of Plumbing testing shall include entire Plumbing installation. Testing shall include measuring capacities and effectiveness of operational and control functions.

C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.

D. The CxA along with the Plumbing contractor, balancing subcontractor shall prepare detailed testing plans, procedures, and checklists for Plumbing systems, subsystems, and equipment.

E. Tests will be performed using design conditions whenever possible.

F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.

G. The CxA may direct that set points be altered when simulating conditions is not practical.

H. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.

I. If tests cannot be completed because of a deficiency outside the scope of the Plumbing system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.

J. If the testing plan indicates specific seasonal testing, complete appropriate initial

performance tests and documentation and schedule seasonal tests.

3.9 PLUMBING SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES

A. Equipment Testing and Acceptance Procedures: Testing requirements are specified in individual Division 22 sections. Provide submittals, test data, inspector record, and certifications to the CxA.

B. Plumbing Instrumentation and Control System Testing: Field testing plans and testing requirements are specified in Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operations for HVAC Controls." Assist the CxA with preparation of testing plans.

C. Pipe system cleaning, flushing, hydrostatic tests, and chemical treatment: Test requirements are specified in Division 22 piping Sections. Plumbing Contractor shall prepare a pipe system cleaning, flushing, and hydrostatic testing plan. Provide cleaning, flushing, testing, and treating plan and final reports to the CxA. Plan shall include the following:

1. Sequence of testing and testing procedures for each section of pipe to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed to Drawings for each pipe sector, showing the physical location of each designated pipe test section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.
2. Description of equipment for flushing operations.
3. Minimum flushing water velocity.
4. Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.

D. Plumbing Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of air, fuel gas, sanitary waste and vent piping, storm drainage piping, sprinkler and domestic water distribution systems.

E. Vibration and Sound Tests: Provide technicians, instrumentation, tools, and equipment to test performance of vibration isolation and seismic controls.

F. The work included in the commissioning process involves a complete and thorough evaluation of the operation and performance of all systems. The following equipment and systems shall be evaluated:
1. Compressed Air System
2. Vacuum System
3. Domestic Hot Water System
4. Domestic Water System

5. Domestic Water Heater
6. Hot Water Circulating Pump
7. RO/DI Purified Water System
8. Plumbing Piping

3.10 DEFICIENCIES/NON-CONFORMANCE, COST OF RETESTING, FAILURE DUE TO MANUFACTURER DEFECT

A. Refer to Division 01 Section “General Commissioning Requirements” for requirements pertaining to deficiencies/non-conformance, cost of retesting, or failure due to manufacturer defect.

3.11 APPROVAL

A. Refer to Division 01 Section “General Commissioning Requirements” for approval procedures.

3.12 DEFERRED TESTING

A. Refer to Division 01 Section “General Commissioning Requirements” for requirements pertaining to deferred testing.

3.13 OPERATION AND MAINTENANCE MANUALS

A. The Operation and Maintenance Manuals shall conform to Contract Documents requirements as stated in Division 01.

B. Refer to Division 01 Section “General Commissioning Requirements” for the AE and CxA roles in the Operation and Maintenance Manual contribution, review and approval process.

3.14 TRAINING OF OWNER PERSONNEL

A. Refer to Division 01 Section “General Commissioning Requirements” for requirements pertaining to training.

END OF SECTION 220800

SECTION 221113 - FACILITY WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes water-distribution piping and related components outside the building for water service and fire-service mains.

B. Related Work:

1. Section 017419 – Construction and Demolition Waste Management Disposal.
2. Section 018113 – Sustainable Design Requirements.
3. Section 018119 – Construction Indoor Air Quality Requirements.

1.3 DEFINITIONS

A. EPDM: Ethylene propylene diene terpolymer rubber.

B. LLDPE: Linear, low-density polyethylene plastic.

C. PA: Polyamide (nylon) plastic.

D. PE: Polyethylene plastic.

E. PP: Polypropylene plastic.

F. PVC: Polyvinyl chloride plastic.

G. RTRF: Reinforced thermosetting resin (fiberglass) fittings.

H. RTRP: Reinforced thermosetting resin (fiberglass) pipe.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Detail precast concrete vault assemblies and indicate dimensions, method of field assembly, and components.

1. Wiring Diagrams: Power, signal, and control wiring for alarms.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: For piping and specialties including relation to other services in same area, drawn to scale. Show piping and specialty sizes and valves, meter and specialty locations, and elevations.

B. Field quality-control test reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For water valves and specialties to include in emergency, operation, and maintenance manuals.

1.8 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
3. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.

B. Piping materials shall bear label, stamp, or other markings of specified testing agency.

C. 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.

D. Comply with ASTM F645 for selection, design, and installation of thermoplastic water piping.

E. Comply with FMG's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire- service-main products.

F. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.

1. Potable-water piping and components shall comply with NSF 14, NSF 61, and

NSF 372.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:

1. Ensure that valves are dry and internally protected against rust and corrosion.
2. Protect valves against damage to threaded ends and flange faces.
3. Set valves in best position for handling. Set valves closed to prevent rattling.

B. During Storage: Use precautions for valves, including fire hydrants, according to the following:

1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
2. Protect from weather. Store indoors and maintain temperature higher than ambient dew- point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

D. Deliver piping 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.

E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

F. Protect flanges, fittings, and specialties from moisture and dirt.

G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.10 PROJECT CONDITIONS

A. Interruption of Existing Water-Distribution 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 water-distribution service according to

requirements indicated:

1. Notify **consultant** no fewer than 7 days in advance of proposed interruption of service.
2. Do not proceed with interruption of water-distribution service without **consultant's** written permission.

1.11 COORDINATION

A. Coordinate connection to water main with utility company.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Application" 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, NSF 61, and NSF 372.

2.2 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe: Cast Iron, Asphaltic Coating, Service Weight, ASTM A74, Bell and Spigot or No hub with Heavy-Duty Stainless-Steel Clamp joints, Cast Iron fittings

1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Flanges: ASME 16.1, Class 125, cast iron.

C. Acceptable Manufacturers: American Cast Iron Pipe Company, Anvil International or Jhonson Controls.

2.3 JOINING MATERIALS

A. Refer to Section 330500 "Common Work Results for Utilities" for commonly used

joining materials.

2.4 PIPING SPECIALTIES

A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

B. Acceptable Manufacturers: Charlotte, Fernco, Southland, American fittings Corp, Siftex Equipment Co, SysTech Design Inc.

C. Tubular-Sleeve Pipe Couplings:
   1. Description: Metal, bolted, sleeve-type, reducing or transition coupling, with center sleeve, gaskets, end rings, and bolt fasteners and with ends of same sizes as piping to be joined.

      a. Standard: AWWA C219.
      b. Center-Sleeve Material: Manufacturer's standard.
      c. Gasket Material: Natural or synthetic rubber.
      d. Pressure Rating: 150 psig (1035 kPa) minimum.
      e. Metal Component Finish: Corrosion-resistant coating or material.

D. Split-Sleeve Pipe Couplings:

   1. Description: Metal, bolted, split-sleeve-type, reducing or transition coupling with sealing pad and closure plates, O-ring gaskets, and bolt fasteners.

      a. Standard: AWWA C219.
      b. Sleeve Material: Manufacturer's standard.
      c. Sleeve Dimensions: Of thickness and width required to provide pressure rating.
      d. Gasket Material: O-rings made of EPDM rubber, unless otherwise indicated.
      e. Pressure Rating: 150 psig (1035 kPa) minimum.
      f. Metal Component Finish: Corrosion-resistant coating or material.

E. Flexible Connectors:

   1. Nonferrous-Metal Piping: Bronze hose covered with bronze wire braid; with copper-tube, pressure-type, solder-joint ends or bronze flanged ends brazed to hose.
   2. Ferrous-Metal Piping: Stainless-steel hose covered with stainless-steel wire braid; with ASME B1.20.1, threaded steel pipe nipples or ASME B16.5, steel pipe flanges welded to hose.

F. Dielectric Fittings:

1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
2. Dielectric Unions:

    a. Description:

        1) Standard: ASSE 1079.
        2) Pressure Rating: 125 psig (860 kPa) minimum at 180 deg F (82 deg C).
        3) End Connections: Solder-joint copper alloy and threaded ferrous.

3. Dielectric Flanges:

    a. Description:

        1) Standard: ASSE 1079.
        2) Factory-fabricated, bolted, companion-flange assembly.
        3) Pressure Rating: 125 psig (860 kPa) minimum at 180 deg F (82 deg C).
        4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

4. Dielectric-Flange Insulating Kits:

    a. Description:

        1) Nonconducting materials for field assembly of companion flanges.
        2) Pressure Rating: 150 psig (1035 kPa).
        3) Gasket: Neoprene or phenolic.
        4) Bolt Sleeves: Phenolic or polyethylene.
        5) Washers: Phenolic with steel backing washers.

5. Dielectric Nipples:

    a. Description:

        1) Standard: IAPMO PS 66.
        2) Electroplated steel nipple complying with ASTM F1545.
        3) Pressure Rating: 300 psig (2070 kPa) at 225 deg F (107 deg C).

4) End Connections: Male threaded.
5) Lining: Inert and noncorrosive, propylene.

2.5 CHECK VALVES

A. Acceptable Manufacturers: Emerson electric, Red Valve Co, Watts Water technology.

B. AWWA Check Valves:
1. Description: Swing-check type with resilient seat. Include interior coating according to AWWA C550 and ends to match piping.

a. Standard: AWWA C508.
b. Pressure Rating: 175 psig (1207 kPa).

C. UL/FMG, Check Valves:
1. Description: Swing-check type with pressure rating; rubber-face checks, unless otherwise indicated; and ends matching piping.

a. Standards: UL 312 and FMG approved.
b. Pressure Rating: 175 psig (1207 kPa).

2.6 DETECTOR CHECK VALVES

A. Acceptable Manufacturers: Emerson electric, Red Valve Co, Watts Water technology.

B. Detector Check Valves:
1. Description: Galvanized cast-iron body, bolted cover with air-bleed device for access to internal parts, and flanged ends. Include one-piece bronze disc with bronze bushings, pivot, and replaceable seat. Include threaded bypass taps in inlet and outlet for bypass meter connection. Set valve to allow minimal water flow through bypass meter when major water flow is required.

a. Standards: UL 312 and FMG approved.
b. Pressure Rating: 175 psig (1207 kPa).
c. Water Meter: AWWA C700, disc type, at least one-fourth size of detector check valve. Include meter, bypass piping, gate valves, check valve, and connections to detector check valve.

2. Description: Iron body, corrosion-resistant clapper ring and seat ring material, flanged ends, with connections for bypass and installation of water meter.

a. Standards: UL 312 and FMG approved.
b. Pressure Rating: 175 psig (1207 kPa).

2.7 BUTTERFLY VALVES

A. Acceptable Manufacturers: NIBCO, Apollo, Emerson Electric Co, Milwaukee Valve Company.

B. AWWA Butterfly Valves:

1. Description: Rubber seated.

a. Standard: AWWA C504.
b. Body: Cast or ductile iron.
c. Body Type: Flanged.
d. Pressure Rating: 150 psig (1035 kPa).

C. UL Butterfly Valves:

1. Description: Metal on resilient material seating.

a. Standards: UL 1091 and FMG approved.
b. Body: Cast or ductile iron.
c. Body Type: Flanged.
d. Pressure Rating: 175 psig (1207 kPa).

2.8 PLUG VALVES

A. Acceptable Manufacturers: DeZURIK, XOMOX Corp., Henry Pratt Company.

B. Plug Valves:
1. Description: Resilient-seated eccentric.

a. Standard: MSS SP-108.
b. Body: Cast iron.
c. Pressure Rating: 175-psig (1207-kPa) minimum CWP.
d. Seat Material: Suitable for potable-water service.

2.9 WATER METERS

A. Water meters will be furnished by utility company.

B. Displacement-Type Water Meters:

1. Description: With bronze main case.

a. Standard: AWWA C700.
b. Registration: Flow in cubic feet (cubic meters).

C. Turbine-Type Water Meters:

1. Description:

a. Standard: AWWA C701.
b. Registration: Flow in cubic feet (cubic meters).

D. Compound-Type Water Meters:

1. Description:

a. Standard: AWWA C702.
b. Registration: Flow in cubic feet (cubic meters).

E. Remote Registration System:

1. Description: Utility company standard; direct-reading type. Include meter modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly.

a. Standard: AWWA C706.
b. Registration: Flow in cubic feet (cubic meters).

F. Remote Registration System:

1. Description: Utility company standard; encoder type. Include meter modified with signal- transmitting assembly, low-voltage connecting wiring, and remote register assembly.

a. Standard: AWWA C707.
b. Registration: Flow in cubic feet (cubic meters).
c. Data-Acquisition Units: Comply with utility company requirements for type and quantity.

d. Visible Display Units: Comply with utility company requirements for type and quantity.

2.10 DETECTOR-TYPE WATER METERS

A. Detector-Type Water Meters:

B. Description: Main line, proportional meter with second meter on bypass. Register flow in cubic feet (cubic meters).

1. Standards: AWWA C703, UL listed, and FMG approved.
2. Pressure Rating: 150 psig (1035 kPa).
3. Bypass Meter: AWWA C701, turbine-type, bronze case.

a. Size: At least one-half nominal size of main-line meter.

C. Remote Registration System:

1. Description: Utility company standard; direct-reading type. Include meter modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly.

a. Standard: AWWA C706.
b. Registration: Flow in cubic feet (cubic meters).

D. Remote Registration System:

1. Description: Utility company standard; encoder type. Include meter modified with signal- transmitting assembly, low-voltage connecting wiring, and remote register assembly.

a. Standard: AWWA C707.
b. Registration: Flow in cubic feet (cubic meters).
c. Data-Acquisition Units: Comply with utility company requirements for type and quantity.
d. Visible Display Units: Comply with utility company requirements for type and quantity.

E. Air-Release Valves:
1. Description: Hydromechanical device to automatically release accumulated air.

a. Standard: AWWA C512.

b. Pressure Rating: 300 psig (2070 kPa)
c. Body Material: Cast iron
d. Trim Material: Stainless steel
e. Water Inlet Size: As required
f. Air Outlet Size: As required
g. Orifice Size: As required

2.11 BACKFLOW PREVENTERS

A. Acceptable Manufacturers: Watts Water Tech., Zurn Wilkins or Conbraco Industries.

B. Double-Check, Backflow-Prevention Assemblies:
1. Standard: ASSE 1015 or AWWA C510.
2. Operation: Continuous-pressure applications, unless otherwise indicated.
3. Pressure Loss: 5 psig (35 kPa) maximum, through middle 1/3 of flow range.
4. Size: 6 inch
5. Design Flow Rate: 1000gpm
6. Selected Unit Flow Range Limits: 1500gpm
7. Pressure Loss at Design Flow Rate: for NPS 2-1/2 (DN 65) and larger.
8. Body: Bronze for NPS 2 (DN 50) and smaller; stainless steel for NPS 2-1/2 (DN 65) and larger.
9. End Connections: flanged for NPS 2-1/2 (DN 65) and larger.
10. Configuration: Designed for horizontal, straight through flow.
11. Accessories: Ball valves with threaded ends on inlet and outlet of NPS 2 (DN 50) and smaller; OS&Y gate valves with flanged ends on inlet and outlet of NPS 2-1/2 (DN 65) and larger.

2.12 WATER METER BOXES

A. Description: Cast-iron body and cover for disc-type water meter, with lettering "WATER METER" in cover; and with slotted, open-bottom base section of length to fit over service piping.

1. Option: Base section may be cast-iron, PVC, clay, or other pipe.

B. Description: Cast-iron body and double cover for disc-type water meter, with lettering "WATER METER" in top cover; and with separate inner cover; air space between covers; and slotted, open-bottom base section of length to fit over service piping.

C. Description: Polymer-concrete body and cover for disc-type water meter, with lettering "WATER" in cover; and with slotted, open-bottom base section of length to fit over service piping. Include vertical and lateral design loadings of 15,000 lb minimum over 10

by 10 inches (6800 kg minimum over 254 by 254 mm) square.

2.13 ALARM DEVICES

A. Alarm Devices, General: UL 753 and FMG approved, of types and sizes to mate and match piping and equipment.

B. Water-Flow Indicators: Vane-type water-flow detector, rated for 250-psig (1725-kPa) working pressure; designed for horizontal or vertical installation; with 2 single-pole, double-throw circuit switches to provide isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal when cover is removed.

C. Supervisory Switches: Single pole, double throw; designed to signal valve in other than fully open position.

D. Pressure Switches: Single pole, double throw; designed to signal increase in pressure.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Refer to Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.

B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.

C. Flanges, unions, grooved-end-pipe couplings (Mechanical rooms only), and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.

3.3 VALVE APPLICATIONS

A. General Application: Use mechanical-joint-end valves for NPS 3 (DN 80) and larger

underground installation. Use threaded- or flanged-end valves for installation in vaults. Use UL/FMG, nonrising-stem gate valves for installation with indicator posts. Use corporation valves and curb valves with ends compatible with piping, for NPS 2 (DN 50) and smaller installation.

B. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Use the following for valves in vaults and aboveground:
   a. Check Valves: AWWA C508 or UL/FMG, swing type.

2. Pressure-Reducing Valves: Use for water-service piping in vaults and aboveground to control water pressure.
3. Relief Valves: Use for water-service piping in vaults and aboveground.

   a. Air-Release Valves: To release accumulated air.
   b. Air/Vacuum Valves: To release or admit large volume of air during filling of piping.
   c. Combination Air Valves: To release or admit air.

4. Detector Check Valves: Use for water-service piping in vaults and aboveground to detect unauthorized use of water.

3.4 PIPING SYSTEMS - COMMON REQUIREMENTS

A. See Section 330500 "Common Work Results for Utilities" for piping-system common requirements.

3.5 PIPING INSTALLATION

A. Water-Main Connection: Arrange with utility company for tap of size and in location indicated in water main.

B. Water-Main Connection: Tap water main according to requirements of water utility company and of size and in location indicated.

C. Make connections larger than NPS 2 (DN 50) with tapping machine according to the following:

1. Install tapping sleeve and tapping valve according to MSS SP-60.
2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
3. Use tapping machine compatible with valve and tapping sleeve; cut hole in main.

Remove tapping machine and connect water-service piping.

4. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.

D. Make connections NPS 2 (DN 50) and smaller with drilling machine according to the following:

1. Install service-saddle assemblies and corporation valves in size, quantity, and arrangement required by utility company standards.
2. Install service-saddle assemblies on water-service pipe to be tapped. Position outlets for corporation valves.
3. Use drilling machine compatible with service-saddle assemblies and corporation valves. Drill hole in main. Remove drilling machine and connect water-service piping.
4. Install corporation valves into service-saddle assemblies.
5. Install manifold for multiple taps in water main.
6. Install curb valve in water-service piping with head pointing up and with service box.

E. Comply with NFPA 24 for fire-service-main piping materials and installation.

1. Install PE corrosion-protection encasement according to ASTM A674 or AWWA C105.
2. Install copper tube and fittings according to CDA's "Copper Tube Handbook."

F. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.

1. Install PE corrosion-protection encasement according to ASTM A674 or AWWA C105.

G. Bury piping with depth of cover over top at least 30 inches (750 mm), with top at least 12 inches (300 mm) below level of maximum frost penetration, and according to the following:

1. In Loose Gravelly Soil and Rock: With at least 12 inches (300 mm) additional cover.

H. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.

I. Extend water-service piping and connect to water-supply source and building-water-piping systems at outside face of building wall in locations and pipe sizes indicated.

1. Terminate water-service piping at building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.

J. Sleeves are specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

K. Mechanical sleeve seals are specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

L. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

M. See Section 211200 "Fire-Suppression Standpipes," Section 211313 "Wet-Pipe Sprinkler Systems," and Section 211316 "Dry-Pipe Sprinkler Systems" for fire-suppression-water piping inside the building.

N. See Section 221116 "Domestic Water Piping" for potable-water piping inside the building.

3.6 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for hangers, supports, and anchor devices specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet (6 m) long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet (6 m) or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

C. Install hangers for copper tubing with maximum spacing and minimum rod diameters to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

D. Support horizontal piping within 12 inches (300 mm) of each fitting and coupling.

E. Support vertical runs of copper tubing to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.7 JOINT CONSTRUCTION

A. See Section 330500 "Common Work Results for Utilities" for basic piping joint construction.

B. Make pipe joints according to the following:
   1. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.
   2. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.
   3. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

      a. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric nipples.
      b. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric flanges.
      c. Dielectric Fittings for NPS 5 (DN 125) and Larger: Use dielectric flange kits.

3.8 ANCHORAGE INSTALLATION

A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:

   1. Concrete thrust blocks.
   2. Locking mechanical joints.
   3. Set-screw mechanical retainer glands.
   4. Bolted flanged joints.
   5. Heat-fused joints.
   6. Pipe clamps and tie rods.

B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:

   1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
   2. Fire-Service-Main Piping: According to NFPA 24.

C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of

installed ferrous anchorage devices.

3.9 VALVE INSTALLATION

A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.

B. AWWA Valves Other Than Gate Valves: Comply with AWWA C600 and AWWA M44.

C. UL/FMG, Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.

D. UL/FMG, Valves Other Than Gate Valves: Comply with NFPA 24.

E. MSS Valves: Install as component of connected piping system.

F. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.

G. Pressure-Reducing Valves: Install in vault or aboveground between shutoff valves.

H. Relief Valves: Comply with AWWA C512. Install aboveground with shutoff valve on inlet.

3.10 DETECTOR-CHECK VALVE INSTALLATION

A. Install aboveground.

B. Install for proper direction of flow. Install bypass with water meter, gate valves on each side of meter, and check valve downstream from meter.

C. Support detector check valves, meters, shutoff valves, and piping on brick or concrete piers.

3.11 WATER METER INSTALLATION

A. Install water meters, piping, and specialties according to utility company's written instructions.

B. Water Meters: Install turbine-type water meters, NPS 2 (DN 50) and smaller, in meter boxes with shutoff valves on water meter inlets. Include valves on water meter outlets and valved bypass around meters unless prohibited by authorities having jurisdiction.

C. Water Meters: Install turbine-type water meters, NPS 3 (DN 80) and larger, in meter vaults. Include shutoff valves on water meter inlets and outlets and valved bypass around meters. Support meters, valves, and piping on brick or concrete piers.

D. Water Meters: Install detector-type water meters in meter vault according to AWWA M6. Include shutoff valves on water meter inlets and outlets and full-size valved bypass around meters. Support meters, valves, and piping on brick or concrete piers.

3.12 ROUGHING-IN FOR WATER METERS

A. Rough-in piping and specialties for water meter installation according to utility company's written instructions.

3.13 VACUUM BREAKER ASSEMBLY INSTALLATION

A. Install pressure vacuum breaker assemblies of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.

B. Do not install pressure vacuum breaker assemblies in vault or other space subject to flooding.

3.14 BACKFLOW PREVENTER INSTALLATION

A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.

B. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.

C. Do not install bypass piping around backflow preventers.

D. Support NPS 2-1/2 (DN 65) and larger backflow preventers, valves, and piping near floor and on brick or concrete piers.

3.15 WATER METER BOX INSTALLATION

A. Install water meter boxes in paved areas flush with surface.

B. Install water meter boxes in grass or earth areas with top 2 inches (50 mm) above surface.

3.16 ALARM DEVICE INSTALLATION

A. General: Comply with NFPA 24 for devices and methods of valve supervision. Underground valves with valve box do not require supervision.

B. Supervisory Switches: Supervise valves in open position.

1. Valves: Bolt switch, with plunger in stem depression, to OS&Y gate-valve yoke.
2. Indicator Posts: Install switch, with toggle against target plate, on barrel of indicator post.

C. Locking and Sealing: Secure unsupervised valves as follows:

1. Valves: Install chain and padlock on open OS&Y gate valve.
2. Post Indicators: Install padlock on wrench on indicator post.

D. Pressure Switches: Drill and thread hole in exposed barrel of fire hydrant. Install switch.

E. Water-Flow Indicators: Install in water-service piping in vault. Select indicator with saddle and vane matching pipe size. Drill hole in pipe, insert vane, and bolt saddle to pipe.

F. Connect alarm devices to building fire alarm system. Wiring and fire-alarm devices are specified in Section 284621.11 "Addressable Fire-Alarm Systems" and Section 284621.13 "Conventional Fire-Alarm Systems."

3.17 CONNECTIONS

A. See Section 330500 "Common Work Results for Utilities" for piping connections to valves and equipment.

B. Connect water-distribution piping to interior domestic water piping.

C. Connect waste piping from concrete vault drains to sanitary sewerage system. See Section 221313 "Facility Sanitary Sewers" for connection to sanitary-sewer piping.

D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors

and Cables."

3.18 FIELD QUALITY CONTROL

A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

B. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.

1. Increase pressure in 50-psig (350-kPa) increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig (0 kPa). Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts (1.89 L) per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

C. Prepare reports of testing activities.

3.19 IDENTIFICATION

A. Install continuous underground detectable warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Section 312000 "Earth Moving."

B. Permanently attach equipment nameplate or marker indicating plastic water-service piping, on main electrical meter panel. See Section 330500 "Common Work Results for Utilities" for identifying devices.

3.20 CLEANING

A. Clean and disinfect water-distribution piping as follows:

1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:

a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
b. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
c. Submit water samples in sterile bottles to authorities having jurisdiction.

Repeat procedure if biological examination shows evidence of contamination.

B. Prepare reports of purging and disinfecting activities.

END OF SECTION 221113

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Copper tube and fittings.
2. Piping joining materials.
3. Encasement for piping.
4. Transition fittings.
5. Dielectric fittings.

B. Related Requirements:

1. Section 221113 "Facility Water Distribution Piping" for water-service piping and water meters outside the building from source to the point where water-service piping enters the building.

C. Related Work:

1. Section 017419 – Construction and Demolition Waste Management Disposal.
2. Section 018113 – Sustainable Design Requirements.
3. Section 018119 – Construction Indoor Air Quality Requirements.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Pipe and tube.
2. Fittings.
3. Joining materials.
4. Transition fittings.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Piping layout, or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.

B. System purging and disinfecting activities report.

C. 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 **consultant** no fewer than 7 days in advance of proposed interruption of service.
2. Do not proceed with interruption of water-distribution service without **consultant's** written permission.

1.6 WARRANTY

A. Polypropylene Piping (PP-R) Manufacturer's Warranty: Manufacturer agrees to repair or replace PP-R pipe and fittings that fail in materials or workmanship within 10 years from date of Substantial Completion.

1. Warranty is to cover labor and material costs of repairing and/or replacing defective materials and repairing any incidental damage caused by failure of the piping system due to defects in materials or manufacturing.
2. Warranty is to be in effect only upon submission by the Contractor to the manufacturer of valid pressure/leak documentation indicating that the system was tested and passed the manufacturer's pressure/leak test.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Potable-water piping and components shall comply with NSF 14, NSF 61, and NSF 372.

2.2 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tube: ASTM B88, Type L (ASTM B88M, Type B)

B. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings.

C. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

D. Cast Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and- socket, metal-to-metal seating surfaces and solder-joint or threaded ends.

E. Wrought Copper Unions: ASME B16.22.

F. Copper-Tube, Mechanically Formed Tee Fitting: For forming T-branch on copper water tube.
   1. Description: Tee formed in copper tube in accordance with ASTM F2014.

G. Grooved, Mechanical-Joint, Copper Tube Appurtenances (Mechanical rooms only):
   1. Grooved-End, Copper Fittings: ASTM B75 (ASTM B75M) copper tube or ASTM B584 bronze castings.
   2. Grooved-End-Tube Couplings: To fit copper-tube dimensions; rigid pattern unless otherwise indicated; gasketed fitting, EPDM-rubber gasket, UL classified per NSF 61 and NSF 372, and rated for minimum 180 deg F (80 deg C) for use with ferrous housing and steel bolts and nuts; 300 psig (2060 kPa)minimum CWP pressure rating.

2.3 POLYPROPYLENE (PP-R) PIPE AND FITTINGS FOR RO/DI WATER

A. Polypropylene Pipe: ASTM F2389, pipe pressure rating to comply with temperature and pressure ratings of code requirements for the applicable service.

   1. Polypropylene Fittings: ASTM F2389, socket fusion, butt fusion, electrofusion, or fusion outlet fittings to be used for fusion-welded joints between pipe and fittings.
   2. Mechanical fittings and transition fittings to be used where transitions are made to other piping materials or to valves and appurtenances.
   3. Polypropylene pipe is to be unthreaded. Threaded transition fittings per ASTM F2389 to be used where a threaded connection is required.

B. Smoke and Fire Ratings:

   1. Where indicated on the Drawings that a plenum-rated piping system is required, the pipe is to be wrapped and/or insulated with fiberglass or mineral wool pipe insulation, and field installed.
   2. The system is to have a flame spread classification of less than 25 and smoke development rating of less than 50.
   3. Pipe, wrap, or insulation as a system to meet the requirements of CAN/ULC-S102.2-03, ASTM E84, or UL 2846.
   4. For insulation required for thermal and condensation reasons, see Section

220719 "Plumbing Piping Insulation."

C. Integration of PP-R Piping Systems with Other Systems:

1. When integrating PP-R piping systems with other systems or with components not made of PP-R (for example, valves, pumps, other piping, check valves, or strainers), ensure the operating parameters for PP-R will not damage other materials in the system or vice versa.
2. Verify that all parts of the system are compatible with the medium being carried before installation. PP-R pipe does not require treatment to protect it from corrosion. Metals (ferrous and non-ferrous) in the system may be susceptible to corrosion. Provide water treatment to protect system metals.
3. Do not mix PP-R pipe with other piping systems in conditions that will cause the other system or components to fail.

D. PP-R Socket Fittings: ASTM F2389.

2.4 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:

1. AWWA C110/A21.10, rubber, flat face, 1/8 inch (3.2 mm) 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 B32, lead-free alloys.

D. Flux: ASTM B813, water flushable.

E. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general- duty brazing unless otherwise indicated.

F. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.5 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.

D. Plastic-to-Metal Transition Fittings:
1. Description:

a. PVC one-piece fitting with manufacturer's Schedule 40 equivalent dimensions.
b. One end with threaded brass insert and one solvent-cement-socket or threaded end.

E. Plastic-to-Metal Transition
Unions: 1.
2. Description:

a. PVC four-part union.
b. Brass threaded end.
c. Solvent-cement-joint or threaded plastic end.
d. Rubber O-ring.
e. Union nut.

2.6 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Flanges:
1. Standard: ASSE 1079.
2. Factory-fabricated, bolted, companion-flange assembly.
3. Pressure Rating: 125 psig (860 kPa) minimum at 180 deg F (82 deg C)
4. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

C. Dielectric-Flange Insulating Kits:
1. Nonconducting materials for field assembly of companion flanges.
2. Pressure Rating: 150 psig (1035 kPa)

3. Gasket: Neoprene or phenolic.
4. Bolt Sleeves: Phenolic or polyethylene.
5. Washers: Phenolic with steel backing washers.

D. Dielectric Nipples:
1. Standard: IAPMO PS 66.
2. Electroplated steel nipple complying with ASTM F1545.
3. Pressure Rating and Temperature: 300 psig (2070 kPa) at 225 deg F (107 deg C)
4. End Connections: Male threaded or grooved.
5. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.

D. Aboveground domestic water piping, NPS 2 (DN 50) and smaller, shall be the following:
1. Drawn-temper copper tube, ASTM B88, Type L (ASTM B88M, Type B); wrought-copper, solder-joint fittings; and soldered joints.

E. Aboveground domestic water piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100), shall be one of the following:

1. Drawn-temper copper tube, ASTM B88, Type L (ASTM B88M, Type B); wrought-copper, solder-joint fittings; and soldered joints.

F. Aboveground domestic water piping, NPS 5 to NPS 8 (DN 125 to DN 200), shall be one of the following:

1. Drawn-temper copper tube, ASTM B88, Type L (ASTM B88M, Type B); wrought-copper, solder-joint fittings; and soldered joints.
2. Drawn-temper copper tube, ASTM B88, Type L (ASTM B88M, Type B); grooved-joint, copper-tube appurtenances; and grooved joints.

3.2 INSTALLATION OF PIPING

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.

D. Install underground ductile-iron pipe in PE encasement according to ASTM A674 or AWWA C105/A21.5.

E. Install valves according to the following:

1. Section 220523.12 "Ball Valves for Plumbing Piping."
2. Section 220523.13 "Butterfly Valves for Plumbing Piping."
3. Section 220523.14 "Check Valves for Plumbing Piping."

F. Install domestic water piping level without pitch and plumb.

G. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

H. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

I. 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.

J. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

K. Install piping to permit valve servicing.

L. 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.

M. Install piping free of sags and bends.

N. Install fittings for changes in direction and branch connections.

O. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

P. Install pressure gauges on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gauges in Section 220519 "Meters and Gages for Plumbing Piping."

Q. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 221123 "Domestic Water Pumps."

R. Install thermometers on outlet piping from each water heater. Comply with requirements for thermometers in Section 220519 "Meters and Gages for Plumbing Piping."

S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.

E. Soldered Joints for Copper Tubing: Apply ASTM B813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B828 or CDA's "Copper Tube Handbook."

F. Joint Construction for Grooved-End Copper Tubing: Make joints according to AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.

G. 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.

H. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.4 INSTALLATION OF TRANSITION FITTINGS

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:

1. Fittings for NPS 1-1/2 (DN 40) and Smaller: Fitting-type coupling.
2. Fittings for NPS 2 (DN 50) and Larger: Sleeve-type coupling.

C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 (DN 50) and Smaller: Plastic- to-metal transition fittings.

3.5 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for hangers, supports, and anchor devices in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

B. Install hangers for copper tubing and piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

C. Support horizontal piping within 12 inches (300 mm) of each fitting.

D. Support vertical runs of copper tubing to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

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.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
4. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 (DN 65) and larger.

3.7 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."

3.8 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
b. Adjust calibrated balancing valves to flows indicated.

5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.9 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.

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.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Vacuum breakers.
2. Backflow preventers.
3. Balancing valves.
4. Temperature-actuated, water mixing valves.
5. Strainers for domestic water piping.
6. Hose stations.
7. Hose bibbs.
8. Wall hydrants.
9. Drain valves.
10. Water-hammer arresters.
11. Trap-seal primer device.
12. Flexible connectors.

B. Related Requirements:

1. Section 211100 "Facility Fire-Suppression Water-Service Piping" for fire water-service backflow prevention devices.
2. Section 220519 "Meters and Gauges for Plumbing Piping" for thermometers, pressure gauges, and flow meters in domestic water piping.
3. Section 221116 "Domestic Water Piping" for water meters.
4. Section 224500 "Emergency Plumbing Fixtures" for water tempering equipment.
5. Section 224716 "Pressure Water Coolers" for water filters for water coolers.
6. Section 224723 "Remote Water Coolers" for water filters for water coolers.

C. Related Work:

1. Section 017419 – Construction and Demolition Waste Management Disposal.
2. Section 018113 – Sustainable Design Requirements.
3. Section 018119 – Construction Indoor Air Quality Requirements.

1.3 DEFINITIONS

A. AMI: Advanced Metering Infrastructure.

B. AMR: Automatic Meter Reading.

C. FKM: A family of fluroelastomer materials defined by ASTM D1418.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For domestic water piping specialties.

1. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Test and inspection reports.

B. Field quality-control reports.

1.6 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. Domestic water piping specialties intended to convey or dispense water for human consumption are to comply with the SDWA, requirements of authorities having jurisdiction, and NSF 61 and NSF 372, or to be certified in compliance with NSF 61 and NSF 372 by an American National Standards Institute (ANSI)-accredited third-party certification body that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

B. Acceptable manufacturers for all piping specialties shall be the following:
   1. Apollo
   2. Zurn
   3. Watts

2.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig (860 kPa) unless otherwise indicated.

2.3 VACUUM BREAKERS

A. Acceptable manufacturers: ITT Hoffman Specialty, FEBCO, Zurn Wilkins.

   Pipe-Applied, Atmospheric-Type Vacuum Breakers:
   1. Standard: ASSE 1001.
   2. Size: NPS 1/4 to NPS 3 (DN 8 to DN 80), as required to match connected piping.
   3. Body: Bronze.
   4. Inlet and Outlet Connections: Threaded.
   5. Finish: Rough bronze.

B. Hose-Connection Vacuum Breakers:
   1. Standard: ASSE 1011.
   2. Body: Bronze, nonremovable, with manual drain.
   3. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
   4. Finish: Chrome or nickel plated.

C. Laboratory-Faucet Vacuum Breakers:
   1. Standard: ASSE 1035.
   2. Size: NPS 1/4 or NPS 3/8 (DN 8 or DN 10) matching faucet size.
   3. Body: Bronze.
   4. End Connections: Threaded.
   5. Finish: Chrome plated.

D. Spill-Resistant Vacuum Breakers:
   1. Standard: ASSE 1056.
   2. Operation: Continuous-pressure applications.
   3. Accessories:
      a. Valves: Ball type, on inlet and outlet.

2.4 BACKFLOW PREVENTERS

A. Acceptable manufacturers: Watts Water, Zurn Wilkins or FEBCO.

B. Double-Check, Backflow-Prevention Assemblies:
1. Standard: ASSE 1015.
2. Operation: Continuous-pressure applications unless otherwise indicated.
3. Pressure Loss: 5 psig (35 kPa) maximum, through middle third of flow range.
4. Size: 6 inch
5. Design Flow Rate: 1000 gpm
6. Selected Unit Flow Range Limits: 1500gpm
7. Pressure Loss at Design Flow Rate: for NPS 2-1/2 (DN 65) and larger.
8. Body: stainless steel for NPS 2 (DN 50) and smaller; stainless steel for NPS 2-1/2 (DN 65) and larger.
9. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.
10. Configuration: Designed for horizontal, straight-through flow.
11. Accessories:
    a. Valves NPS 2 (DN 50) and Smaller: Ball type with threaded ends on inlet and outlet.
    b. Valves NPS 2-1/2 (DN 65) and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.

B. Hose-Connection Backflow Preventers:
1. Standard: ASSE 1052.
2. Operation: Up to 10-foot head of water (30-kPa) back pressure.
3. Inlet Size: NPS 3/4 (DN 20).
4. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
5. Capacity: At least 3-gpm (0.19-L/s) flow.

C. Backflow-Preventer Test Kits:
1. Description: Factory calibrated, with gauges, fittings, hoses, and carrying case with test- procedure instructions.

2.5 BALANCING VALVES

A. Acceptable manufacturers: Danfoss, Taco, NIBCO,

B. Copper-Alloy Calibrated Balancing Valves:
1. Type: Ball or Y-pattern globe valve with two readout ports and memory-setting indicator.
2. Body: Brass or bronze.
3. Size: Same as connected piping, but not larger than NPS 2 (DN 50).
4. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

C. Memory-Stop Balancing Valves:
1. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
2. Pressure Rating: 400-psig (2760-kPa) minimum CWP.
3. Size: NPS 2 (DN 50) or smaller.
4. Body: Copper alloy.
5. Port: Standard or full port.
6. Ball: Chrome-plated brass or stainless steel.
7. Seats and Seals: Replaceable.
8. End Connections: Solder joint or threaded.
9. Handle: Vinyl-covered steel with memory-setting device.

D. Automatic Flow Control Balancing Valves:
1. Flow Regulation: Plus or minus 5 percent over 95 percent of the working range.
2. Pressure Rating: 200 psig (1380 kPa).
3. Size: NPS 2 (DN 50) or smaller.
4. Body: Stainless steel or brass.
5. Flow Cartridge: Stainless steel or antiscale polymer.
6. End Connections: Threaded or solder joint.

2.6 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Acceptable manufacturers: Taco, Watts, NIBCO, Holby or Zurn Wilkins.

B. Primary, Thermostatic, Water Mixing Valves:
1. Standard: ASSE 1017.
2. Pressure Rating: 125 psig (860 kPa) minimum unless otherwise indicated.
3. Type: Cabinet-type, thermostatically controlled, water mixing valve.
4. Material: Bronze body with corrosion-resistant interior components.
5. Connections: Threaded inlets and outlet.
6. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
7. Tempered-Water Setting: 85 degF.
8. Tempered-Water Design Flow Rate: see drawings
9. Selected Valve Flow Rate at 45-psig (310-kPa) Pressure Drop: see drawings
10. Pressure Drop at Design Flow Rate: see drawings
11. Valve Finish: Rough bronze.
12. Piping Finish: Copper.
13. Cabinet: Factory fabricated, stainless steel, for recessed mounting and with hinged, stainless steel door.

2.7 STRAINERS FOR DOMESTIC WATER PIPING

A. Acceptable manufacturers: Tate Andale Inc, Titan Flow Control or Zurn Wilkins.

B. Y-Pattern Strainers:
1. Pressure Rating: 125 psig (860 kPa) minimum unless otherwise indicated.
2. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 (DN 65) and larger.
3. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.
4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Perforation Size:

   a. Strainers NPS 2 (DN 50) and Smaller: 0.062 inch (1.57 mm)
   b. Strainers NPS 2-1/2 to NPS 4 (DN 65 to DN 100):125 inch (3.18 mm)
   c. Strainers NPS 5 (DN 125) and Larger: 0.25 inch (6.35 mm)

6. Drain: Pipe plug.

2.8 HOSE BIBBS

A. Acceptable manufacturers: Arrowhead Brass and Plumbing, NIBCO or American Valve.

B. Hose Bibbs:
1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or NPS 3/4 (DN 15 or DN 20) threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig (860 kPa).
7. Vacuum Breaker: Integral or field-installation, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Finish for Service Areas: Rough bronze.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Wheel handle.
13. Operation for Finished Rooms: Wheel handle.
14. Include operating key with each operating-key hose bibb.
15. Include wall flange with each chrome- or nickel-plated hose bibb.

2.9 WALL HYDRANTS

A. Acceptable manufacturers: Jay R. Smith, Zurn Wilkins or Watts.
B. Nonfreeze Wall Hydrants:
   1. Standard: ASME A112.21.3M for exposed-outlet, self-draining wall hydrants.
   2. Pressure Rating: 125 psig (860 kPa).
   3. Operation: Loose key.
   4. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
   5. Inlet: NPS 3/4 or NPS 1 (DN 20 or DN 25).
   6. Outlet, Concealed: With integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
   7. Box: Deep, flush mounted with cover.
   8. Box and Cover Finish: Polished nickel bronze.
   9. Outlet, Exposed: With integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
   10. Nozzle and Wall-Plate Finish: Polished nickel bronze
   11. Operating Keys(s): Two with each wall hydrant.

2.10 DRAIN VALVES

A. Acceptable manufacturers: NIBCO, APCOM Inc. or ThermOmegaTech, Inc.

B. Ball-Valve-Type, Hose-End Drain Valves:

   1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
   2. Pressure Rating: 400-psig (2760-kPa) minimum CWP.
   3. Size: NPS 3/4 (DN 20).
   4. Body: Copper alloy.
   5. Ball: Chrome-plated brass.
   6. Seats and Seals: Replaceable.
   7. Handle: Vinyl-covered steel.
   8. Inlet: Threaded or solder joint.
   9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

C. Stop-and-Waste Drain Valves:

   1. Standard: MSS SP-110 for ball valves.
   2. Pressure Rating: 200-psig (1380-kPa) minimum CWP or Class 125.
   3. Size: NPS 3/4 (DN 20).
   4. Body: Copper alloy or ASTM B62 bronze.
   5. Drain: NPS 1/8 (DN 6) side outlet with cap.

2.11 WATER-HAMMER ARRESTERS

A. Acceptable Manufacturers: Watts Water Tech., Zurn Wilkins or Jay R. Smith.

B. Water-Hammer Arresters:
   1. Standard: ASSE 1010 or PDI-WH 201.
   2. Type: Diaphragm.
   3. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.12 TRAP-SEAL PRIMER DEVICE

A. Acceptable Manufacturers: Watts Water Tech., Zurn Wilkins or Jay R. Smith.

B. Drainage-Type, Trap-Seal Primer Device:
   1. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 (DN 10) minimum, trap makeup connection.
   2. Size: NPS 1-1/4 (DN 32) minimum.
   3. Material: Chrome-plated, cast brass.

2.13 FLEXIBLE CONNECTORS

A. Acceptable Manufacturers: Fernco, BrassCraft or Hose Master.

B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.

   1. Working-Pressure Rating: Minimum 200 psig (1380 kPa)
   2. End Connections NPS 2 (DN 50) and Smaller: Threaded copper pipe or plain-end copper tube.
   3. End Connections NPS 2-1/2 (DN 65) and Larger: Flanged copper alloy.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING SPECIALTIES

A. Backflow Preventers: Install 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. Water Control Valves: Install with inlet and outlet shutoff valves. Install pressure gauges on inlet and outlet.

C. Balancing Valves: Install in locations where they can easily be adjusted. Set at indicated design flow rates.

D. Temperature-Actuated, Water Mixing Valves: Install with check stops or shutoff valves on inlets and with shutoff valve on outlet.

1. Install cabinet-type units recessed in or surface mounted on wall as specified.

E. Y-Pattern Strainers: For water, install on supply side of each control valve and pump.

F. Hose Stations: Install with check stops or shutoff valves on inlets and with thermometer on outlet.

1. Install cabinet-type units recessed in or surface mounted on wall as specified. Install 1- 1/2-by-3-1/2-inch (38-by-89-mm) fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 061000 "Rough Carpentry."

G. Water-Hammer Arresters: Install in water piping in accordance with PDI-WH 201.

H. Drainage-Type, Trap-Seal Primer Device: Install 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 PIPING CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping specialties adjacent to equipment and machines, allow space for service and maintenance.

3.3 ELECTRICAL CONNECTIONS

A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.

3.4 CONTROL CONNECTIONS

A. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."

3.5 IDENTIFICATION

A. Plastic Labels for Equipment: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Balancing valves.
5. Temperature-actuated, water mixing valves.
6. Hose stations.
7. Wall hydrants.
8. Trap-seal primer device.

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."

3.6 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.

D. Adjust each pressure vacuum breaker and double-check, backflow-prevention assembly in accordance with manufacturer's written instructions, authorities having jurisdiction and the device's reference standard.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative.

1. Test each pressure vacuum breaker and double-check, backflow-prevention assembly according to authorities having jurisdiction and the device's reference standard.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION 221119

SECTION 224500 - EMERGENCY 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.

1.2 SUMMARY

A. Section Includes:

1. Emergency showers.
2. Eyewash equipment.
3. Eye/face wash equipment.
4. Combination units.
5. Supplemental equipment.
6. Water-tempering equipment.

B. Related Work:

1. Section 017419 – Construction and Demolition Waste Management Disposal.
2. Section 018113 – Sustainable Design Requirements.
3. Section 018119 – Construction Indoor Air Quality Requirements.

1.3 DEFINITIONS

A. Accessible Fixture: Emergency plumbing fixture that can be approached, entered, and used by people with disabilities.

B. Plumbed Emergency Plumbing Fixture: Fixture with fixed, potable-water supply.

C. Self-Contained Emergency Plumbing Fixture: Fixture with flushing-fluid-solution supply.

D. Tepid: Moderately warm.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include flow rates and capacities, furnished specialties, and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, and mounting 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. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
4. Include diagrams for power, signal, and control wiring.

1.6 INFORMATIONAL SU BMITTALS

A. Product Certificates: Submit certificates of performance testing specified in "Source Quality Control" Article.

B. Field quality-control test reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For emergency plumbing fixtures to include in operation and maintenance manuals.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Flushing-Fluid Solution: Separate lot and equal to at least 200 percent of amount of solution installed for each self-contained unit.

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.

B. ISEA Standard: Comply with ISEA Z358.1.

C. NSF Standard: Comply with NSF 61 and NSF 372, for fixture materials that will be in contact with potable water.

D. Regulatory Requirements: Comply with requirements in ICC A117.1, ; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.

2.2 EMERGENCY SHOWERS

A. Off-Floor, Plumbed Emergency Showers
1. Capacity: Not less than 20 gpm (76 L/min.) for at least 15 minutes.
2. Supply Piping: NPS 1 (DN 25) chrome-plated brass or stainless steel with flow regulator and stay-open control valve.
3. Control-Valve Actuator: Pull rod.
4. Shower Head: 8-inch- (200-mm-) minimum-diameter, stainless steel, or plastic.
5. Mounting: Vertical from ceiling and supported from piping.

2.3 EYEWASH EQUIPMENT

A. Sink, Swivel-Type, Plumbed Eyewash Unit:
1. Capacity: Not less than 0.4 gpm (1.5 L/min.) for at least 15 minutes.
2. Supply Piping: NPS 1/2 (DN 15) chrome-plated brass or stainless steel with flow regulator and stay-open control valve.
3. Control-Valve Actuator: Movement of spray-head assembly to position over sink.
4. Spray-Head Assembly: Two spray heads with offset piping.
5. Mounting: Deck next to sink.

2.4 SUPPLEMENTAL EQUIPMENT

A. Deck-Mounted, Plumbed Drench Hoses:
1. Capacity: Not less than 0.4 gpm (1.5 L/min.).
2. Supply Fitting: NPS 1/2 (DN 15) brass with flow regulator.
3. Drench Hose: Hand-held spray head with squeeze-handle actuation and hose.
4. Mounting: In hole in deck.

2.5 WATER-TEMPERING EQUIPMENT

A. Acceptable manufacturers: Taco, Watts, NIBCO, Holby or Zurn Wilkins.

B. Hot- and Cold-Water, Water-Tempering Equipment:
   1. Description: Factory-fabricated equipment with thermostatic mixing valve.

      a. Thermostatic Mixing Valve: Designed to provide 85 deg F (29 deg C tepid, potable water at emergency plumbing fixtures, to maintain temperature at plus or minus 5 deg F (3 deg C) throughout required 15-minute test period, and in case of unit failure to continue cold-water flow, with union connections, controls, metal piping, and corrosion-resistant enclosure.
      b. Supply Connections: For hot and cold water.

2.6 SOURCE QUALITY CONTROL

A. Certify performance of emergency plumbing fixtures by independent testing organization acceptable to authorities having jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water piping systems to verify actual locations of piping connections before plumbed emergency plumbing fixture installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF EMERGENCY PLUMBING FIXTURE INSTALLATION

A. Assemble emergency plumbing fixture piping, fittings, control valves, and other components.

B. Install fixtures level and plumb.

C. Fasten fixtures to substrate.

D. Install shutoff valves in water-supply piping to fixtures, to facilitate maintenance of the equipment. Use ball or gate valve if specific type valve is not indicated. Install valves chained or locked in open position if permitted. Install valves in locations where they can easily be reached for operation. Comply with requirements for valves specified in

Section 220523.12 "Ball Valves for Plumbing Piping" and Section 220523.15 "Gate Valves for Plumbing Piping."

1. Shut off valves shall be provided to all domestic water branching and shall be placed outside the lab.
2. Exception: Omit shutoff valve on supply to group of plumbing fixtures that includes emergency equipment.
3. Exception: Omit shutoff valve on supply to emergency equipment if prohibited by authorities having jurisdiction.

E. Install dielectric fitting in supply piping to emergency equipment if piping and equipment connections are made of different metals. Comply with requirements for dielectric fittings specified in Section 221116 "Domestic Water Piping."

F. Install thermometers in supply and outlet piping connections to water-tempering equipment. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."

G. Install trap and waste piping on drain outlet of emergency equipment receptors that are indicated to be directly connected to drainage system. Comply with requirements for waste piping specified in Section 221316 "Sanitary Waste and Vent Piping."

H. Install indirect waste piping on drain outlet of emergency equipment receptors that are indicated to be indirectly connected to drainage system. Comply with requirements for waste piping specified in Section 221316 "Sanitary Waste and Vent Piping."

I. Install escutcheons on piping wall and ceiling penetrations in exposed, finished locations. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

J. Fill self-contained fixtures with flushing fluid.

3.3 CONNECTIONS

A. Connect cold-water-supply piping to plumbed emergency plumbing fixtures not having water- tempering equipment. Comply with requirements for cold-water piping specified in Section 221116 "Domestic Water Piping."

B. Connect hot- and cold-water-supply piping to hot- and cold-water, water-tempering equipment. Connect output from water-tempering equipment to emergency plumbing fixtures. Comply with requirements for hot- and cold-water piping specified in Section 221116 "Domestic Water Piping."

C. Directly connect emergency plumbing fixture receptors with trapped drain outlet to sanitary waste and vent piping. Comply with requirements for waste piping specified in Section 221316 "Sanitary Waste and Vent Piping."

D. Indirectly connect emergency plumbing fixture receptors without trapped drain outlet to sanitary waste piping.

E. Where installing piping adjacent to emergency plumbing fixtures, allow space for service and maintenance of fixtures.

3.4 IDENTIFICATION

A. Install equipment nameplates or equipment markers on emergency plumbing fixtures and equipment and equipment signs on water-tempering equipment. Comply with requirements for identification materials specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.5 FIELD QUALITY CONTROL

A. Mechanical-Component Testing: After plumbing connections have been made, test for compliance with requirements. Verify ability to achieve indicated capacities.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation.

4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Emergency plumbing fixtures and water-tempering equipment will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust or replace fixture flow regulators for proper flow.

B. Adjust equipment temperature settings.

END OF SECTION 224500

SECTION 226113 - COMPRESSED-AIR PIPING FOR LABORATORY FACILITIES

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. Laboratory compressed-air piping, designated "laboratory air."
2. Shape-memory-metal couplings.
3. Pressure-seal fittings.
4. Flexible pipe connectors.
5. Zone valve box assemblies.
6. Ball valves.
7. Check valves.
8. Gas safety valves.
9. Compressed-air service connections.
10. Compressed-air manifolds.
11. Compressed-air cylinder storage racks.

B. Related Requirements:

1. Section 115313 "Laboratory Fume Hoods" for compressed-air outlets in laboratory fume hoods.
2. Section 123553.13 "Metal Laboratory Casework" for compressed-air outlets in laboratory casework.
3. Section 123553.16 "Plastic-Laminate-Clad Laboratory Casework" for compressed-air outlets in laboratory casework.
4. Section 123553.19 "Wood Laboratory Casework" for compressed-air outlets in laboratory casework.
5. Section 221513 "General-Service Compressed-Air Piping" for general-service compressed-air piping and specialties.
6. Section 226119 "Compressed-Air Equipment for Laboratory and Healthcare Facilities" for air compressors and specialties.

C. Related Work:

1. Section 017419 – Construction and Demolition Waste Management Disposal.
2. Section 018113 – Sustainable Design Requirements.
3. Section 018119 – Construction Indoor Air Quality Requirements.

1.3 DEFINITIONS

A. Compressed-Air Piping Systems: laboratory air.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and testing agency.

B. Brazing certificates.

C. Field Quality-Control Reports: Brazing certificates.

D. Source Quality Control Reports:

1. Certificates of Shop Inspection and Data Report for Bulk Gas Storage Tanks: As required by ASME Boiler and Pressure Vessel Code, Section VIII.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For compressed-air piping specialties to include in emergency, operation, and maintenance manuals.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.9 QUALITY ASSURANCE

A. Installer Qualifications:

1. Shape-Memory-Metal Coupling Joints: An authorized representative who is trained and approved by manufacturer in accordance with ASSE Standard #6040 and NFPA 99.

B. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the vacuum piping testing indicated, that is an NRTL, and that is acceptable to authorities having jurisdiction.

C. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications," or AWS B2.2/B2.2M.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Laboratory air operating at 50 psig (345 kPa).

2.2 PERFORMANCE REQUIREMENTS

A. Comply with NFPA 99.

2.3 PIPES, TUBES, AND FITTINGS

A. Comply with ASME B31.1 for laboratory air piping operating at more than 150 psig (1035 kPa).

B. Comply with ASME B31.9 for laboratory air piping operating at 150 psig (1035 kPa) or less.

C. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type.

D. Copper Unions: ASME B16.22 or MSS SP-123, wrought-copper or cast-copper alloy.

E. Cast-Copper-Alloy Flanges: ASME B16.24, Class 150.

1. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch (3-mm) maximum thickness, full-face type.
2. Flange Bolts and Nuts: ASME B18.2.1 carbon steel.

F. Shape-Memory-Metal Couplings:

1. Description: Cryogenic compression fitting made of nickel-titanium, shape-memory alloy.

G. Flexible Pipe Connectors:

1. Description: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.

a. Working-Pressure Rating: 200 psig (1380 kPa) minimum.
b. End Connections: Plain-end copper tube.

2.4 JOINING MATERIALS

A. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys.

B. Threaded-Joint Tape: PTFE.

2.5 VALVES

A. General Requirements for Valves: Manufacturer cleaned, purged, and bagged in accordance with CGA G-4.1 for oxygen service.

B. Ball Valves:
1. Standard: MSS SP-110.
2. Description: Three-piece body, brass or bronze.
3. Pressure Rating: 300 psig (2070 kPa) minimum.
4. Ball: Full-port, chrome-plated brass.
5. Seats: PTFE or TFE.
6. Handle: Lever
7. Stem: Blowout proof with PTFE or TFE seal.
8. Ends: Manufacturer-installed ASTM B819, copper-tube extensions

C. Check Valves:
1. Description: In-line pattern, bronze.
2. Pressure Rating: 300 psig (2070 kPa) minimum.
3. Operation: Spring loaded.
4. Ends: Manufacturer-installed, ASTM B819, copper-tube extensions.
5. Positive-pressure compressed-air valves shall be manufacturer cleaned, purged, and sealed as for oxygen service, in accordance with CGA G-4.1.

a. Valves shall be delivered sealed and labeled and kept sealed until prepared for installation.

D. Compressed-Air Safety Valves:

1. Bronze body.
2. ASME-construction, poppet, pressure-relief type.
3. Settings to match system requirements.
4. Positive-pressure compressed-air valves shall be manufacturer cleaned,

purged, and sealed as for oxygen service, in accordance with CGA G-4.1.

a. Valves shall be delivered sealed and labeled and kept sealed until prepared for installation.

E. Pressure Regulators:

1. Bronze body and trim.
2. Spring-loaded, diaphragm-operated, relieving type.
3. Manual pressure-setting adjustment.
4. Rated for 250-psig (1725-kPa) minimum inlet pressure.
5. Capable of controlling delivered air pressure within 0.5 psig for each 10-psig (5.0 kPa for each 100-kPa) inlet pressure.

2.6 COMPRESSED-AIR MANIFOLDS

A. Manufacturer cleaned, purged, and sealed as for oxygen service, in accordance with CGA G- 4.1.

B. Comply with NFPA 99, Ch. "Manifolds for Gas Cylinders without Reserve Supply."

C. Comply with NFPA 55.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Central Control-Panel Unit:

1. Weatherproof cabinet.
2. Supply and delivery pressure gages.
3. Electrical alarm-system connections and transformer.
4. Indicator lights or devices.
5. Manifold connection.
6. Pressure changeover switch.
7. Line-pressure regulator.
8. Shutoff valves.
9. Safety valve.

F. Manifold and Headers:

1. Duplex, nonferrous-metal header for number of cylinders indicated, divided into two equal banks.

2. Designed for 2000-psig (13.8-MPa) minimum inlet pressure.
3. Cylinder-bank headers with inlet (pigtail) connections complying with CGA V-1.
4. Individual inlet check valves, shutoff valve, pressure regulator, check valve, and pressure gage.

G. Operation: Automatic, pressure-switch-activated changeover from one cylinder bank to the other when first bank becomes exhausted, without line-pressure fluctuation or resetting of regulators and without supply interruption by shutoff of either cylinder-bank header.

H. Mounting: Wall with mounting brackets for manifold control cabinet and headers

I. Label manifold control unit with permanent label identifying compressed air and system operating pressure.

J. Compressed-Air Cylinders: Number and type of compressed-air cylinders required for complete manifold systems.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. General Location and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of compressed-air piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, air-compressor sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Comply with NFPA 99 for installation of compressed-air piping.

C. Install piping concealed from view and protected from physical contact by building occupants 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, and coordinate with other services occupying that space.

F. Install piping adjacent to equipment and specialties to allow service and maintenance.

G. Install piping with 1 percent slope downward in direction of flow.

H. Install nipples, unions special fittings, and valves with pressure ratings same as or higher than system pressure rating used in applications specified in "Piping Schedule" Article unless otherwise indicated.

I. Install eccentric reducers, if available, where compressed-air piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.

J. Install branch connections to mains from top of main. Provide drain leg at end of each main and branch at low points.

K. Install piping to permit valve servicing.

L. Install piping free of sags and bends.

M. Install fittings for changes in direction and for branch connections.

N. Install service connections recessed in walls. Attach roughing-in assembly to substrate; attach finishing assembly to roughing-in assembly.

O. Connect piping to air compressors and to compressed-air outlets and equipment requiring compressed-air service.

P. Install unions in copper tubing adjacent to each valve and at final connection to each machine, specialty, and piece of equipment.

Q. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

R. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.2 VALVE INSTALLATION

A. Install shutoff valve at each connection to and from compressed-air equipment and specialties.

B. Install check valves to maintain correct direction of compressed-air flow from compressed-air equipment.

C. Install valve boxes recessed in wall and anchored to substrate. Single boxes may be used for multiple valves that serve same area or function.

D. Install zone valves and gages in valve boxes. Rotate valves to angle that prevents closure of cover when valve is in closed position.

E. Install pressure regulators on compressed-air piping where reduced pressure is required.

F. Install flexible pipe connectors in discharge piping of each air compressor.

3.3 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of cleaned tubing and fittings before assembly.

C. Threaded Joints: Apply appropriate tape to external pipe threads.

D. Brazed Joints: Join copper tube and fittings in accordance with CDA's "Copper Tube Handbook," Ch. "Brazed Joints." Do not use flux. Continuously purge joint with oil-free dry nitrogen during brazing.

E. Soldered Joints: Apply ASTM B813, water-flushable flux to tube end. Join copper tube and fittings in accordance with ASTM B828.

F. Extruded-Tee Outlets: Form branches in copper tube in accordance with ASTM F2014, with tools recommended by tube manufacturer.

G. Flanged Joints:

1. Copper Tubing: Install flange on copper tubes. Use pipe-flange gasket between flanges. Join flanges with gasket and bolts in accordance with ASME B31.9 for bolting procedure.

H. Shape-Memory-Metal Coupling Joints: Join new copper tube to existing tube according to procedures developed by fitting manufacturer for installation of shape-memory-metal coupling joints.

3.4 COMPRESSED-AIR SERVICE COMPONENT INSTALLATION

A. Install compressed-air pressure-control panel in walls. Attach to substrate.

B. Install compressed-air manifolds anchored to substrate.

C. Install compressed-air cylinders and connect to manifold piping.

D. Install compressed-air-cylinder wall storage racks attached to substrate.

3.5 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for hangers, supports, and anchor devices specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

B. Vertical Piping: MSS Type 8 or Type 42 clamps.

C. Individual, Straight, Horizontal Piping Runs:

1. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel, clevis hangers.
2. Longer Than 100 Feet (30 m): MSS Type 43, adjustable, roller hangers.

D. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44 pipe rolls. Support pipe rolls on trapeze. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for trapeze hangers.

E. Base of Vertical Piping: MSS Type 52 spring hangers.

F. Install hangers for copper tubing with maximum horizontal spacing and minimum rod diameters to comply with MSS SP-58, NFPA 99, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

G. Support horizontal piping within 12 inches (300 mm) of each fitting and coupling.

H. Support vertical runs of copper tubing to comply with MSS SP-58, NFPA 99, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.6 IDENTIFICATION

A. Install identifying labels and devices for laboratory compressed-air piping, valves, and specialties. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment."

B. Install identifying labels and devices for compressed-air piping systems in accordance with NFPA 99. Use the following or similar captions and color-coding for piping products where required by NFPA 99:
   1. Laboratory Air: Black letters on yellow-and-white checkerboard background.

3.7 FIELD QUALITY CONTROL FOR COMPRESSED-AIR PIPING IN LABORATORY FACILITIES

A. Testing Agency: Engage qualified testing agency to perform tests and inspections of compressed-air piping in laboratory facilities and to prepare test and inspection reports.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections with the assistance of a factory-authorized service representative.

D. Tests and Inspections:

   1. Piping Leak Tests for Compressed-Air Piping: Test new and modified parts of existing piping. Cap and fill compressed-air piping with oil-free dry nitrogen to pressure of 50 psig (345 kPa) above system operating pressure, but not less than 150 psig (1035 kPa). Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
   2. Repair leaks and retest until no leaks exist.

E. Piping will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

3.8 PROTECTION

A. Protect tubing from damage.

B. Retain sealing plugs in tubing, fittings, and specialties until installation.

C. Clean tubing not properly sealed, and where sealing is damaged, in accordance with "Preparation" Article.

3.9 PIPING SCHEDULE

A. Connect new tubing to existing tubing with memory-metal couplings.

B. Flanges may be used where connection to flanged equipment is required.

C. Laboratory Air Piping, NPS 3 (DN 80) and Smaller Shall Operate between 15 psig (103 kPa) and 50 psig (345 kPa): Type L copper tubing, wrought copper fittings and brazed joints.

3.10 VALVE SCHEDULE

A. Shutoff Valves: Ball valve with manufacturer-installed ASTM B819, copper-tube extensions.

B. Zone Valves: Ball valve with manufacturer-installed ASTM B819, copper-tube extensions with pressure gauge on one copper-tube extension.

END OF SECTION 226113

SECTION 226119 - COMPRESSED-AIR EQUIPMENT FOR LABORATORY FACILITIES

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. Oilless, reciprocating air compressors.
2. Inlet-air filters.
3. Refrigerant compressed-air dryers.
4. Compressed-air purification systems.
5. Compressed-air filter assemblies.

B. Related Work:

1. Section 017419 – Construction and Demolition Waste Management Disposal.
2. Section 018113 – Sustainable Design Requirements.
3. Section 018119 – Construction Indoor Air Quality Requirements.

1.3 DEFINITIONS

A. Actual Air: Air delivered at air-compressor outlet. Flow rate is compressed air delivered and measured in acfm (actual L/s).

B. Laboratory Air Equipment: Compressed-air equipment and accessories for nonmedical laboratory facilities.

C. Standard Air: Free air at 68 deg F (20 deg C) and 1 atmosphere (29.92 in. Hg) before compression or expansion and measured in scfm (standard L/s).

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For air compressors, compressed-air dryers, and compressed-air purification
systems.

1. Include plans, elevations, sections, and mounting 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. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments
to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
4. Include diagrams for power, signal, and control wiring.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and testing agency.

B. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For compressed-air equipment to include in operation and maintenance manuals.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective
covering for storage and identified with labels describing contents.

1.9 QUALITY ASSURANCE

A. Installer Qualifications:

1. Laboratory Air Equipment for Nonmedical Laboratory Facilities: An employer of workers
trained and approved by manufacturer.

B. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the compressed-air equipment testing indicated, that is an NRTL and that is acceptable to authorities having jurisdiction.

1. Qualify testing personnel according to ASSE 6020 for inspectors and ASSE

6030 for verifiers.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR AIR COMPRESSORS

A. Source Limitations for air compressors: Obtain each type of air compressor from single source from single manufacturer. Acceptable manufacturers:
   1. BeaconMedaes
   2. Sullair
   3. Ingersoll Rand
   4. Quincy

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Description: Factory-assembled, -wired, -piped, and -tested; electric-motor-driven; air-cooled; continuous-duty air compressors and receivers that deliver air of quality equal to intake air.

D. Control Panels: Automatic control station with load control and protection functions. Comply with NEMA ICS 2 and UL 508.

   1. Enclosure: NEMA ICS 6, Type 12 control panel unless otherwise indicated.
   2. Motor Controllers: Full-voltage, combination-magnetic type with undervoltage release feature and motor-circuit-protector-type disconnecting means and short-circuit protective device.
   3. Control Voltage: 120-V ac or less, using integral control power transformer.
   4. Motor Overload Protection: Overload relay in each phase.
   5. Starting Devices: Hand-off-automatic selector switch in cover of control panel, plus pilot device for automatic control.
   6. Automatic control switches to air compressors.
   7. Instrumentation: Include discharge-air and receiver pressure gages, air-filter maintenance indicator, hour meter, air-compressor discharge-air and coolant temperature gages, and control transformer.
   8. Alarm Signal Device: For connection to alarm system to indicate when backup air compressor is operating.

E. Receivers: Steel tank constructed according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

1. Pressure Rating: At least as high as highest discharge pressure of connected air compressors and bearing appropriate code symbols.
2. Interior Finish: Corrosion-resistant coating.
3. Accessories: Include safety valve, pressure gage, automatic drain, and pressure regulator.

2.2 SCROLL AIR COMPRESSORS

A. Scroll Air Compressors:
1. Description: Packaged unit.
2. Air Compressor(s): Single-stage, oil-free, rotary, oscillating-volute type of construction that prohibits oil from entering compression chamber.

    a. Mounting: Freestanding.

B. Capacities and Characteristics:

1. Compressed-Air Service: Nonmedical laboratory air.
2. Air Compressor(s): One.
3. Standard-Air Capacity of Each Air Compressor: 125 free air.
4. Actual-Air Capacity of Each Air Compressor: acfm delivered.
5. Discharge-Air Pressure: 125 psig.
6. Intake-Air Temperature: deg F.
7. Discharge-Air Temperature: deg F.
8. Motor (Each Air Compressor):

    a. Horsepower: 15.
    b. Speed: 3600 rpm.

9. Electrical Characteristics:

    a. Volts: 208.
    b. Phase(s): Three.
    c. Hertz: 60.
    d. Full-Load Amperes: 110.1

10. Receiver: ASME construction steel tank.

    a. Orientation: Vertical arrangement.
    b. Capacity: 250 gal..
    c. Interior Finish: Galvanized.
    d. Pressure Rating: 125 psig (860 kPa) minimum.
    e. Pressure Regulator Setting: psig.

f. Pressure Relief Valve Setting: 115 psig.
g. Drain: Automatic valve.

2.3 INLET-AIR FILTERS

A. Description: Combination inlet-air filter-silencer, suitable for remote installation, for each air compressor.

1. Construction: Weatherproof housing for replaceable, dry-type filter element, with silencer tubes or other method of sound reduction.
2. Capacity: Match capacity of air compressor, with collection efficiency of 99 percent retention of particles larger than 10 micrometers.

B. Description: Combination inlet-air filter-silencer, suitable for remote installation, for multiple air compressors.

1. Construction: Weatherproof housing for replaceable, dry-type filter element, with silencer tubes or other method of sound reduction.
2. Capacity: Match total capacity of connected air compressors, with collection efficiency of 99 percent retention of particles larger than 10 micrometers.

2.4 COMPRESSED-AIR DRYERS

A. Refrigerant Compressed-Air Dryers:
1. Description: Noncycling, air-cooled, electric-motor-driven unit with steel enclosure and capability to deliver 35 deg F (2 deg C), 100-psig (690-kPa) air at dew point. Include automatic ejection of condensate from airstream, step-down transformers, disconnect switches, inlet and outlet pressure gages, thermometers, automatic controls, and filters.

B. Capacities and Characteristics:

1. Standard-Air Capacity of Each Compressed-Air Dryer: 125 scfm free air.
2. Pressure: 115 psig.
3. Entering-Air Temperature: 100 deg F.
4. Leaving-Air Temperature: deg F.
5. Leaving-Air Pressure Dew Point: 38 deg F.
6. Ambient-Air Temperature: 100 deg F.
7. Maximum Air-Pressure Drop: 5 psig.
8. Inlet Filter: 5 micrometers.
9. Outlet Filter: 1 micrometer(s).
10. Motor Horsepower: 30.

11. Electrical Characteristics:

    a. Volts: 115.
    b. Phase(s): Single.
    c. Hertz: 60.
    d. Full-Load Amperes: 12.7

2.5 COMPRESSED-AIR FILTER ASSEMBLIES

A. Compressed-Air Filter Assemblies:

1. Description: Filter assemblies suitable for compressed air, in parallel duplex arrangement. Size each assembly for maximum capacity of connected equipment and operating pressure of compressed-air system. Include automatic ejection of condensate from airstream, inlet and outlet pressure gages, and shutoff valves.

    a. Option: Factory-fabricated filter system consisting of three air filters equivalent to those specified, pipe, fittings, valves, differential pressure switch, and enclosure; and with additional automatic drain traps and gages.

2. Size filter assemblies for 5-psig (34.5-kPa) maximum air-pressure drop when filters are new and clean, at system rated capacity, and at 100-psig (690-kPa) pressure.
3. Differential Pressure Switch: Adjustable, diaphragm type, with electrical connections for alarm system, to indicate when air-pressure drop through filters rises to more than 2 psig (13.8 kPa) greater than when new and clean.
4. Particulate Filters: Collection efficiency of 98 percent retention of particles 1 micrometer and larger.
5. Odor and Taste Filters: Vapor-absorbing, activated charcoal.
6. Coalescing Filters: Collection efficiency of 99.9 percent retention of particles 0.3 micrometer and smaller.
7. Include automatic drain trap for each filter.

2.6 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."

1. Enclosure: Open, dripproof
2. Enclosure Materials: Cast iron
3. Motor Bearings:

4. Efficiency: Premium efficient.
5. NEMA Design: 1
6. Electrical Characteristics:

    a. Horsepower: 15
    b. Volts: 240
    c. Phase: Three
    d. Hertz: 60
    e. Full-Load Amperes: 39.7

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean compressed-air equipment, accessories, and components that have not been cleaned for oxygen service and sealed or that are furnished unsuitable for laboratory air applications, according to CGA G-4.1, "Cleaning Equipment for Oxygen Service."

3.2 COMPRESSED-AIR EQUIPMENT INSTALLATION

A. General Requirements for Compressed-Air Equipment Installation:

1. Install compressed-air equipment to allow maximum headroom unless specific mounting heights are indicated.
2. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces unless otherwise indicated.
3. Install mechanical 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.
4. Install equipment to allow right of way for piping installed at required slope.
5. Install the following devices on compressed-air equipment:

    a. Thermometer, Pressure Gage, and Safety Valve: Install on each compressed-air receiver.
    b. Pressure Regulators: Install downstream from air compressors, dryers, purification units, and filter assemblies.
    c. Drain Valves: Install on aftercoolers, receivers, and dryers. Discharge condensate over nearest floor drain.

B. Nonmedical Laboratory Compressed-Air Equipment Installation:

1. Install compressed-air equipment, except wall-mounted equipment, on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
2. Comply with requirements for vibration isolation devices specified in Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment."
3. Install diaphragm air compressors on floor.

   a. Anchor air compressors to surface according to manufacturer's written instructions.

3.3 CONNECTIONS

A. Comply with requirements for water-supply piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Comply with requirements for drain piping specified in Section 221316 "Sanitary Waste and Vent Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

C. Comply with requirements for compressed-air piping specified in Section 226113 "Compressed- Air Piping for Laboratory and Healthcare Facilities." Drawings indicate general arrangement of piping, fittings, and specialties.

D. Where installing piping adjacent to equipment, allow space for service and maintenance.

E. Connect compressed-air piping to compressed-air equipment, accessories, and specialties with shutoff valve and union or flanged connection.

F. Connect water supply to compressed-air equipment that requires water. Include backflow preventer. Backflow preventers are specified in Section 221119 "Domestic Water Piping Specialties."

3.4 IDENTIFICATION

A. Identify nonmedical laboratory compressed-air equipment system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Check for lubricating oil in lubricated-type equipment.
3. Check belt drives for proper tension.
4. Verify that air-compressor inlet filters and piping are clear.
5. Check for equipment vibration-control supports and flexible pipe connectors and verify that equipment is properly attached to substrate.
6. Check safety valves for correct settings. Ensure that settings are higher than air- compressor discharge pressure, but not higher than rating of system components.
7. Drain receiver tank(s).
8. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
9. Test and adjust controls and safeties.

B. Prepare written report documenting testing procedures and results.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air compressors, compressed-air dryers, compressed-air purification units and compressed-air filter assemblies.

END OF SECTION 226119

SECTION 226600 - CHEMICAL-WASTE SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES

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. Single-wall piping.
2. Double-containment piping.
3. Field-fabrication containment piping.
4. Piping specialties.
5. Neutralization tanks.
6. Neutralization systems.
7. Manholes - holding tanks.
8. Leak-detection systems.

B. Laboratory Waste

1. Laboratory waste piping and approved dilution or neutralization system(s) shall be provided for all plumbing fixtures where corrosive waste, spent acids, or other harmful chemicals are discharged to the sanitary sewer. Point of use disposal/collection programs are a Campus elected option.

   a. If plastic piping materials are intended to be used, an analysis of the expected chemicals to be encountered shall be performed and used to select suitable piping material.

   b. Exception: Laboratory waste piping and neutralization system(s) may be omitted where all the following occur:

      1) The Campus expresses this preference in writing.
      2) The local sewer authority agrees.
      3) The Campus has protocols for user control of laboratory waste at each source.
      4) Valved sampling port is provided for future testing of the discharge.

1.3 DEFINITIONS

A. FPM: Vinylidene fluoride (hexafluoropropylene copolymer rubber).

1.4 SUBMITTALS

A. Submittals for this section are subject to the re-evaluation fee identified in Article 4 of the General Conditions.

B. Manufacturer's installation instructions shall be provided along with product data.

C. Submittals shall be provided in the order in which they are specified and tabbed (for combined submittals)

D. Product Data: For each type of product.

E. Shop Drawings: For neutralization system and leak-detection system.

1. Include plans, elevations, sections, and attachment details.
2. Include details of neutralization-system assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include details of leak-detection-system assemblies. Indicate required clearances, method of field assembly, components, and location and size of each field connection.
4. Include diagrams for power, signal, and control wiring.

F. Delegated-Design Submittal: For seismic restraints of aboveground piping.

1. Include design calculations for selecting seismic restraints.

G. Profile Drawings for Outdoor Underground Piping: Show system piping in elevation. Draw profiles at horizontal scale of not less than 1 inch equals 50 feet and vertical scale of not less than 1 inch equals 5 feet. Indicate underground structures and pipes. Show types, sizes, materials, and elevations of other utilities crossing system piping.

H. Coordination Drawings: Reflected ceiling plan(s) 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. Pipe sizes, locations, and elevations.
2. Other piping in same trench and clearances from sewerage system piping.
3. Interface and spatial relationship between piping and proximate structures.

I. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For chemical-waste specialties and [**neutralization tanks**] [**neutralization systems**] [**and**] [**leak-detection systems**] to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store piping and specialties with sealing plugs in ends or with end protection.

B. Do not store plastic pipe or fittings in direct sunlight.

C. Protect pipe, fittings, and seals from dirt and damage.

1.8 FIELD CONDITIONS

A. Interruption of Existing Chemical-Waste Service: Do not interrupt chemical-waste service to facilities occupied by Director's Representative or others unless permitted under the following conditions and then only after arranging to provide temporary chemical-waste service in accordance with requirements indicated:

1. Notify Director's Representative no fewer than [**two**] <**Insert number**> days in advance of proposed interruption of chemical-waste service.
2. Do not proceed with interruption of chemical-waste service without Director's Representative's written permission.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70 "Standard for Electrical Safety in the Workplace", by an NRTL, and marked for intended location and application.

B. NFPA Compliance: Comply with NFPA 70 "Standard for Electrical Safety in the Workplace".

2.2 SINGLE-WALL PIPE AND FITTINGS

A. PP Drainage Pipe and Fittings: ASTM F1412 "Standard Specification for Polyolefin Pipe and Fittings for Corrosive Waste Drainage Systems", extruded pipe and drainage-pattern fittings molded, with Schedule 40 dimensions and with fire-retardant additive complying with ASTM D4101 "Standard Classification System and Basis for Specification for Polypropylene Injection and Extrusion Materials"; with [**fusion-**] [**and**] [**mechanical-**]joint ends.

1. Exception: Pipe and fittings made from PP resin without fire-retardant additive may be used for underground installation.
2. 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. IPEX USA LLC.
   b. Orion Fittings; A Watts Water Technologies Company.
   c. Zurn Industries, LLC.
   d. Or equal.

3. Source Limitations: Obtain pipe and fittings from single source from single manufacturer.

B. CPVC Drainage Pipe and Fittings: ASTM F2618 "Standard Specification for Chlorinated Poly Pipe and Fittings for Chemical Waste Drainage Systems", pipe and drainage-pattern fittings.

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. Charlotte Pipe and Foundry Company.
   b. Spears Manufacturing Company.
   c. Or equal.

2. Source Limitations: Obtain pipe and fittings from single source from single manufacturer.

C. PVDF Drainage Pipe and Fittings: ASTM F1673 "Standard Specification for Polyvinylidene Fluoride Corrosive Waste Drainage Systems", Schedule 40, pipe and drainage-pattern fittings. Include fittings with [**fusion-**] [**and**] [**mechanical-**]joint ends.

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. IPEX USA LLC.
   b. Orion Fittings; A Watts Water Technologies Company.
   c. Zurn Industries, LLC.
   d. Or equal.

2. Source Limitations: Obtain pipe and fittings from single source from single manufacturer.

D. Fiberglass Pipe and Fittings, Centrifugally Cast: ASTM D2997 “Standard Specification for Centrifugally Cast "Fiberglass" Pipe”, Type II, [**Grade 1**] [**Grade 2**] <**Insert grade**>, [**Class A**] [**Class B**] [**Class C**], RTRP pipe; with ASTM D5685 “Standard Specification for "Fiberglass" Pressure Pipe and Fittings”, Type 4, fiberglass thermosetting resin fittings matching pipe; and [**adhesive-bonding**] [**and**] [**butt-and-wrap-joint**] materials. Include wall thickness that will provide [**160-psig**] <**Insert value**> minimum, sustained water test pressure rating.

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. Smith Fiberglass; a National Oilwell Varco brand.
   b. Or equal

2. Source Limitations: Obtain pipe and fittings from single source from single manufacturer.

E. Fiberglass Pipe and Fittings, Filament Wound: ASTM D2996 “Standard Specification for Filament-Wound "Fiberglass" Pipe”, Type I, [**Grade 1**] [**Grade 2**] <**Insert grade**>, [**Class A**] [**Class B**] [**Class C**] [**Class E**] [**Class F**] <**Insert class**>, RTRP pipe; ASTM D5685 “Standard Specification for "Fiberglass" Pressure Pipe and Fittings”, Type 1, reinforced thermosetting resin fittings matching pipe; and [**adhesive-bonding**] [**and**] [**butt-and-wrap-joint**] materials. Include wall thickness that will provide [**160-psig**] <**Insert value**> minimum, sustained water test pressure rating.

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. Ameron International.
   b. Smith Fiberglass; a National Oilwell Varco brand.
   c. Or equal.

2. Source Limitations: Obtain pipe and fittings from single source from single manufacturer.

F. Stainless Steel Drainage Pipe and Fittings: ASME A112.3.1 “Stainless Steel Drainage Systems for Sanitary DMV, Storm, and Vacuum Applications Above & Below Ground”, ASTM A666 “Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar”, Type 316L, stainless steel pipe and drainage-pattern fittings; with socket-and-spigot ends for gasket joints; and having piping manufacturer's FPM lip-seal rubber gaskets shaped to fit socket groove, with plastic backup ring.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Josam Company.
   b. Or equal.

2. Source Limitations: Obtain pipe and fittings from single source from single manufacturer.

G. Borosilicate Glass Pipe and Fittings: ASTM C1053 “Standard Specification for Borosilicate Glass Pipe and Fittings for Drain, Waste, and Vent Applications”, pipe and drainage-pattern fittings; with manufacturer's standard couplings.

1. Covering: Factory-applied polystyrene for pipe installed underground.
2. 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. Schott North America, Inc.
   b. Or equal.

3. Source Limitations: Obtain pipe and fittings from single source from single manufacturer.

H. Adapters and Transition Fittings: Assemblies with combinations of clamps, couplings, adapters, and gaskets; compatible with piping and system liquid; made for joining different piping materials.

2.3 DOUBLE-CONTAINMENT PIPE AND FITTINGS

A. Description: Factory-fabricated, double-wall pipe and fittings. Sizes indicate carrier-pipe size; with carrier (inner) pipe and fittings; annular-space, carrier-pipe supports; containment (outer) pipe and fittings; and joining materials and fasteners.

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. Flo Safe, Inc.
2. IPEX USA LLC.
3. Orion Fittings; A Watts Water Technologies Company.
4. Or equal.

C. Source Limitations: Obtain pipe and fittings from single source from single manufacturer.

D. Piping Materials:

1. PP Double-Containment Drainage Pipe and Fittings: Made of ASTM D4101 “Standard Classification System and Basis for Specification for Polypropylene Injection and Extrusion Materials” PP resin.

   a. Carrier and Containment Pipes: ASTM F1412 “Standard Specification for Polyolefin Pipe and Fittings for Corrosive Waste Drainage Systems”, Schedule 40.
   b. Fittings: ASTM F1412 “Standard Specification for Polyolefin Pipe and Fittings for Corrosive Waste Drainage Systems”, Schedule 40 drainage pattern complying with ASTM D3311 “Standard Specification for Drain, Waste, and Vent Plastic Fittings Patterns”.

2. PVDF Double-Containment Drainage Pipe and Fittings: Made of ASTM D3222 "Standard Specification for Unmodified Poly Molding Extrusion and Coating Materials" PVDF resin.

   a. Carrier and Containment Pipes: ASTM F1673 "Standard Specification for Polyvinylidene Fluoride Corrosive Waste Drainage Systems", Schedule 40.
   b. Fittings: ASTM F1673 "Standard Specification for Polyvinylidene Fluoride Corrosive Waste Drainage Systems", Schedule 40 drainage pattern complying with ASTM D3311 "Standard Specification for Drain, Waste, and Vent Plastic Fittings Patterns".

E. Include design and fabrication of double-containment pipe and fitting assemblies with provision for field installation of cable leak-detection system in annular space between carrier and containment piping.

2.4 FIELD-FABRICATION CONTAINMENT PIPING

A. Description: Containment split pipe and split fittings with carrier-pipe centralizers. Include manufacturer's fastening devices and materials.

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. Flo Safe, Inc.
   2. GF Piping Systems: Georg Fischer LLC.
   3. Or equal.

C. Source Limitations: Obtain containment piping from single source from single manufacturer.

D. Material: [**HDPE**] [**PP**] pipe and fittings.

E. Fastening System: FPM gaskets, clamps, and pins.

2.5 JOINING MATERIALS

A. Couplings: Assemblies with combinations of clamps, gaskets, sleeves, and threaded or flanged parts; compatible with piping and system liquid; and made by piping manufacturer for joining system piping.

B. Adapters and Transition Fittings: Assemblies with combinations of clamps, couplings, adapters, gaskets, and threaded or flanged parts; compatible with piping and system liquid; and made for joining different piping materials.

C. Flanges: Assemblies of companion flanges and gaskets complying with ASME B16.21 "Nonmetallic Flat Gaskets for Pipe Flanges" and compatible with system liquid, and bolts and nuts.

D. Solvent Cement for Joining CPVC Piping: ASTM F493 "Standard Specification for Solvent Cements for Chlorinated Poly Plastic Pipe and Fittings". Include primer in accordance with

ASTM F656 "Standard Specification for Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) Plastic Pipe and Fittings".

E. Fiberglass-Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.6 PIPING SPECIALTIES

A. Plastic Dilution Traps:

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. IPEX USA LLC.
   b. Orion Fittings; A Watts Water Technologies Company.
   c. Zurn Industries, LLC.
   d. Or equal.

2. Source Limitations: Obtain traps from single source from single manufacturer.
3. Material: Corrosion-resistant PP, with removable base.
4. End Connections: Mechanical joint.
5. Dilution Tanks: 1-gal. capacity, with clear base unless colored base is indicated; with two 1-1/2 inch top inlets and one 1-1/2 inch side outlet.
6. Small Dilution Jars: 1-pint capacity, with clear base unless colored base is indicated; with 1-1/2 inch top inlet and 1-1/2 inch side outlet.
7. Large Dilution Jars: 1-quart capacity; with 1-1/2 inch top inlet and 1-1/2 inch side outlet.

B. Glass, Drain-Line, Interceptor Traps:

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. Schott North America, Inc.
   b. Or equal.

2. Source Limitations: Obtain traps from single source from single manufacturer.
3. Standard: ASTM C1053 "Standard Specification for Borosilicate Glass Pipe and Fittings for Drain, Waste, and Vent Applications".
4. Type: Drum trap.
5. Size: 1-1/2 inch, 2 inch by 1-1/2 inch, or 2 inch, as required to match connecting piping.

C. Corrosion-Resistant Traps:

1. Type: P-trap or drum trap.
2. Size: 1-1/2 inch or 2 inch, as required to match connected piping.

3. High-Silicon Iron: ASTM A861 "Standard Specification for High-Silicon Iron Pipe and Fittings", with horizontal outlet and hub-and-plain or plain ends to match connecting piping.
4. PP: ASTM D4101 "Standard Classification System and Basis for Specification for Polypropylene Injection and Extrusion Materials", with mechanical-joint pipe connections.
5. PVDF: ASTM D3222 "Standard Specification for Unmodified Poly Molding Extrusion and Coating Materials", with mechanical-joint pipe connections.
6. Glass: ASTM C1053 "Standard Specification for Borosilicate Glass Pipe and Fittings for Drain, Waste, and Vent Applications", with coupling pipe connections.

D. Stainless Steel Floor Drains:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Josam Company.
   b. Sioux Chief Manufacturing Company, Inc.
   c. Or equal.

2. Source Limitations: Obtain floor drains from single source from single manufacturer.
3. Standard: ASME A112.3.1 "Stainless Steel Drainage Systems for Sanitary DMV, Storm, and Vacuum Applications Above & Below Ground"; ASTM A666 "Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar", Type 316L.
4. Body: With [**8.5-by-8.5-inch**] [**12.4-by-12.4-inch**] top with grate.
5. Outlet: Bottom, of size indicated.

E. PP Floor Drains:

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. IPEX USA LLC.
   b. Orion Fittings; A Watts Water Technologies Company.
   c. WATTS; A Watts Water Technologies Company.
   d. Zurn Industries, LLC.
   e. Or equal.

2. Source Limitations: Obtain floor drains from single source from single manufacturer.
3. Body: With 7- to 9-inch top diameter, with flashing flange and weep holes; and with [**flashing clamp**] [**basket strainer**] [**funnel attachment**] [**and**] [**trap-primer connection**].
4. Outlet: Bottom, to match connecting pipe, with 2 inch, 3 inch, 4 inch, or 6 inch outlet as indicated.

F. Stainless Steel Cleanouts:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Josam Company.
    b. Sioux Chief Manufacturing Company, Inc.
    c. Or equal.

2. Source Limitations: Obtain cleanouts from single source from single manufacturer.
3. Standard: ASME A112.3.1 "Stainless Steel Drainage Systems for Sanitary DMV, Storm, and Vacuum Applications Above & Below Ground"; ASTM A666 "Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar", Type 316L.
4. Aboveground Piping: Cleanout tee of size matching piping.
5. Underground and Underslab Piping: Floor access cleanout of size matching piping.

G. Plastic Backwater Valves:

1. Description: Full-port 3 inch check valve, PP or PVDF, matching or compatible with system piping and compatible with system liquid, with EPDM seals and flanged ends.

    a. Exception: PVC material for use with PVC piping systems.

H. PP Sink Outlets:

1. Description: 1-1/2 inch, with clamping device, stopper, and 7-inch- high overflow fitting.

I. Glass Sink Outlets:

1. Description: 1-1/2 inch; with sink assembly of outlet, strainer, gasket, and locknut; overflow fitting of length indicated; and tailpiece assembly of borosilicate glass and locknut.

2. 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. Schott North America, Inc.
    b. Or equal.

3. Source Limitations: Obtain sink outlets from single source from single manufacturer.
4. Standard: ASTM C1053 "Standard Specification for Borosilicate Glass Pipe and Fittings for Drain, Waste, and Vent Applications" components for field assembly.

PART 3 - EXECUTION

3.1 CONCRETE BASES

A. Equipment Mounting:

1. Install [**neutralization tanks**] [**and**] [**neutralization system tanks**] on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
2. Comply with requirements for vibration isolation and seismic-control devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
3. Comply with requirements for vibration isolation devices specified in Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment."

B. Anchor [**neutralization tanks] [and] [neutralization system tanks**] to concrete bases.

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 19-inch centers around full perimeter of base.
2. For installed equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be imbedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.2 PIPING INSTALLATION

A. Chemical-Waste Sewerage Outside the Building:

1. Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground chemical-waste sewerage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
2. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings in accordance with manufacturer's written instructions for using lubricants, cements, and other installation requirements.
3. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.
4. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
5. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, jacking, or combination of both.
6. Install drainage piping pitched down in direction of flow, at minimum slope of [**1**] [**2**] <**Insert number**> percent unless otherwise indicated.
7. Install drainage piping with [**36-inch**] [**48-inch**] [**60-inch**] [**72-inch**] <Insert dimension> minimum cover.

8. Install CPVC drainage piping in accordance with ASTM D2321 “Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications” and ASTM F1668 “Standard Guide for Construction Procedures for Buried Plastic Pipe”.
9. Install PVDF drainage piping in accordance with ASTM D2321 “Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications” and ASTM F1668 “Standard Guide for Construction Procedures for Buried Plastic Pipe”.
10. Install field-fabrication containment piping over[**new and**] existing carrier piping. Use containment piping manufacturer's fastening system.
11. Clear interior of piping and structures of dirt and superfluous material as work progresses. Maintain a swab or drag inside piping and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

B. Chemical-Waste Piping Inside the Building:

1. Install piping adjacent to equipment, accessories, and specialties, to allow space for service and maintenance.
2. Transition and special fittings with pressure ratings at least equal to piping pressure rating may be used unless otherwise indicated.
3. Flanges may be used on aboveground piping unless otherwise indicated.
4. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
5. 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.
6. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
7. Install piping at indicated slopes.
8. Install piping free of sags and bends.
9. Install fittings for changes in direction and branch connections.
10. Verify final equipment locations for roughing-in.
11. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
12. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
13. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 PIPING SPECIALTY INSTALLATION

A. Embed floor drains in 4-inch- minimum depth of concrete around bottom and sides. Comply with requirements in Section 033000 "Cast-in-Place Concrete" for concrete.

B. Fasten grates to drains if indicated.

C. Set floor drains with tops flush with pavement surface.

D. Install cleanouts and riser extension from sewer pipe to cleanout at grade. Use fittings of same material as sewer pipe at branches for cleanouts and riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in pipe.

1. Set cleanout bodies in earth in cast-in-place concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch above surrounding grade. Set cleanout plugs in concrete pavement, with tops flush with pavement surface. Comply with requirements in Section 033000 "Cast-in-Place Concrete" for formwork, reinforcement, and concrete requirements.

E. Install backwater valves in horizontal position. Include riser to cleanout at grade.

3.4 JOINT CONSTRUCTION

A. Chemical-Waste Sewerage Outside the Building:

1. Plastic-Piping Fusion Joints: Make PP drainage-piping joints in accordance with ASTM F1290 “Standard Practice for Electrofusion Joining Polyolefin Pipe and Fittings”.
2. Join dissimilar pipe materials with adapters compatible with pipe materials being joined.

B. Chemical-Waste Piping Inside the Building:

1. Plastic-Piping Fusion Joints: Make PP drainage-piping joints in accordance with ASTM F1290 “Standard Practice for Electrofusion Joining Polyolefin Pipe and Fittings”.
2. Dissimilar-Material Piping Joints: Make joints using adapters compatible with both system materials.

3.5 HANGER AND SUPPORT INSTALLATION

A. Pipe sizes in this article refer to aboveground single-wall piping[**and carrier piping of containment piping**].

B. Comply with requirements in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.

C. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices. Install the following:

1. Vertical Piping: MSS Type 8 or MSS Type 42 riser clamps.
2. Individual, Straight, Horizontal Piping Runs:

   a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
   c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.

4. Base of Vertical Piping: MSS Type 52 spring hangers.

D. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for installation of supports.

E. Support horizontal piping and tubing within 12 inches of each fitting and coupling.

F. Support vertical piping and tubing at base and at each floor.

G. Rod diameter may be reduced one size for double-rod hangers, to minimum of 3/8 inch.

H. Install vinyl-coated hangers for PP piping with the following maximum horizontal spacing and minimum rod diameters:

1. 2 inch: 33 inches with 3/8-inch rod.
2. 2-1/2 inch and 3 inch: 42 inches with 1/2-inch rod.
3. 4 inch and 5 inch: 48 inches with 5/8-inch rod.
4. 6 inch: 48 inches with 3/4-inch rod.
5. 8 inch: 48 inches with 7/8-inch rod.

I. Install supports for vertical PP piping every 72 inches.

J. Install vinyl-coated hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. 1-1/2 inch and 2 inch: 36 inches with 3/8-inch rod.
2. 2-1/2 inch and 3 inch: 42 inches with 1/2-inch rod.
3. 4 inch and 5 inch: 48 inches with 5/8-inch rod.
4. 6 inch: 48 inches with 3/4-inch rod.
5. 8 inch to 12 inch: 48 inches with 7/8-inch rod.

K. Install supports for vertical CPVC piping every 48 inches.

L. Install vinyl-coated hangers for PVDF piping with the following maximum horizontal spacing and minimum rod diameters:

1. All Sizes: Install continuous support for piping with liquid waste at temperatures above 140 deg F.
2. 1/4 inch and Smaller: 30 inches with 3/8-inch rod.
3. 3/4 inch to 1-1/2 inch: 36 inches with 3/8-inch rod.
4. 2 inch: 36 inches with 3/8-inch rod.
5. 2-1/2 inch and 3 inch: 42 inches with 1/2-inch rod.
6. 4 inch and 5 inch: 48 inches with 5/8-inch rod.
7. 6 inch: 48 inches with 3/4-inch rod.

M. Install supports for vertical PVDF piping 1-1/2 inch every 48 inches and 2 inch and larger every 72 inches.

N. Install hangers for stainless steel drainage piping with the following maximum horizontal spacing and minimum rod diameters:

1. 2 inch: 10 feet with 3/8-inch rod.
2. 2-1/2 inch: 11 feet with 1/2-inch rod.
3. 3 inch: 12 feet with 1/2-inch rod.
4. 4 inch and 5 inch: 12 feet with 5/8-inch rod.
5. 6 inch: 12 feet with 3/4-inch rod.

O. Install supports for vertical, stainless steel drainage piping every 15 feet.

P. Install vinyl-coated hangers for glass piping with the following maximum horizontal spacing and minimum rod diameters:

1. 1 inch and 1-1/4: 72 inches with 3/8-inch rod.
2. 1-1/2 inch and 2 inch: 96 inches with 3/8-inch rod.
3. 3 inch: 96 inches with 1/2-inch rod.
4. 4 inch and 6 inch: 96 inches with 5/8-inch rod.

Q. Install supports for vertical glass piping every 96 inches.

R. Support piping and tubing not listed above in accordance with MSS SP-58 “Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application and Installation”.

3.6 NEUTRALIZATION TANK INSTALLATION

A. Install exterior [**collection**] [**and**] [**neutralization**] tanks, complete with appurtenances indicated.

1. Set tops of tank covers flush with finished surface where covers occur in pavements. Set covers 3 inches above finished surface elsewhere unless otherwise indicated.
2. Include initial fill of limestone for neutralization tanks.

B. Install interior neutralization tanks on smooth and level [**concrete base**] [**floor surface**]. Include full initial charge of limestone.

3.7 CONCRETE PLACEMENT

A. Comply with requirements in Section 033000 "Cast-in-Place Concrete" for concrete supports.

B. Place cast-in-place concrete in accordance with ACI 318/318R “Building Code Requirements for Structural Concrete and Commentary”.

3.8 PIPING CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Make connections to existing piping, so finished Work complies as nearly as practical with requirements specified for new Work.

C. Use commercially manufactured wye fittings for sewerage piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of [**3000 psi**] <**Insert value**>.

D. Protect existing piping to prevent concrete or debris from entering while making connections. Remove debris or other extraneous material that may accumulate.

E. Where installing piping adjacent to equipment, allow space for service and maintenance.

3.9 LABELING AND IDENTIFICATION

A. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for labeling of equipment and piping.

1. Use [**warning tape or**]detectable warning tape over ferrous piping.
2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.10 ADJUSTING

A. Adjust neutralization-system set points.

B. Adjust leak-detection-system control and device settings.

3.11 CLEANING

A. Use procedures prescribed by authorities having jurisdiction or, if not prescribed, use procedures described below:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Clean piping by flushing with potable water.

3.12 STARTUP SERVICE

A. Engage a Company Field Advisor to perform startup service for [**neutralization systems**] [**and**] [**leak-detection systems**].

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Neutralization Systems:

a. Verify that neutralization system is installed and connected according to the Contract Documents.
b. Verify that electrical wiring installation complies with manufacturer's submittal.
c. Install neutralizing solutions and limestone.
d. Energize circuits.
e. Start and run systems through complete sequence of operations.
f. Adjust operating controls.
g. <**Insert startup steps if any**>.

3. Leak-Detection Systems:

a. Verify that electrical wiring installation complies with manufacturer's submittal.
b. Energize circuits.
c. Adjust operating controls.
d. <**Insert startup steps if any**>.

3.13 FIELD QUALITY CONTROL

A. Inspect interior of sewerage piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place and again at completion of Project.

1. Defects requiring correction include the following:

a. Alignment: Less than full diameter of inside of pipe is visible between inspection points.
b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
c. Crushed, broken, cracked, or otherwise damaged piping.
d. Hydrostatic Tests for Drainage Piping:

1) Allowable leakage is a maximum of [**50 gal./inch of nominal pipe size per mile**] <**Insert value**> of pipe during 24-hour period.
2) Close openings in system and fill with water.
3) Purge air and refill with water.
4) Disconnect water supply.
5) Test and inspect joints for leaks.

e. Air Tests for Drainage Piping: Comply with UNI-B-6 “Recommended Practice of Low-Pressure Air Testing of Installed Sewer Pipe”.

2. Leaks and loss in test pressure constitute defects that must be repaired.
3. Submit separate reports for each test.

B. Replace leaking sewerage piping using new materials and repeat testing until leakage is within allowances specified.

C. Testing Agency: Director's Representative will engage a qualified testing agency to perform tests and inspections.

D. Manufacturer's Field Service: Engage a Company Field Advisor to test and inspect components, assemblies, and equipment installations, including connections.

E. Perform tests and inspections with the assistance of a Company Field Advisor.

F. Tests and Inspections:

1. Manufacturer's Field Service: Engage a Company Field Advisor to inspect assembled [**neutralization systems**] [**and**] [**leak-detection systems**] and their installation, including piping and electrical connections, and to assist in testing.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

G. Chemical-waste piping will be considered defective if it does not pass tests and inspections.

H. Prepare test and inspection reports.

3.14 DEMONSTRATION

A. Engage a Company Field Advisor to train Director's Representative's Facility's maintenance personnel to adjust, operate, and maintain [**neutralization systems**] [**and**] [**leak-detection systems**].

3.15 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping pressure rating may be used in applications below unless otherwise indicated.

B. Single-Wall, Chemical-Waste Sewerage Piping: Use[**any of**] the following piping materials for each size range:

a. Polypropylene, ASTM F1412, Flame Retardant, Polypropylene fittings, Heat Fusion joints.

b. Polyvinylidene Fluoride, ASTM F1673, Polyvinylidene Fluoride fittings, Heat Fusion joints.

c. Chlorinated Polyvinyl Chloride, ASTM D1784/F2618, Schedule 40, NSF CW-SE Certified with Chlorinated Polyvinyl Chloride fittings, Solvent Welded, ASTM F493 joints.

d. Borosilicate Glass, ASTM C1053, Borosilicate Glass fittings, Stainless Steel Compression Coupling joints with TFE Seal.

e. Silicon Iron, ASTM A518/A861,Cast Iron fittings, Bell and Spigot joints with Acid Resistant Sealant

C. Underground, Double-Containment, Chemical-Waste Sewerage Piping: Use[**any of**] the following piping materials for each size range:

1. 2 inch to 12 inch: PP double-containment drainage pipe and fittings.
2. 2 inch to 12 inch: CPVC double-containment drainage pipe and fittings.
3. 2 inch to 12 inch: PVDF double-containment drainage pipe and fittings.
4. 2 inch to 12 inch: PVDF/CPVC double-containment drainage pipe and fittings.

D. Aboveground Chemical-Waste Piping: Use[**any of**] the following piping materials for each size range:

1. 1-1/2 inch to 6 inch: PP drainage piping and [**fusion**] [**mechanical**] joints.
2. 1-1/2 inch to 6 inch: CPVC drainage piping and solvent-cemented joints.
3. 1-1/2 inch to 6 inch: PVDF drainage piping and [**fusion**] [**mechanical**] joints.
4. 1-1/2 inch to 6 inch: Use 2 inch to 4 inch stainless steel drainage piping with socket-and-spigot ends and gasketed joints.
5. 1-1/2 inch to 6 inch: Borosilicate glass pipe and fittings, couplings, and coupled joints.

E. Under Slab-on-Grade, Indoor, Chemical-Waste Piping: Use[**any of**] the following piping materials for each size range:

1. 1-1/2 inch to 6 inch: PP drainage piping and fusion joints.
2. 1-1/2 inch to 6 inch: PVDF drainage piping and fusion joints.
3. 1-1/2 inch to 6 INCH: Stainless steel drainage piping with socket-and-spigot ends and gasketed joints.
4. 1-1/2 inch to 6 inch: Borosilicate glass piping with covering, couplings, and coupled joints.
5. 1-1/2 inch to 6 inch: [**PP**] [**PVDF**], double-containment drainage piping and manufacturer's standard joints.
6. 8 inch: [**PP**] [**PVDF**], double-containment drainage piping and manufacturer's standard joints.

END OF SECTION 226600

SECTION 226713 - PROCESSED WATER PIPING FOR LABORATORY FACILITIES

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 deionized-water and reverse-osmosis-water piping, fittings, and valves,
including the following:

1. CPVC pipe and fittings.
2. PP pipe and fittings for heat-fusion joints.
3. PP pipe and fittings for electro-fusion joints.
4. CPVC valves.
5. PP valves.

1.3 DEFINITIONS

A. RO: Reverse osmosis.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and operators in accordance with ASME Boiler and
Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

B. ASME Compliance: Comply with ASME B31.3 for piping conveying fluid at a pressure of 15 psig (105 kPa) or greater.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure Ratings:
1. Deionized-Water Piping: 150 psig (1035 kPa) unless otherwise indicated.
2. RO Water Piping: 150 psig (1035 kPa) unless otherwise indicated.

2.2 PLASTIC PIPE AND FITTINGS

A. Standards: Comply with NSF 14, NSF 61, and NSF 372.

B. PP Pipe and Fittings for Heat-Fusion Joints: Made from ASTM D4101 PP resin.

C. PP Pipe and Fittings, Schedule 40: Schedule 40 or SDR 11 dimensions; with socket- or butt- fusion fittings matching pipe dimensions.

D. PP Pipe and Fittings for Electro-Fusion Joints: Made from ASTM D4101 PP resin.
1. PP Pipe and Fittings, Schedule 80: Schedule 80 or SDR dimensions; with socket fittings matching pipe dimensions.
2. Electro-Fusion Fitting: Electrical-resistance heating coil for PP piping joints.

2.3 TRANSITION FITTINGS

A. Couplings, flanges, or other manufactured fittings; same size as, with pressure rating at least
equal to, and ends compatible with piping to be joined.

2.4 PP VALVES

A. PP Ball Valves:
1. Description:

a. Standard: MSS SP-122.
b. Pressure Rating: 150 psig (1035 kPa) at 73 deg F (23 deg C)
c. Body Material: ASTM D4101 PP resin.
d. Body Design: Union type.

e. End Connections: Detachable, butt or socket.
f. Ball: ASTM D4101 PP resin.
g. Port: Full.
h. Seats: PTFE.
i. Stem: ASTM D4101 PP resin.
j. Stem Seals: FKM-rubber O-rings.
k. Handle: Tee shaped.

B. PP Ball-Check Valves:
1. Description:

a. Pressure Rating: 150 psig (1035 kPa) at 73 deg F (23 deg C).
b. Body Material: ASTM D4101 PP resin.
c. Body Design: Union type.
d. End Connections: Detachable, socket.
e. Ball: ASTM D4101 PP resin.
f. Seat and Seals: FKM-rubber O-rings.

C. PP Swing-Check Valves:
1. Description:

a. Pressure Rating: 150 psig (1035 kPa) at 73 deg F (23 deg C).
b. Body Material: ASTM D4101 PP resin.
c. Body Design: Bolted-bonnet type.
d. End Connections: Flanged.
e. Shaft: ASTM D4101 PP resin.
f. Disc and Arm: ASTM D4101 PP resin.
g. Gasket and Seals: FKM rubber.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING

A. General Locations and Arrangements: Drawing and details indicate general location and arrangement of water piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and 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 removal of ceiling panel, and coordinate with other services occupying that space.

E. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

F. Install piping to permit valve servicing.

G. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure ratings unless otherwise indicated.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

K. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

L. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.2 JOINT CONSTRUCTION

A. Where specific joint construction is not indicated, follow piping manufacturer's written instructions.

B. PP Piping Electro-Fusion Joints: Make in accordance with ASTM F1290.

C. PP Piping Heat-Fusion Joints: Make in accordance with ASTM D2657.

D. Join dissimilar pipe materials with transition fittings compatible with pipe materials being joined.

3.3 INSTALLATION OF VALVES

A. Install sectional valves close to mains on each branch and riser serving equipment.

B. Install shutoff valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

C. Locate valves for easy access, and provide separate support where necessary.

D. Install valves of same size as the pipe or tube in which they are installed unless otherwise indicated.

E. Install plastic valves of the same material as the plastic pipe in which they are installed.

F. Install valves in horizontal piping with stem at or above center of pipe.

G. Install valves in position to allow full movement of stem and lever handle.

H. Install swing-check valves in horizontal position with the hinge pin level.

3.4 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install stainless steel pipe hangers for horizontal piping in corrosive environments.
3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
4. Install stainless steel pipe support clamps for verticalpiping in corrosive environments.
5. Clamps for Vertical Piping: MSS Type 8 or Type 42.
6. Individual, Straight, Horizontal Piping Runs:

    a. 100 Feet (30 m) and Less: MSS Type 1 adjustable clevis hangers.
    b. Longer Than 100 Feet (30 m): MSS Type 43 adjustable roller hangers.
    c. Longer Than 100 Feet (30 m) if Indicated: MSS Type 49 spring cushion rolls.

7. Multiple, Straight, Horizontal Piping Runs, 100 Feet (30 m) or Longer: MSS Type

44 pipe rolls. Support pipe rolls on trapeze.

8. Base of Vertical Piping: MSS Type 52 spring hangers.

B. Support horizontal piping and tubing within 12 inches (300 mm) of each fitting[, valve,] and coupling.

C. Support vertical runs of stainless steel piping to comply with MSS SP-58, NFPA 99, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

D. Support vertical runs of PP piping to comply with manufacturer's written recommendations, NFPA 99, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.5 PIPING CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

C. Connect deionized-water and RO water piping to equipment and service outlets with unions or flanges.

3.6 IDENTIFICATION

A. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections with the assistance of a factory-authorized service representative.

E. Tests and Inspections:

1. Test new piping and parts of existing piping that have been altered, extended, or repaired for leaks and defects.
2. Schedule tests and their inspections by authorities having jurisdiction, with at least 24 hours' advance notice.
3. Do not cover piping or put into service before inspection and approval by the authorities having jurisdiction.

4. If piping does not pass the test, replace leaking joints with new materials and retest until no leaks exist.
5. Submit separate reports for each test.

F. Processed-water system will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

3.8 CLEANING OF PIPING SERVING HEALTHCARE

A. Use procedures prescribed by authorities having jurisdiction or, if not prescribed, use procedures described below:

1. Cleaning of system as indicated or in accordance with AWWA-C601.
2. Before using, purge new piping and parts of existing piping that have been altered, extended, or repaired.
3. Remove flow indicators and flow-measuring devices before flushing. Replace after cleaning is completed.
4. Clean piping by flushing at a sufficient velocity and quantity to dislodge sediment or dirt with deionized- and RO- water mixture throughout the system.
5. After flushing, introduce chlorine or chlorine compound into the system with a dosage sufficient to give an initial residual chlorine content of 50 ppm.
6. Open and close valves several times to collect samples from various fixtures throughout the system during introduction of chlorine, to assure uniform distribution.
7. After 12-hour contact period, flush chlorinated water from system.
8. After flushing, provide evidence of effectiveness of disinfection by filing a report of bacteriological tests on samples taken from the system with the authorities having jurisdiction. The report shall include the number and locations of where the samples were taken.

9. If satisfaction is not achieved, repeat the above disinfection process until satisfactory results are obtained. And do not put the system online until this has been obtained.

3.9 CLEANING OF PIPING SERVING LABORATORIES

A. Use procedures prescribed by authorities having jurisdiction or, if not prescribed, use procedures described below:

1. Before using, purge new piping and parts of existing piping that have been altered, extended, or repaired.
2. Remove flow indicators and flow-measuring devices before flushing. Replace after cleaning is completed.
3. Provide storage tank(s), heat exchanger(s) and pumping system(s) required for cleaning.
4. Clean piping by pumping at a sufficient velocity and quantity to dislodge sediment or dirt with sodium hypochlorite and deionized- and RO- water mixture throughout the system.
5. Open all taps until cleaning solution is detected, then close taps. Retain solution in the system at least three hours.

B. At the end of the retention period, open all faucets and taps to thoroughly flush with clean deionized- and RO water until solution is drained from the system.

3.10 PIPING APPLICATION

A. Transition and special fittings with pressure ratings at least equal to piping, and of same or compatible material, may be used in applications below.

B. Pipe fittings shall be the same material as the piping to which it is connected.

C. Deionized-Water Piping: Use any of the following piping materials for each pipe size range:

1. NPS 3 (DN 80) and Smaller: PP pipe and fittings and heat-fusion joints.
2. NPS 3 (DN 80) and Smaller: PP pipe and fittings and electro-fusion joints.

D. RO Water Piping: Use[any of] the following piping materials for each pipe size range:

1. NPS 3 (DN 80) and Smaller: PP pipe and fittings and heat-fusion joints.
2. NPS 3 (DN 80) and Smaller: PP pipe and fittings and electro-fusion joints.

3.11 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Valves shall be the same material as the piping to which they are connected.
2. Shutoff Duty: Install ball valves in piping NPS 2 (DN 50) and smaller. Install butterfly or diaphragm valves for NPS 3 (DN 80) piping.
3. Throttling Duty: Install ball valves in piping NPS 2 (DN 50) and smaller. Install diaphragm valves for NPS 3 (DN 80) piping.

END OF SECTION 226713

SECTION 226719 - PROCESSED WATER EQUIPMENT FOR LABORATORY FACILITIES

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 deionized-water and reverse-osmosis-water equipment and processed water
faucets. Equipment and associated control and accessories shall be capable of producing Type
2 reagent grade water.

1. Multimedia filter.
2. Carbon filter.
3. Water softeners.
4. Dechlorination filter.
5. Deionized (DI) mixed beds.
6. RO systems.
7. Recirculating pump.
8. Purified-water storage tank
9. Point-of-use portable polishers.
10. Ultra-violet sterilization unit.
11. Recirculating pure-water faucet.

B. Related Requirements:

1. Section 226713 " PROCESSED WATER PIPING FOR LABORATORY FACILITIES " for piping , fittings and valves.

1.3 DEFINITIONS

A. RO: Reverse osmosis.

1.4 ACTION SUBMITTALS

A. Product Data for each type of product, including the following.

1. Pump curves.
2. Equipment dimensions and weight data.
3. Electrical wiring data.
4. Control panel layout.
5. Vibration data.

B. Sustainable Design Submittals:

C. Shop Drawings:

1. Provide a flow schematic of the proposed system, showing:
   a. Equipment and accessories.
   b. Piping and directional flows and sizes.
   c. Flow rates.
   d. Connection to domestic water.
   e. Components.
   f. Interconnection piping.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Operation and Maintenance Data: For all equipment in this section.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer shall have the qualifications for supplying and servicing process water equipment, including engineering services.

B. The process water quality shall be in accordance with ASTM D1193.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Source Limitations for Processed Water Equipment: Obtain all processed water equipment from single source or from single manufacturer. Acceptable manufacturers:
   1. Culligan Matrix
   2. Culligan
   3. Evoqua
   4. AquaPure

2.2 PERFORMANCE REQUIREMENTS

A. Contractor shall perform feedwater analysis at domestic cold water service entrance to obtain existing water quality information. The feedwater analysis shall include the following parameters, at a minimum:

1. Inlet water pressure (psig)
2. Inlet water temperature (F)
3. Turbidity (NTU)
4. pH
5. Chlorine (mg/L)
6. Total dissolved solids (mg/L)
7. Silt density index
8. Iron (mg/L)
9. Salt rejection (%)
10. Water hardness

B. Design equipment based on the feedwater analysis completed at the water service entrance.
   1. Deionized-Water Piping: 150 psig (1035 kPa) unless otherwise indicated.
   2. RO Water Piping: 150 psig (1035 kPa) unless otherwise indicated.

2.3 MULTIMEDIA FILTRATION

A. Filter Tank:

   1. Material: Fiberglass with a polyethylene liner and inner shell constructed of HDPE.
   2. Rated Working Pressure: 150 psig (1034 kPa) psig at 120 deg F (49 deg C) temperature.

B. Distributor Assembly:

   1. Hub and Lateral Distribution System:

      a. For tanks 21 inches (5333 mm) in diameter and larger.
      b. Material: ABS or PVC.

   2. Single Nonclogging Segmented Distributor:

      a. For tanks 18 inches (457 mm) in diameter and smaller.
      b. Material: ABS.

C. Operating Valves:

   1. Fully Automatic Multiport Control Valve:

      a. Motor-driven single-piston valve with a piston timer to control regeneration program.
      b. Fully adjustable.

2. Diaphragm Valves: Permit separate water source for backwashing.

D. Regeneration Initiation Control:

1. Provide a seven-day time clock to allow the system to regenerate at any time of the day or night and on any day of the week.
2. Provide a differential pressure switch to initiate backwash based on measurement of increased pressure loss across the system.

E. Filter Media:

1. Top Layer: 1.0- to 1.2-mm anthracite.
2. Second Layer: 0.4- to 0.5-mm flint sand.
3. Third Layer: 0.35- to 0.45-mm garnet.
4. All Layers: Resting on coarse gravel underbedding.

2.4 CARBON FILTER

A. Filter Tank:

1. Welded, industrial-grade, cold-rolled carbon steel with dished heads constructed and stamped in accordance with ASME Boiler and Pressure Vessel Code, Section VIII, Rules for Construction of Pressure Vessels. Tank shall have the maximum working pressure of not less the 150 psig (1034 kPa).
2. Filter Media:

   a. Two layers of graduated supporting gravel.
   b. One layer of 2 cu. ft. (56 L) of activated carbon.
   c. Bottom layer of coarse gravel underbedding.

3. The tank shall be provided with O-Ring seals at the openings, inlets, and outlets.
4. Tank shall have an epoxy enamel finish.
5. Provide seven-day time clock to allow the system to regenerate at any time of the day or night and on any day of the week.

2.5 WATER SOFTENERS

A. Standards: Comply with NSF 44.

B. Softener Tank: Fiberglass-reinforced polyester (FRP).

1. 150-psig (1034-kPa) operating pressure and ASME stamped.
2. Design at a temperature of 120 degF.
3. Tank to be lined with 20-mil-thick vinyl bag.
4. Mineral Bed: Non-phenolic polystyrene resin with a minimum exchange capacity of 30,000 grains per cubic foot when regenerated with 15 lbs (6.8 kg) of salt per cubic foot. Mineral shall be solid and particle the proper size, not more than 4 percent through a No. 40 mesh wet screening, and shall not contain any foreign shapes that will interfere with the normal operation of the softener.

2.6 DECHLORINATION FILTER

A. Filter: Two independent, activated carbon filters in parallel. Resultant residual chlorine concentration shall be less than 0.1 ppm.

B. Filter Vessel: Fiberglass-reinforced molded-thermoplastic inner shell with dished heads, equipped with reinforced openings for piping connections.

1. Hand hole at the top and bottom.
2. Vessel to be rated at 150-psig (1034-kPa) working pressure in accordance with ASME Boiler and Pressure Vessel Code, Section VIII, Rules for Construction of Pressure Vessels.

C. Provide controls compatible with the facility control system. Provide connection for trouble alarm.

D. Provide pressure gauges with simple cocks on inlet and outlet of each tank.

2.7 DEIONIZED (DI) MIXED BEDS

A. Tank:

1. Material: Reinforced fiberglass with vinyl ester lining for removing dissolved ionized solids.
2. Minimum Water Resistivity: 10 megohm - cm at 25 deg C.
3. Pressure Ratings: Operating pressure of not less than 150 psig (1034 kPa) and test pressure not less than 185 psig (1275 kPa).

B. Resin: Suitable for using in mixed-bed deionizer application and for intended application.

2.8 REVERSE OSMOSIS (RO) SYSTEMS

A. Pressurized Membrane System: High-pressure pump forces water through the membrane(s) to remove 99 percent of organic solids, bacteria, contaminants, and particles and 97 percent of dissolved solids.

B. Pre-filtration: Polypropylene depth filters, capable of removing 90 percent of particles greater than 5 micron.

1. Housing:

a. Type 304 stainless steel.
b. Include vent and drain plugs with EPDM o-rings.
c. Include Type 304 pressure gauge at the inlet and outlet.

C. Membrane modules with thin-film composite type membranes and membrane vessels to allow a maximum flux for the following:

1. First State: 18 gallons per square foot per day (733 liters per square meter per day) of membrane surface area at 17 percent recovery.
2. Second Stage: 30 gallons per square foot (114 liters per square meter per day) per day of membrane surface area at 35 percent recovery.

D. Panel-Mounted Controls and Instrumentation on a Common Frame:

1. Material: Stainless steel or Epoxy-coated aluminum.
2. Features:

a. Flow meters
b. Type 304 stainless steel pressure gauges for pump discharge and regulated pump pressure.
c. Control valves.
d. Pump starter with indicated light.
e. Feedwater pressure switch with time delay for low-pressure shutdown.
f. Time controller for automatic fast flush.
g. Monitor/controller with selector switch for feed to monitor conductivity.
h. Trouble alarm with ability to connect to the building management system.

2.9 PURIFED-WATER STORAGE TANK

A. Material: Fabricated of molded polyethylene with a cone bottom and extra heavy wall construction. Provide with two lifting lugs of Type 304 stainless steel.

B. Mounting: Steel stand assembly with hold-down lugs of Type 304 stainless steel.

2.10 BOOSTER PUMP

A. By Vendor as part of the skid

B. 1 HP

C. 208 V

D. Single Phase

E. Size and capacity as shown on Drawings.

2.11 ULTRA-VIOLET STERILIZATION UNIT

A. Inline Sterilizer Light: Provide to reduce the bacteria.

B. Ultra-Violet Lamps: ultra-violet lamp(s), designed to operate at 115 V, single phase, 60 Hz.

1. Housing: Type 304, electro-polished and passavated stainless steel, complying with MIL- S-5002.

C. Provide a sensor that will be able to indicate level of UV radiation being produced.

2.12 NON-RECIRCULATING PURE-WATER FAUCET

A. Faucet:

1. Deck-mounted non-recirculating type.
2. Brass casting and inert polypropylene-lined interior.
3. Include diaphragm valve with a brass valve stem and bonnet; on-off control.

2.13 SOURCE QUALITY CONTROL

A. Manufacturer to perform a factory test of components, piping, and skid assemblies prior to shipment and furnish certification that the testing has been performed and the certification meets specified design requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General Locations and Arrangements: Drawings and details indicate general location and arrangement of water piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install equipment in accordance with all codes, standards, and manufacturers recommendations.

C. Provide documentation that the equipment has been installed in accordance with manufacturers requirements.

D. Provide a startup of the equipment and a per-check of all associated piping, valves, control devices and control panels.

E. After completion of the installation, provide up to eight hours of instructional time with the Owner's personnel.

F. Mount equipment and/or skid(s) on concrete pads.

G. Connect, calibrate, balance, and adjust equipment, devices, and instrumentation to perform functions as specified.

3.2 PIPING CONNECTIONS

A. Drawings indicate general arrangement of equipment, piping, fittings, and specialties.

B. Where installing equipment, allow space for service and maintenance.

C. Connect deionized-water and RO water piping to equipment and service outlets with unions or flanges.

3.3 IDENTIFICATION

A. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections with the assistance of a factory-authorized service representative.

E. Tests and Inspections:

1. After installation, Installer shall test equipment for performance, leaks, and defects.
2. The Installer shall notify the authorities having jurisdiction with at least 24 hours' advance notice.
3. Do not cover equipment or put into service before inspection and approval by the authorities having jurisdiction
4. Submit separate reports for each test.

F. Processed-water system will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

3.5 SANITIZING OF EQUIPMENT SERVING LABORATORIES

A. Use procedures prescribed by authorities having jurisdiction or, if not prescribed, use procedures described below:

1. Remove flow indicators and flow-measuring devices before flushing. Replace after cleaning is completed.
2. Clean equipment by pumping at a sufficient velocity and quantity to dislodge sediment or dirt with sodium hypochlorite and a deionized- and RO- water mixture throughout the system.
3. Open all taps until solution is detected, then close taps. Retain solution in the

system at least four hours.

END OF SECTION 226719

SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Certain requirements common to all the mechanical trades (Fire Suppression, Plumbing and HVAC) are specified in Division 20. To avoid repetition, they are not repeated in each relevant Division of the Specifications. However, these requirements are applicable to the work of this Division and are hereby incorporated by reference.

1. For example, prior to requesting an occupancy permit, the documentation listed in Part 3 of Section 20000 must be submitted and approved so the Engineer can certify that the MEP systems and life safety provisions are completed.

B. 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. HVAC demolition.
2. Equipment installation requirements common to equipment sections.
3. Painting and finishing.
4. Grouting
5. Access and access panel coordination.
6. Material and workmanship.

1.3 REFERENCES

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form part of this specification to the extent referenced. Publications are referenced in the text by the basic designations only.

1. American Iron and Steel Institute (ASI)
2. National Fire Protection Association (NFPA)
   a. NFPA 70 National Electric Code
3. American Society for Testing and Materials (ASTM)
   a. ASTM A36Standard Specification for Carbon Structural Steel
   b. ASTM A53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
   c. ASTM A109Standard Specification for Steel, Strip, Carbon (0.25 Maximum Percent), Cold-Rolled

d. ASTM A123Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

e. ASTM A240Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

f. ASTM A500Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

g. ASTM A501Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing

h. ASTM A633 Standard Specification for Normalized High-Strength Low-Alloy Structural Steel Plates

i. ASTM A635Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Commercial Steel, Drawing Steel, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, Hot-Rolled

j. ASTM A653Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

k. ASTM A682Standard Specification for Steel, Strip, High-Carbon, Cold-Rolled

l. ASTM A924Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

m. ASTM A1011Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability

n. ASTM A1018Standard Specification for Steel, Sheet and Strip, Heavy Thickness Coils, Hot Rolled, Carbon, Structural, High-Strength Low-Alloy, Columbium or Vanadium, and High-Strength Low-Alloy with Improved Formability

o. ASTM B117Standard Practice for Operating Salt Spray (Fog) Apparatus

p. ASTM B633Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel

q. ASTM C920Standard Specification for Elastomeric Joint Sealants

r. ASTM C1193Standard Guide for Use of Joint Sealants

s. ASTM D522Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings

t. ASTM D523Standard Test Method for Specular Gloss

u. ASTM D610 Standard Test Method for Evaluating Degree of Rusting on Painted Steel Surfaces.

v. ASTM D2247Standard Practice for Testing Water Resistance of Coatings in 100 per Relative Humidity

w. ASTM D3451Standard Guide for Testing Coating Powders and Powder Coatings

x. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials

y. ASTM F1136Standard Specification for Chromium/Zinc Corrosion Protective Coatings for Fasteners

4. American Wood-Preservers' Association (AWPA)

a. AWPA C2 Lumber, Timber, Bridge Ties and Mine Ties - Preservative Treatment by Pressure Processes

b. AWPA C9 Plywood - Preservative Treatment by Pressure Process

c. AWPA C20 Structural Lumber - Fire-Retardant Treatment by Pressure Processes

d. AWPA C22 Lumber and Plywood for Permanent Wood Foundations-Preservative Treatment by Pressure Processes

e. AWPA C27Plywood-Fire-Retardant Treatment by Pressure Processes

5. American Welding Society (AWS)

6. Code of Federal Regulations (CFR)

7. Metal Framing Manufactures Association (MFMA)

a. MFMA Metal Framing Standards Publication

8. Underwriters Laboratories (UL)

a. UL 723 Test for Surface Burning Characteristics of Building Materials

1.4 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct 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 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.

2. PE: Polyethylene plastic.

3. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.

2. NBR: Acrylonitrile-butadiene rubber.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Rated fire construction penetration sealants.

1.6 QUALITY ASSURANCE

A. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect and cover equipment (VAV boxes, coils, fans, pumps, control valves, etc) and ductwork components with plastic when stored on site to prevent entrance of dirt, debris and moisture.

1.8 COORDINATION

A. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 HVAC DEMOLITION

A. Refer to Division 01 and Division 02 for general demolition requirements and procedures.

B. Refer to drawings for general description of areas requiring demolition.

C. Refer to Contractor’s/Construction Manager’s Instructions for existing equipment and materials that shall remain the property of the Owner.

D. Where it is noted that items of value are not to be returned to the Owner, the items shall become the property of the Contractor. Storage or sale of items on the project site is prohibited. Items shall be removed from site and legally disposed of.

E. Protection: Ensure the safe passage of persons in and around the building/site during demolition. Prevent injury to persons and damage to property. Provide adequate shoring and bracing to prevent collapse. Immediately repair damage to the condition

before being damaged to the satisfaction of the architect and Owner. Take effective measures to prevent windblown dust.

F. Utilities: Maintain utilities except those requiring removal or relocation. Keep utilities in service and protect from damage. Do not interrupt utilities serving in-use areas without first obtaining permission from the utility company and the Owner. Provide temporary services as required.

G. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap remaining piping with same or compatible piping material.
2. Piping to Be Abandoned in Place: Drain piping and cap piping with same or compatible piping material.
3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and cap remaining ducts with same or compatible ductwork material.
4. Ducts to Be Abandoned in Place: Cap ducts with same or compatible ductwork material.
5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

H. 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 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install 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.

D. Install equipment to allow right of way for piping installed at required slope.

E. Avoid interference with structure and with work of other trades, preserving adequate headroom and clearing doors and passageways, to satisfaction of Architect and in accordance with code requirements.

F. Distribute equipment loads on building structural members provided for equipment support. Roof-mounted equipment shall be installed and supported on structural steel.

G. Provide suspended platforms, strap hangers, brackets, shelves, stands or legs for floor, wall or ceiling mounting of equipment.

H. Provide steel supports and hardware for proper installation of hangers, anchors and guides.

I. Provide cuts, weights, and other pertinent data required for proper coordination of equipment support provisions and installation.

J. Structural steel and hardware shall conform to Standard Specifications of ASTM; use of steel and hardware shall conform to requirements of Section Five of Code of Practice of American Institute of Steel Construction.

K. Verify site conditions and dimensions of equipment to ensure access for proper installation of equipment without disassembly that will void warrantee. Report in writing to Architect, prior to purchase or shipment of equipment involved, on conditions that may prevent proper installation.

L. For all equipment installed external to the building; whether on roofs, supports, grade, etc., the installation shall comply with wind loading and impact requirements of the applicable codes for this project site. All equipment provided for this project shall be certified by the manufacturer that the equipment meets the applicable wind impact requirements as set forth by the Authority Having Jurisdiction.

3.3 PAINTING

A. Painting of HVAC systems, equipment, and components is specified in Division 09.

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

C. Equipment installed shall have shop coat of non-lead gray paint. Hangers and supports shall have one coat of non-lead red primer. Machinery (e.g. pumps, fans and air handling units) shall be stenciled with equipment name. Stencil shall be at least 6 inches high for large equipment, 2 inches high for small equipment.

D. Note requirement for Architect's approval invoked under paragraph MATERIALS AND WORKMANSHIP regarding finish of material and equipment that is visible or subject to corrosive or atmospheric conditions.

3.4 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.5 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.6 GROUTING

A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

3.7 ACCESS AND ACCESS PANEL COORDINATION

A. Refer to air distribution system specification section for duct access doors and panels.

B. Access panels in walls, ceilings and floors are generally not shown on the drawings, but shall be provided to maintain proper access to materials and equipment that require inspection, replacement, repair or service. Coordination where access doors or panels are required by Division 08. If proper access cannot be provided, confer with Architect as to best method of approach for minimizing effect of reduced access that may result.

C. Coordinate and prepare a location, size, and function schedule of access panels required to fully service equipment and deliver to Division 08. Furnish and install distinctively colored buttons (color as selected by Architect) in finished ceiling to identify access panels.

D. Coordinate access panel locations for installation under other Sections where fire dampers, smoke dampers, volume dampers, smoke detectors, controls, shut-off valves, control valves, check valves, or other items installed under this Section require access and are concealed in floor, wall, furred space or above ceiling.

E. Ceilings consisting of lay-in or removable splined tiles do not require access panels and dampers, splitters, or test hole openings above ceiling shall have location marked with thumbtack on finished ceiling panel. Location shall be noted on record drawings.

F. Access panels shall be at least large enough to remove the component requiring access. .

1. Minimum Access Door Sizes:

a. One-Hand or Inspection Access: 8 inches by 5 inches.

b. Two-Hand Access: 12 inches by 6 inches.

c. Head and Hand Access: 18 inches by 10 inches.

d. Head and Shoulders Access: 21 inches by 14 inches.

e. Body Access: 25 inches by 14 inches.

f. Body Plus Ladder Access: 25 inches by 17 inches.

3.8 MATERIALS AND WORKMANSHIP

A. Work shall be neat and rectilinear. Ductwork, piping and conduit shall run concealed except in mechanical rooms and areas where no hung ceiling exists. Install material and equipment in accordance with manufacturers written instructions. Installation shall operate safely and without leakage, undue wear, noise, vibration, corrosion or water hammer. Work shall be properly and effectively protected, and pipe and duct openings shall be temporarily closed to prevent obstruction and damage before completion.

B. Except as specified otherwise, material and equipment shall be new. Provide supplies, appliances and connections necessary for complete and operational installation. Provide components required or recommended by OSHA and applicable NFPA documents.

C. Owner will not be responsible for material and equipment before testing, commissioning, and acceptance.

END OF SECTION

SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Certain requirements common to all the mechanical and electrical trades (Fire Suppression, Plumbing, HVAC, Electrical, and Tele/Data) are specified in Division 20. To avoid repetition, they are not repeated in each relevant Division of the Specifications. However, these requirements are applicable to the work of this Division and are hereby incorporated by reference.

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

1.2 SUMMARY

A. Section includes general requirements for 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.

1.3 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.

B. Comply with NEMA MG 1 unless otherwise indicated.

C. Comply with IEEE 841 for severe-duty motors.

D. Motors under 1/2 HP shall be designed for 120V, 60 Hz, single phase, unless otherwise specified.

E. Motors 1/2 HP and over shall be voltages as indicated in schedules on drawings.

F. Individual pumps serving variable flow systems and VAV fans with a motor horsepower of 5 hp or larger shall be provided with variable speed drives that will result in pump or fan motor demand of no more than 30 percent of design wattage at 50 percent of design flow.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 SINGLE-PHASE MOTORS

A. Except where specified as part of terminal equipment (i.e. ECM motors in fan coil units), motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application and shall be premium efficiency type:

1. Permanent-split capacitor.
2. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to 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.

F. Electronically Commutated Motors (ECM): Motors shall be an electronic commutation (EC) motor specifically designed for HVAC applications. AC induction type motors are not acceptable. Motors shall be permanently lubricated with heavy-duty ball bearings to match the load, and prewired to the specific voltage and phase. Internal motor circuitry shall convert AC power supplied to the equipment to DC power to operate the motor. Motor shall be speed controllable down to 20 percent of full speed (5:1 turndown). Speed shall be controlled by either a potentiometer dial mounted on the motor or by a 0-10 VDC control signal. Motor shall be a minimum of 85 percent efficient at all speeds.

2.4 ELECTRONICALLY COMMUTATED MOTOR (ECM)

A. For equipment specified with ECM motors, provide the following.

1. Synchronous, constant torque, ECM with permanent magnet rotor. Rotor magnets to be time-stable, nontoxic ceramic magnets (Sr-Fe).
2. Driven by a frequency converter with an integrated power factor correction filter. Conventional induction motors will not be acceptable.
3. Each motor with an integrated variable-frequency drive, tested as one unit by manufacturer.
4. Motor speed adjustable over full range from 0 rpm to maximum scheduled speed.
5. Variable motor speed to be controlled by a 0- to 10 V-dc or 4- to 20-mA input.
6. Integrated motor protection verified by UL to protect the pump against over and under voltage, over temperature of motor and/or electronics, overcurrent, locked rotor, and dry run (no-load condition).

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Certain requirements common to all the mechanical and electrical trades (Fire Suppression, Plumbing, HVAC, Electrical, and Tele/Data) are specified in Division 20. To avoid repetition, they are not repeated in each relevant Division of the Specifications. However, these requirements are applicable to the work of this Division and are hereby incorporated by reference.

B. 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 hangers and supports for HVAC system piping and equipment:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Fastener systems.
4. Equipment supports.

B. Related Sections include the following:

1. Division 05 for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry Inc.

B. MSS SP-58-2018, “Pipe Hangers and Supports – Materials, Design, Manufacture, Selection, Application, and Installation

1.4 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

B. Design supports for multiple ducts, capable of supporting combined weight of supported systems and system contents.

C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 ACTION SUBMITTALS

A. Product Data: For the following:

1. Steel pipe hangers and supports.
2. Thermal-hanger shield inserts.
3. Components of trapeze pipe hangers and metal framing systems.
4. Pipe stands.

B. Shop Drawings: Show fabrication and installation details for the following:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Pipe stands.
4. Equipment supports.

C. Delegated-Design Submittal: For trapeze hangers, metal framing systems and equipment supports provide analysis data verifying submitted supports meet performance requirements and design criteria, signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design calculations for designing trapeze hangers, metal framing systems and equipment supports based on approved piping and equipment submittal data.
2. Wind-Restraint Details:
   a. Design Analysis: To support selection and arrangement of wind restraints. Include calculations of combined tensile and shear loads.
   b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacing. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during design wind speed. Indicate association with vibration isolation devices.
   c. Comply with requirements in other Sections for equipment mounted outdoors.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.7 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel." and AWS D1.3, "Structural Welding Code--Sheet Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code, Section IX.

C. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."
2. AWS D1.2, "Structural Welding Code--Aluminum."
3. AWS D1.3, "Structural Welding Code--Sheet Steel."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Connection Design Criteria

1. Upper attachments to structure shall have an allowable gravity load of 25 percent of the failure load (proof test).
2. Maximum load from hangers attached to the underside of the slabs shall be 250 pounds. If higher loads are required due to space or coordination constraints, submit formal request for interpretation (RFI) to structural design professional of record for review before work commences.
3. Do not cut any notches or drill or cut any holes on structural members without the expressed approval of the structural design professional of record.
4. Core openings only in areas indicated on the documents and in additional areas only with the approval of the structural design professional.
5. Do not attach or suspend any MEP items from metal deck.
6. Survey location of concrete reinforcement before drilling anchors in reinforced concrete walls, beams, or slabs. Do not cut any reinforcing bars during drilling of anchors unless approved by the structural design professional.
7. Provide patching of fireproofing removed or accidentally damaged during the attachment of suspended items. Provide documentation that patch shall does not reduce performance of the fireproofing system.
8. For steel framing, maximum load from hangers attached to steel beams shall be 400 pounds. For the parts that will be fireproofed, if clamps or any other attachments are attached after the fireproofing is in place, enough fireproofing must be removed at the point of contact so that the attachment can be placed with the proper edge distance and develop the required “bite” on the steel. Patch fireproofing after attachment is in place.
9. Wind Load Parameters
   a. Basic Wind Speed V = 126 MPH
   b. Directionality Factor Kd = 0.85
   c. Occupancy Category = III
   d. Importance Factor I = 1.15
   e. Mean Roof Height = 48.5 Feet

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and hanger types specified.

2.3 METAL FRAMING SYSTEMS

A. Description: Shop- or field-fabricated, pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes including cross bracing to support piping weight and resist wind loads. Provide G90 galvanized coated supports for outdoor locations.

B. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.

C. Channels: Continuous slotted carbon-steel, Type 304 stainless-steel or extruded-aluminum channel with in-turned lips.

D. Channel Width: Selected for applicable load criteria.

E. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.

F. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel or stainless steel matching hanger material.

G. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.

H. Non-metallic Coatings: Plastic coating, jacket, or liner.

2.4 FASTENER SYSTEMS

A. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated or stainless steel, for use in hardened Portland cement concrete with pull-out, tension, and shear capacities meeting supported loads and suitable for use with building materials.

2.5 MISCELLANEOUS MATERIALS

A. Carbon Steel: ASTM A1011/A1011M.

B. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

C. Stainless Steel: ASTM A240/A240M.

D. Stainless Steel: ASTM A240/A240M.

E. Threaded Rods: Continuously threaded. Zinc-plated or galvanized steel for indoor applications and stainless steel for outdoor applications. Mating nuts and washers of similar materials as rods.

F. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, non-shrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Non-staining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with requirements in Division 07 for fire-stopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

B. Strength of Support Assemblies: Select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

C. Examine areas and equipment to receive wind-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

D. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are specified in other Division 23 Sections specifying piping systems and equipment.

B. Comply with MSS SP-58 for pipe hanger 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 nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers and metal framing systems and attachments for general service applications.

F. Use stainless-steel pipe hangers and stainless-steel corrosion-resistant attachments for hostile environment applications.

G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Use thermal-hanger shield inserts for insulated piping and tubing.

J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, provide and space hangers in accordance with the following table:

Nom. Pipe Size (inches)	Max. Span (feet)	Min. Rod Size (inches)	Hanger Type

Nom. Pipe Size (inches)	Max. Span (feet)	Min. Rod Size (inches)	Hanger Type
0.75 and Smaller	5	0.375	Clevis Hanger
1	6	0.375	Clevis Hanger
1.25	7	0.375	Clevis Hanger
1.5	8	0.375	Clevis Hanger
2	8	0.375	Clevis Hanger
2.5	11	0.5	Clevis Hanger
3	12	0.5	Clevis Hanger
4	12	0.625	1 Rod Roller Type Hangers
5	12	0.625	1 Rod Roller Type Hangers
6	12	0.75	1 Rod Roller Type Hangers
8 – 12	12	0.75 (two)	2 Rod Roller Type Hangers
14 – 18	12	0.875 (two)	2 Rod Roller Type Hangers
20	12	1.25 (two)	2 Rod Roller Type Hangers
24	12	1.25 (two)	2 Rod Roller Type Hangers
Vertical Piping	15		

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of non-insulated or insulated stationary pipes.
2. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
3. Adjustable, Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
4. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
5. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.
6. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
7. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
8. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.

L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
4. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
3. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
4. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
5. C-Clamps (MSS Type 23): For structural shapes.
6. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
7. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
8. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
9. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
10. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
11. 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.
12. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.

13. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

14. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.

2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.

3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.

2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.

3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.

4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.

5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.

6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.

7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.

8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

a. Horizontal (MSS Type 54): Mounted horizontally.

b. Vertical (MSS Type 55): Mounted vertically.

c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

P. Comply with MSS SP-58 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

R. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.3 HANGER AND SUPPORT INSTALLATION

A. Comply with MSS SP-58. Install hangers, supports, clamps, and attachments to properly support piping from building structure.

B. Pipe hangers:

1. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

2. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

   a. 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.

   b. Field fabricate from ASTM A36/A36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

3. Metal Framing Pipe Hanger System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled strut systems.

4. Comply with MSS SP-58 for pipe hanger selections and applications that are not specified in piping system Sections.

5. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.

C. Insulated piping installation: Install shield in pipe hanger for insulated piping.

1. Attach clamps and spacers to piping.

   a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.

   b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.

b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.

c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 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.

5. Pipes NPS 8 (DN 200) and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.

6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

D. Fastener System Installation: Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

E. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.

2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.

F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

I. Install lateral bracing with pipe hangers and supports to prevent swaying.

J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 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. Where attachments to structure eccentrically place weight on structural members, alternate hangers to minimize bending moment (e.g. support supply pipe from one side of bottom flange and return pipe on other side) or provide alternate clamps that symmetrically load beam.

K. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

L. 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.

3.4 EQUIPMENT SUPPORTS

A. Equipment Support Installation: Fabricate from welded-structural-steel shapes 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.

3.5 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/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.

3.6 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 1-1/2 inches (40 mm).

3.7 PAINTING

A. Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05 mm).

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780/A780M.

END OF SECTION

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Certain requirements common to all the mechanical and electrical trades (Fire Suppression, Plumbing, HVAC, Electrical, and Tele/Data) are specified in Division 20. To avoid repetition, they are not repeated in each relevant Division of the Specifications. However, these requirements are applicable to the work of this Division and are hereby incorporated by reference.

B. 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. Equipment labels.
2. Duct labels.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch minimum thickness and having predrilled or stamped holes for attachment hardware.

2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

4. Fasteners: Stainless-steel rivets or self-tapping screws.

5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 DUCT LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

C. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

D. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

E. Fasteners: Stainless-steel rivets or self-tapping screws.

F. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

G. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, connected system, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
2. Lettering Size: At least 1-1/2 incheshigh.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 DUCT LABEL INSTALLATION

A. Install plastic-laminated duct labels with permanent adhesive on air ducts in the following color codes:

1. Blue: For cold-air supply ducts.
2. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
3. ASME A13.1 Colors and Designs: For hazardous material exhaust.

B. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

END OF SECTION

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Certain requirements common to all the mechanical and electrical trades (Fire Suppression, Plumbing, HVAC, Electrical, and Tele/Data) are specified in Division 20. To avoid repetition, they are not repeated in each relevant Division of the Specifications. However, these requirements are applicable to the work of this Division and are hereby incorporated by reference.

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

C. Refer to Division 23 for systems commissioning requirements applicable to this Section.

1.2 SUMMARY

A. Section Includes:

1. Testing, Adjusting, and Balancing of Air Systems:
   a. Constant-volume air systems.
   b. Critical zone airflow systems including but not limited to the following space types:
      1) Laboratories.
      2) Laboratory Support.
      3) Chemical Storage.
2. Testing, Adjusting, and Balancing of Hydronic Piping Systems:
   a. Constant-flow hydronic systems.
3. Testing, adjusting, and balancing of equipment.
4. Testing, adjusting, and balancing of existing HVAC systems and equipment.
5. Procedures for canopy exhaust hoods.
6. Procedures for critical zone equipment exhaust.
7. Supplemental testing and balancing for critical systems and zones.
8. Duct leakage test verification.

1.3 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. ASHRAE: American Society of Heating, Refrigerating and Air Conditioning Engineers

C. NEBB: National Environmental Balancing Bureau.

D. SMACNA: Sheetmetal and Air Conditioning National Association

E. TAB: Testing, adjusting, and balancing.

F. TABB: Testing, Adjusting, and Balancing Bureau.

G. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

H. TDH: Total dynamic head.

1.4 PREINSTALLATION MEETINGS

A. TAB Conference: Conduct a TAB conference at Project site after approval of the TAB strategies and procedures plan, to develop a mutual understanding of the details. Meeting will include at minimum TAB supervisor, TAB technician, design professional, owner representative, commissioning authority and Division 23 contractor. Provide a minimum of 14 day advance notice of scheduled meeting time and location.

1. Minimum Agenda Items:

a. The Contract Documents examination report.

b. The TAB plans.

c. Needs for coordination and cooperation of trades and subcontractors.

d. Proposed procedures for documentation and communication flow.

1.5 ACTION SUBMITTALS

A. Sustainable Design Submittals:

1. Air-Balance Report for Prerequisite IEQ 1: Documentation of work performed for ASHRAE 62.1-2013, Section 7.2.2 - "Air Balancing and Verification of Outdoor Air Performance."

2. TAB Report: Documentation of work performed for ASHRAE/IESNA 90.1-2016, Section 6.7.2.3 - "System Balancing" for both air systems and hydronic systems.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 45 days of Contractor's Notice to Proceed, submit the Contract Documents review report, as specified in Part 3.

C. Strategies and Procedures Plan: Within 60 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures, as specified in "Preparation" Article.

D. System Readiness Checklists: Within 75 days of Contractor's Notice to Proceed, submit system readiness checklists, as specified in "Preparation" Article.

E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.

F. Certified TAB reports.

G. Sample report forms.

H. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.7 QUALITY ASSURANCE

A. TAB Specialists Qualifications, Certified by AABC, NEBB or TABB:

1. TAB Field Supervisor: Employee of the TAB firm certified as a TAB specialist.
2. TAB Technician: Employee of the TAB firm certified as a TAB technician.

B. Code and AHJ Compliance: TAB is required to comply with governing codes and requirements of authorities having jurisdiction.

C. Certify TAB field data reports and perform the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this specification.

D. TAB Report Forms: Use standard TAB contractor forms meeting requirements of this section approved by Design Professional and the Commissioning Authority.

1.8 FIELD CONDITIONS

A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.9 COORDINATION

A. Notice: Provide seven-day advance notice for each test. Include scheduled test dates and times.

B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.

B. Examine installed systems for balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine equipment performance data, including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

F. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

G. Examine test reports specified in individual system and equipment Sections.

H. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

I. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible, and their controls are connected and functioning.

J. Examine temporary and permanent strainers. Verify that temporary strainer screens used during system cleaning and flushing have been removed and permanent strainer baskets are installed and clean.

K. Examine control valves for proper installation for their intended function of isolating, throttling, diverting, or mixing fluid flows.

L. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

M. Examine system pumps to ensure absence of entrained air in the suction piping.

N. Examine operating safety interlocks and controls on HVAC equipment.

O. Examine control dampers for proper installation for their intended function of isolating, throttling, diverting, or mixing air flows.

P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes the following:

1. Equipment and systems to be tested.
2. Strategies and step-by-step procedures for balancing the systems.
3. Instrumentation to be used.
4. Sample forms with specific identification for all equipment.

B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:

1. General:
   a. Permanent electrical-power wiring is complete.
   b. Automatic temperature-control systems are operational.
2. Airside:
   a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed in accordance with specification 233113 duct leakage testing requirements.
   b. Duct systems are complete with terminals installed.
   c. Volume, smoke, and fire dampers are open and functional.
   d. Equipment and duct access doors are securely closed.
   e. Clean filters are installed.
   f. Fans are operating, free of vibration, and rotating in correct direction.
   g. Variable-frequency controllers' startup is complete, and safeties are verified.
   h. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
   i. Windows and doors are installed and closed so indicated conditions for system operation can be met.
   j. Suitable access to balancing devices and equipment is provided.
3. Hydronics:

a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed per Sections 3.3 thru 3.9.

b. Piping is complete with terminals installed.

c. Water treatment is complete.

d. Systems are flushed, filled, and air purged.

e. Strainers are pulled and cleaned.

f. Control valves are functioning in accordance with the sequence of operation.

g. Shutoff and balance valves have been verified to be 100 percent open.

h. Pumps are started, and proper rotation is verified.

i. Pump gauge connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.

j. Variable-frequency controllers' startup is complete, and safeties are verified.

k. Suitable access to balancing devices and equipment is provided.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system in accordance with the procedures contained in this Section and the applicable portions of one of the following standards and guidelines. Where the selected standard does not include all required procedures, select from alternate standard. Where conflicting procedures are found, comply with requirements of ASHRAE Standard 111 as required by ASHRAE 62.1-2013, Section 7.2.2, " Air Balancing and Verification of Outdoor Air Performance."

1. AABC "National Standards for Total System Balance."

2. ASHRAE 111 “Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems.”

3. NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.

4. SMACNA “HVAC Systems - Testing, Adjusting and Balancing.”

B. Cut insulation, ducts, pipes, and equipment casings for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.

2. Where holes for probes are required in piping or hydronic equipment, install pressure and temperature test plugs to seal systems.

3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish in accordance with Division 23.

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in units indicated on the drawings (IP or Metric).

3.4 TESTING, ADJUSTING, AND BALANCING OF HVAC EQUIPMENT

A. Test, adjust, and balance HVAC equipment indicated on Drawings, including, but not limited to, the following:

1. HVAC Motors.
2. Fans and ventilators.
3. Terminal heating and cooling equipment.
4. Heating Equipment.

3.5 TOLERANCES

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Air Systems:
   a. Fans and Equipment with Fans: Plus or minus 10 percent. If design value is less than 100 cfm, within 10 cfm.
   b. Air Outlets and Inlets:
      1) Plus or minus 10 percent except as follows;
         a) Zero to plus 10 percent for negative pressure critical zone room exhaust.
         b) Zero to plus 5 percent for critical zone equipment exhaust.
         c) Zero to plus 10 percent for positive pressure critical zone room supply.
         d) Zero to minus 5 percent for negative pressure critical zone room supply.
         e) TAB agent shall verify air and fluid flows are adjusted to values indicated in approved submittals. Examples of systems that need utilities to be coordinated include but are not limited to chemical fume hoods, and autoclaves.
         f) Maintaining pressure relationships as designed shall have priority over the tolerances specified above for room supply and exhaust.
2. Hydronic Systems - Water Flow Rate: Plus or minus 5 percent. If design value is less than 10 gpm, within 10 percent

3.6 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' Record drawings duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

L. Check that duct sealing is complete as specified in Division 23.

3.7 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

   a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.

   b. Where duct conditions allow, measure airflow by main Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses close to the fan and prior to any outlets, to obtain total airflow.

   c. Where duct conditions are unsuitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.

2. Measure fan static pressures as follows:

   a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.

   b. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.

   c. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

d. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.

e. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.

f. Report artificial loading of filters at the time static pressures are measured.

3. Review Contractor-prepared shop drawings and Record drawings to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.

4. Obtain approval from Design Professional, Construction Manager and Commissioning Authority for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.

5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure airflow of submain and branch ducts. Where sufficient space in sub-main and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Adjust submain and branch duct volume dampers for specified airflow.

3. Re-measure each submain and branch duct after all have been adjusted. Continue to adjust sub-main and branch ducts to indicated airflows within specified tolerances.

C. Adjust air inlets and outlets for each space to indicated airflows.

1. Set airflow patterns of adjustable outlets for proper distribution without drafts.

2. Measure inlets and outlets airflow. Measure terminal outlets using a direct-reading hood or outlet manufacturer written instructions and calculating factors.

3. Adjust each inlet and outlet for specified airflow within specified tolerances without generating noise levels above limitations prescribed in the contract documents.

4. Adjust patterns of adjustable outlets for proper distribution without drafts.

5. Re-measure each inlet and outlet after they have been adjusted.

D. Verify final system conditions.

1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
2. Re-measure and confirm that total airflow is within design.
3. Re-measure all final fan operating data, speed, volts, amps, and static profile.
4. Mark all final settings.
5. Test system in economizer mode. Verify proper operation and adjust if necessary.
6. Measure and record all operating data.
7. Record final fan-performance data.

3.8 GENERAL PROCEDURES FOR CRITICAL ZONE AIRFLOW SYSTEMS

A. Adjust design volumetric offsets needed to achieve room relative pressurization due to variations in room construction after testing and balancing of all rooms on a shared common corridor or adjacent spaces is complete. In general, for negative spaces, reduce room supply flow in 5 percent increments to increase negative pressure and for positive spaces reduce room exhaust in 5 percent increments to increase space pressure. Pressure differences shall be as indicated on the drawings.

1. If not specifically noted, use the following acceptance criteria for each step of differential between spaces:

a. Laboratories, laboratory support and laboratory corridors: minimum 0.01 inches water column.

B. Balancing of critical zone equipment exhaust connections: Where approved equipment exhaust airflows differ from design documents, adjust to equipment exhaust airflows to values identified in the approved equipment. Critical equipment exhaust connections include but are not limited to:

1. Chemical fume hoods.
2. Point exhaust (e.g. snorkel, elephant trunk).
3. Ventilated chemical storage cabinets (non-fire rated).
4. Autoclaves.

C. Provide certified directional airflow verification report (all critical zone spaces).

3.9 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports for pumps, coils, and other equipment. Obtain approved submittals and manufacturer-recommended testing procedures.

B. Prepare schematic diagrams of systems' Record drawings piping layouts.

C. In addition to requirements in "Preparation" Article, prepare hydronic systems for testing and balancing as follows:

1. Check expansion tank for proper setting.
2. Check highest vent for adequate pressure.

3. Check makeup water-station pressure gage for adequate pressure for highest vent.
4. Check flow-control valves for specified sequence of operation, and set at indicated flow.
5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
6. Set system controls so automatic valves are wide open to heat exchangers.
7. Locate start-stop and disconnect switches, electrical interlocks, and motor controllers.
8. Verify that motor controllers are equipped with properly sized thermal protection.
9. Check that air has been purged from the system by verifying a forceful liquid flow exiting from vents when manually operated.
10. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.

D. Measure and record upstream and downstream pressure of each piece of equipment.

E. Measure and record upstream and downstream pressure of pressure-reducing valves.

F. Check settings and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves. Record final settings.

1. Check settings and operation of each safety valve. Record settings.

3.10 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

A. Crosscheck the summation of required coil and equipment flow rates with pump design flow rate. Request clarification from design professional where variations exceed plus or minus 5 percent.

B. Adjust pumps to deliver total design flow.

1. Measure pump TDH as follows:

a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.

b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.

c. Convert pressure to head and correct for differences in gauge heights.

d. Verify pump impeller size by measuring the TDH with the discharge valve closed and pump at full speed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.

1) If impeller size is not correct, and actual required flow and head cannot be achieved, manufacturer shall replace impeller with correct size.

e. With valves open, start pump at slow speed and then ramp speed up until design water flow is achieved. Do not operate at full speed and use throttling to achieve desired flow. If pump is operating below 30 Hz at design flow, notify the design professional who will determine if pump impellers need to be trimmed due to field conditions.

f. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.

g. Report flow rates that are not within plus or minus 10 percent of design.

2. Measure total water flow.

a. Position valves for full flow through coils.

b. Measure flow by main flow meter, if installed.

c. If main flow meter is not installed, determine flow by pump TDH or known equipment pressure drop.

3. Monitor motor performance during procedures, and do not operate motor in an overloaded condition.

C. Adjust flow-measuring devices installed in mains and branches to design water flows.

1. Measure flow in main and branch pipes.

2. Adjust main and branch balance valves for design flow.

3. Re-measure each main and branch after all have been adjusted.

D. Adjust flow-measuring devices installed at terminals for each space to design water flows.

1. Measure flow at terminals.

2. Adjust each terminal to design flow.

3. Re-measure each terminal after it is adjusted.

4. For three-way control valves, after verifying flow with valve open to the terminal, position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.

5. Perform temperature tests after flows have been balanced.

E. For systems with pressure-independent valves at terminals:

1. Measure differential pressure and verify that it is within manufacturer specified range.

2. Perform temperature tests after flows have been verified.

F. For systems without pressure-independent valves or flow-measuring devices at terminals:

1. Measure and balance coils by either coil pressure drop or temperature method.

2. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

G. Verify final system conditions as follows:

1. Re-measure and confirm that total water flow is within design.
2. Re-measure final pump operating data, TDH, volts, amps, and system pressure drop profile.
3. Measure the differential-pressure-control-valve settings at conclusion of balancing.
4. Check settings and operation of each safety valve. Record settings.
5. Mark final settings.

H. Verify that memory stops have been set.

3.11 PROCEDURES FOR MOTORS

A. Motors 0.5 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Phase and hertz.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter size and thermal-protection-element rating.
8. Service factor and frame size.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.12 PROCEDURES FOR CRITICAL ZONE EQUIPMENT EXHAUST

A. Room Pressure: Measure and record room pressure with respect to atmosphere and adjacent spaces in room initially not operating and then with equipment exhaust operating.

B. Makeup Air: Systems supplying source of makeup air to hoods shall be in operation during testing and balancing of equipment exhaust.

1. Measure and record temperature of makeup air entering equipment. If equipment makeup air is from multiple sources having different temperatures, measure and record the airflow and temperatures of each source and calculate the weighted average temperature.

2. Use simulated smoke to observe supply air-distribution air patterns in vicinity of equipment exhaust. Consult with equipment manufacturer and report conditions that have a detrimental effect on intended capture, containment, and other attributes effecting proper operation.

C. Capture and Containment: Check each piece of equipment for proper capture and containment using a smoke-emitting device. Observe and report performance. Adjust airflows to achieve optimum results.

D. Rooms with Multiple Equipment Exhaust Connections: Test each piece of equipment separately, one at a time, and repeat tests with all equipment intended to operate simultaneously by design.

E. Balance equipment exhaust to airflow values indicated in approved submittals.

F. Laboratory Fume Hoods: Initial adjustment at chemical fume hoods shall ensure proper airflow and face velocity at the chemical fume hood sash opening, verification of alarm point operation and preliminary containment using airflow visualization tests. Measure and record the following:

1. Pressure-drop across hood.

2. Airflow by duct traverse where duct distribution will allow accurate measurement and calculate hood average face velocity. If hood is connected to exhaust duct distribution through an exhaust device with integral airflow measurement, that reading may be used in lieu of a duct traverse.

3. Face velocity across open hood face and calculate hood airflow using ASHRAE/ANSI Standard 110-2019 “Face Velocity Measurement Procedure.”

a. Clearly indicate the direction of flow at each point of measurement.

b. Measure velocity across opening based on a grid spacing of less than 1 square foot and larger dimension no larger than 13 inches. Record velocity at each measurement and calculate average velocity.

4. Preliminary containment testing shall be made in accordance with ASHRAE/ANSI Standard 110-2016 “Flow Visualization Procedure.”

5. After initial balancing and preliminary containment testing is performed, perform fume hood tracer gas testing in accordance with ASHRAE/ANSI Standard 110-2016 “Tracer Gas Test Procedure” specified in Division 23.

G. AHJ Tests: Conduct additional tests required by authorities having jurisdiction.

1. Provide leakage test resulting documentation for all ductwork leakage testing indicated in Specification 233113 Air Distribution Systems Metal Ducts. This includes but is not limited to all ductwork operating in excess of 3 inches of water and all ductwork located outdoors per ASHRAE 90.1-2016.

2. Instrumentation/Materials

a. Dye test equipment will be appropriate group of non-destructive testing dye penetrant products (such as spot check by Magnaflux) used in conjunction with clean towels.

3. Report: As a minimum the test report will include the following:

a. Project name, test date and time

b. Type of test

c. Location of test

d. Duct construction pressure class

e. Test pressure

f. Deficiencies and corrective action

g. Signature of testing agent and witness

h. List of test equipment and calibration date for each

i. Allowable duct leakage

j. Non-compliance issues will be listed, and corrections implemented will be identified in the report. All items will be corrected prior to submission of the final report.

4. Compliance

a. Compliance is met when this procedure is completed for each space and report indicates spaces meet design intent.

H. Room Pressurization/Directional Airflow Verification

1. Directional airflow for all spaces will be verified using visible cold smoke across the space door gaps and thresholds. Test will visually confirm smoke moves in direction shown on the contract documents.

2. Prior to verification of pressurization/directional airflow into or out of any space, controls will be fully functional, startup and testing complete and air balancing report complete.

3. All exhaust hoods, biological safety cabinets, space supply and exhaust terminal devices shall be in place and operating.

4. Smoke will be released through handheld dispensing tube or bulb that will be released smoke near the gaps. A positive result is when smoke is drawn into negative pressure rooms and out of positive pressure rooms.

5. Testing Material:

a. An appropriate visible smoke such as ethylene diamine and acetic acid with dispensing tube and bulb will be used.

6. Directional Airflow Verification Report: As a minimum the test report will include the following:

a. Project name, test date and time

b. Type of test

c. Space number tested

d. Deficiencies and corrective action

e. Signature of testing agent and witness

f. Non-compliance issues shall be listed, and corrections implemented will be identified in the report. All items will be corrected prior to submission of the final report.

7. Compliance

a. Compliance is met when this procedure is completed for each space and report indicates spaces meet design intent.]

3.13 DUCT LEAKAGE TESTS

A. Witness the duct leakage testing performed by Installer.

B. Verify that proper test methods are used and that leakage rates are within specified limits.

C. Report deficiencies observed.

3.14 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.

1. Measure and record the operating speed, airflow, and static pressure of each fan and equipment with fan(s).

2. Measure and record flows, temperatures, and pressures of each piece of equipment in each hydronic system. Compare the values to design or nameplate information, where information is available.

3. Measure motor voltage and amperage. Compare the values to motor nameplate information.

4. Check the condition of filters.

5. Check the condition of coils.

6. Check the operation of the drain pan and condensate-drain trap.

7. Check bearings and other lubricated parts for proper lubrication.

8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.

B. TAB After Construction: Before performing testing and balancing of renovated existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished in accordance with renovation scope indicated by Contract Documents. Verify the following:

1. New filters are installed.

2. Coils are clean and fins combed.

3. Drain pans are clean.

4. Fans are clean.

5. Bearings and other parts are properly lubricated.

6. Deficiencies noted in the preconstruction report are corrected.

C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.

1. Compare the indicated airflow of the renovated work to the measured fan airflows and determine the new fan speed and the face velocity of filters and coils.

2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.

3. If calculations increase or decrease the airflow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.

4. Balance each air outlet.

3.15 PROGRESS REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for system-balancing devices. Recommend changes and additions to system-balancing devices, to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance-measuring and -balancing devices.

B. Status Reports: Prepare biweekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.16 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.

2. Include a list of instruments used for procedures, along with proof of calibration.

3. Certify validity and accuracy of field data.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.

2. Fan curves.

3. Manufacturers' test data.

4. Field test reports prepared by system and equipment installers.

5. Other information relative to equipment performance; do not include Shop Drawings and Product Data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB specialist.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents, including the following:
    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.
12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans performance forms, including the following:
    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Heating coil, dry-bulb conditions.
    e. Face and bypass damper settings at coils.
    f. Fan drive settings, including settings and percentage of maximum pitch diameter.
    g. Variable-frequency controller settings for variable-air-volume systems.
    h. Settings for pressure controller(s).
    i. Other system operating conditions that affect performance.
16. Test conditions for pump performance forms, including the following:
    a. Variable-frequency controller settings for variable-flow hydronic systems.
    b. Settings for pressure controller(s).

c. Other system operating conditions that affect performance.

D. Apparatus-Coil Test Reports:

1. Coil Data:

a. System identification.

b. Location.

c. Coil type.

d. Number of rows.

e. Fin spacing in fins per inch o.c.

f. Make and model number.

g. Face area in sq. ft..

h. Tube size in NPS.

i. Tube and fin materials.

j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm.

b. Average face velocity in fpm.

c. Air pressure drop in inches wg.

d. Outdoor-air, wet- and dry-bulb temperatures in deg F.

e. Return-air, wet- and dry-bulb temperatures in deg F.

f. Entering-air, wet- and dry-bulb temperatures in deg F.

g. Leaving-air, wet- and dry-bulb temperatures in deg F.

h. Water flow rate in gpm.

i. Water pressure differential in feet of head or psig.

j. Entering-water temperature in deg F.

k. Leaving-water temperature in deg F.

E. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

a. System identification.

b. Location.

c. Make and type.

d. Model number and size.

e. Manufacturer's serial number.

f. Arrangement and class.

g. Sheave make, size in inches, and bore.

h. Center-to-center dimensions of sheave and amount of adjustments in inches.

2. Motor Data:

a. Motor make, and frame type and size.

b. Horsepower and speed.

c. Volts, phase, and hertz.

d. Full-load amperage and service factor.

e. Sheave make, size in inches, and bore.

f. Center-to-center dimensions of sheave and amount of adjustments in inches.

g. Number, make, and size of belts.

h. Heater size.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.

b. Total system static pressure in inches wg.

c. Fan speed.

d. Discharge static pressure in inches wg.

e. Suction static pressure in inches wg.

f. Direction of rotation and revolutions per minute.

g. Fan curves showing variation of air flow with static pressure at operating speed and motor loading.

h. Actual air flow percentage above or below design.

F. Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

a. System fan and air-handling-unit number.

b. Location and zone.

c. Traverse air temperature in deg F.

d. Duct static pressure in inches wg.

e. Duct size in inches.

f. Duct area in sq. ft..

g. Indicated airflow rate in cfm.

h. Indicated velocity in fpm.

i. Actual airflow rate in cfm.

j. Actual average velocity in fpm.

k. Barometric pressure in psig.

G. Air-Terminal-Device Reports:

1. Unit Data:

a. System and air-handling unit identification.

b. Location and zone.

c. Apparatus used for test.

d. Area served.

e. Make.

f. Number from system diagram.

g. Type and model number.

h. Size.

i. Effective area in sq. ft..

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm.

b. Air velocity in fpm.

c. Preliminary airflow rate in cfm.

d. Preliminary velocity in fpm.

e. Final airflow rate in cfm.

f. Final velocity in fpm.

g. Space temperature in deg F.

H. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:

a. System and air-handling-unit identification.

b. Location and zone.

c. Room or riser served.

d. Coil make and size.

e. Flowmeter type.

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm.

b. Entering-water temperature in deg F.

c. Leaving-water temperature in deg F.

d. Water pressure drop in feet of head or psig.

e. Entering-air temperature in deg F.

f. Leaving-air temperature in deg F.

I. Fume Hood Testing and Balancing Report Data:

1. Manufacturer and model.

2. Face velocity profile at operating position (1 reading per square foot).

3. Average face velocity.

4. Total airflow.

5. Alarm points.

J. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.

b. Serial number.

c. Application.

d. Dates of use.

e. Dates of calibration.

3.17 VERIFICATION OF TAB REPORT

A. TAB Specialist Initial Verification:

1. After testing and balancing are complete, TAB Specialist shall operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.

2. Check the following for each system:

a. Measure airflow of at least 10 percent of air outlets.

b. Measure water flow of at least 5 percent of terminals.

c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.

d. Verify that balancing devices are marked with final balance position.

e. Note deviations from the Contract Documents in the final report.

B. Final Verification:

1. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Owner, Design Professional, Construction Manager and Commissioning Authority.

2. Commissioning Authority or Design Professional shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to the lesser of either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.

3. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

4. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the TAB shall be considered incomplete and shall be rejected.

5. If recheck measurements find the number of failed measurements noncompliant with requirements indicated, proceed as follows:

   a. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection. All changes shall be tracked to show changes made to previous report.

   b. If the second final inspection also fails, Owner may pursue others Contract options to complete TAB work.

C. Prepare test and inspection reports.

3.18 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION

SECTION 230700 - HVAC INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Certain requirements common to all the mechanical and electrical trades (Fire Suppression, Plumbing, HVAC, Electrical, and Tele/Data) are specified in Division 20. To avoid repetition, they are not repeated in each relevant Division of the Specifications. However, these requirements are applicable to the work of this Division and are hereby incorporated by reference.

B. 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 insulating the following duct services:

1. Unconditioned Outside Air Intake Ducts/Plena and Exhaust Relief Duct and Plena Inside the Building Envelope.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance, thickness, and jackets (both factory- and field-applied if any).

B. Sustainable Design Submittals

1. Adhesives:

a. Product Data for adhesives indicating VOC content.

b. Laboratory Test Reports for: For adhesives, indicating compliance with requirements for low-emitting materials.

2. Coatings

a. Product Data for coatings indicating VOC content.

b. Laboratory Test Reports: For coatings, indicating compliance with requirements for low-emitting materials.

3. Sealants

a. Product Data for sealants indicating VOC content.

b. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of field-applied jackets.

2. Detail application at linkages of control devices.
3. Detail application of protective duct shields, saddles, and inserts at hangers for each type of insulation and hanger.
4. Detail insulation application at duct elbows, fittings, dampers, specialties and flanges for each type of insulation.
5. Detail attachment and covering of equipment heat tracing inside insulation.
6. Detail removable insulation at equipment connections.
7. Detail field application for each equipment type.
8. Detail application of protective piping shields, saddles, and inserts at hangers for each type of insulation and hanger.
9. Detail attachment and covering of piping heat tracing inside insulation.
10. Detail insulation application at pipe expansion joints for each type of insulation.
11. Detail insulation application at pipe elbows, fittings, flanges, valves, and specialties for each type of insulation.
12. Detail removable insulation at piping specialties.

D. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:

1. Sheet Form Insulation Materials: 12 inches square.
2. Sheet Jacket Materials: 12 inches square.
3. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.
4. Preformed Pipe Insulation Materials: 12 inches long by NPS 2 Jacket Materials for Pipe: 12 inches long by NPS 2.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Coordination Documentation: Written documentation indicating specific sheet metal and hanger requirements from fire-rated duct insulation system UL Listing.

D. Field quality-control reports.

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. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

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 sizes and locations of supports, hangers, and insulation shields specified in Division 23.

B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing 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. For fire-rated duct insulation, insulation manufacturer shall forward to the contractor specific sheet metal and hanger requirements needed to meet UL Listing of the fire-rated insulation system including but not limited to minimum sheet metal gauge of fire-rated insulated duct sections, specific sheet metal joint construction requirements and specific hanger requirements.

D. Coordinate clearance requirements with equipment Installer for equipment insulation application. Coordinate installation and testing of equipment heat tracing.

E. Coordinate clearance requirements with piping Installer for piping insulation application. Coordinate installation and testing of piping heat tracing.

1.8 SCHEDULING

A. Schedule insulation application after pressure and leak 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 INSULATION MATERIALS

A. Comply with requirements in Part 3 articles for 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 C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Rigid Mineral-Fiber (Fiberglass) Board Duct Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB.

1. For duct and plenum applications in mechanical rooms and concealed locations, provide insulation with factory applied FSK jacket.

2. For duct and plenum applications exposed in occupied spaces, provide insulation with paintable factory applied ASJ jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

3. Provide insulation with factory applied ASJ for equipment. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

4. Available Manufacturers: Subject to compliance with requirements, available products that may be incorporated into the Work include, the following:

a. CertainTeed Corp.; Commercial Board.

b. Fibrex Insulations Inc.; FBX.

c. Johns Manville; 800 Series Spin-Glas.

d. Knauf Insulation; Earthwool Insulation Board with ECOSE Technology

e. Manson Insulation Inc.; AK Board.

f. Owens Corning; Fiberglas 700 Series.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.

C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

1. Adhesives shall have a VOC content of 250 g/L or less or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, 9 mcg/cu. m or 7 ppb, whichever is less, and that of acetaldehyde shall not exceed 9 mcg/cu. m.

B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

C. ASJ,and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates.

1. VOC Content: 300 g/L or less.
2. Low-Emitting Materials: Mastic coatings shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers.” The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, 9 mcg/cu. m or 7 ppb, whichever is less, and that of acetaldehyde shall not exceed 9 mcg/cu. m.

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.

1. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
2. Service Temperature Range: Minus 20 to plus 180 deg F.
3. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
4. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.

1. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
2. Service Temperature Range: Minus 50 to plus 220 deg F.
3. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
4. Color: White.

D. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Available Manufacturers: Subject to compliance with requirements, available products that may be incorporated into the Work include, the following:
   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company
   b. Eagle Bridges - Marathon Industries
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company
2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

2.5 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
   1. Adhesives shall have a VOC content of 250 g/L or less.
   2. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, 9 mcg/cu. m or 7 ppb, whichever is less, and that of acetaldehyde shall not exceed 9 mcg/cu. m.
   3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
   4. Service Temperature Range: 0 to plus 180 deg F.
   5. Color: White.

2.6 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:
   1. Materials shall be compatible with insulation materials, jackets, and substrates.
   2. Fire- and water-resistant, flexible, elastomeric sealant.
   3. Service Temperature Range: Minus 40 to plus 250 deg F.
   4. Color: Aluminum.
   5. Sealant shall have a VOC content of 420 g/L or less.
   6. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The building concentration of formaldehyde shall not

exceed half of the indoor recommended exposure limit, 9 mcg/cu. m or 7 ppb, whichever is less, and that of acetaldehyde shall not exceed 9 mcg/cu. m.

B. ASJ Flashing Sealants and PVC Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.

2.7 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I. Permeance of jacket shall not exceed 0.02 perm.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I. Permeance of jacket shall not exceed 0.02 perm.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II. Permeance of jacket shall not exceed 0.02 perm.

2.8 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Width: minimum 3 inches.
2. Thickness: minimum 11.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Width: minimum 3 inches.
2. Thickness: minimum 6.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.

6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.9 SECUREMENTS

A. Bands:

1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304; 1/2 inch wide with wing seal.

2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 1/2 inch wide with wing 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- or **0.135-inch-** 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- or 0.135-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, and securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.

b. Spindle: Copper- or zinc-coated, low-carbon steel, or Aluminum, or Stainless steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.

c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, and securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Midwest Fasteners, Inc.; Nylon Insulation Hangers.Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.

b. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.

c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, and securely in position indicated when self-locking washer is in place. Comply with the following requirements:
   a. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
   b. Spindle: Copper- or zinc-coated, low-carbon steel, or Aluminum, or Stainless steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
   c. Adhesive-backed base with a peel-off protective cover.
6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-steel, or aluminum, or stainless-steel sheet matching hanger materials, with beveled edge sized to hold insulation securely in place but not less than 1-1/2 inches in diameter.
   a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick nylon sheet, with beveled edge sized to hold insulation securely in place but not less than 1-1/2 inches in diameter.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

D. Wire: 0.062-inch soft-annealed, stainless steel.

2.10 CORNER ANGLES

A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

C. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances 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.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Duct Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application including dirt, scale, oil, rust and other foreign matter.

B. Equipment Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

C. Piping Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

D. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

E. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Protect insulation from exposure to moisture prior to and after installation. All insulation other than flexible elastomeric that becomes wet shall be replaced at no cost to the project.

B. Install insulation after systems have been tested, proved tight. Remove dirt, scale, oil, rust and other foreign matter prior to installation of insulation.

C. Install insulation, mastics, adhesives, coatings, covers, weather-protection and other work in accordance with manufacturer’s recommendations. 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. 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.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic. Leakage in vapor barrier or voids in insulation will not be accepted.

   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 insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied non-self-sealing jackets as follows:
1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches OC
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at manufacturer recommended spacing but space no further than 4 inches OC
   a. For below ambient services, apply vapor-barrier mastic over staples.
4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.

L. Install insulation with self-sealing factory-applied jackets as follows:
1. Locate all longitudinal pipe insulation jacketing laps in least visible location.
2. Draw jacket tight and smooth.
3. For proper sealing, seal lap joints with reasonable pressure being applied with a plastic squeegee or sealing tool.
4. Vapor seal all circumferential joints with factory furnished matching pressure sensitive butt strips installed with reasonable pressure being applied with a plastic squeegee or sealing tool.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. Insulate flex connections to same thickness as material as adjoining system

Q. Duct Insulation Requirements:
1. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

2. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
3. Insulate standing seams with same material and thickness as duct.
4. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
5. Insulate flex connections to same thickness as material as adjoining ductwork.

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 below top of roof flashing.
   4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. 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.
   4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire-Rated): Install insulation continuously through walls and partitions.

E. Ductwork Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
   1. Comply with requirements in Division 07for firestopping and fire-resistive joint sealers.

F. Duct Insulation Installation at Floor Penetrations:

1. Duct: 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.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07.

3.5 INSTALLATION OF MINERAL-FIBER INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area recommended by the insulation manufacturer but no less than for 50 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. 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:
   a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches OC
   b. On duct sides with dimensions larger than 18 inches, place pins 16 inches OC each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
   c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
   d. Do not over compress insulation during installation. Maximum allowable compressions shall be as recommended by the insulation manufacturer.
   e. Impale insulation over pins and attach speed washers.
   f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. 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 from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch OC Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
   a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.

b. Install vapor stops for ductwork and plenums operating below 50 deg F at 20-foot 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 two times the insulation thickness, but not less than 3 inches.

5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches OC

6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches OC

B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area recommended by the insulation manufacturer but no less than for 50 percent coverage of duct and plenum surfaces.

2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.

3. 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:

a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches OC.

b. On duct sides with dimensions larger than 18 inches, space pins 16 inches OC each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.

c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.

d. Do not over-compress insulation during installation.

e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. 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 from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch OC Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.

b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot 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 two times the insulation thickness, but not less than 3 inches.

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches OC

C. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.

2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.

3. For insulation with factory-applied jackets on above-ambient surfaces, secure using the self-seal system per manufacturer’s recommendations or for non-self-seal systems, secure laps with outward-clinched staples at 6 inches OC

4. For insulation with factory-applied jackets on below-ambient surfaces, secure using the self-seal systems per manufacturer’s recommendations, or for non-self-seal systems, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

D. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.

4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, 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.

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.

F. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.

2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.

3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

4. Install insulation to flanges as specified for flange insulation application.

3.6 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 for exterior and interior painting.

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.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating. Coating for outdoor insulation shall be UV resistant and waterproof.

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 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to two location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.

2. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to two location(s) for each type of equipment defined in the Part 3. For large equipment, remove only a portion adequate to determine compliance.

3. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.8 DUCT INSULATION SCHEDULE GENERAL

A. Items Not Insulated:

1. Fibrous-glass ducts.
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA scheduled values below.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.
5. Vibration-control devices.
6. Factory-insulated access panels and doors.

3.9 DUCT AND PLENUM INSULATION SCHEDULE

A. Provide insulation materials and thicknesses identified below. If more than one material is listed for a duct location, selection from materials listed is Division 23 option.

B. Duct Insulation Schedules:

1. All ductwork routed outside the building envelope shall be factory pre-fabricated with welded seams, double wall, stainless steel, with flanged or mechanically coupled waterproof connections.
2. Where application of rigid versus blanket insulation on components such as coils and supply fans is to be based on the height of a component, height shall be determined based on the bottom of the component listed. Extend applicable insulation over the entire component before transitioning to alternate material. For ductwork, transition from blanket to rigid insulation shall occur no lower than height listed.
3. Exposed ductwork between air volume terminal or local heating or cooling unit mounted within the space served and associated diffusers or registers does not require external insulation. Where air volume terminal or local heating or cooling unit are mounted outside the space served, insulate ductwork between the air volume terminal or local heating or cooling unit and the wall of the space served.

Exhaust/Relief Duct/Plena Inside Building Envelope						
Duct Location	Minimum As-Installed R-Value	Insulation Type	Minimum Thickness (inches)	Minimum Density (lb/cu.ft)	Factory Applied Jacket	Field Applied Jacket
For exhaust/relief ducts and plena, all ductwork and plena between the building envelope and first system isolation damper.	R-12.0	Rigid Mineral-Fiber Board	3.0	6.0	FSK	N/A
		Semi-Rigid Mineral-Fiber Board	3.0	1.5	FSK	

END OF SECTION

SECTION 233113 - AIR DISTRIBUTION SYSTEMS-METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Certain requirements common to all the mechanical and electrical trades (Fire Suppression, Plumbing, HVAC, Electrical, and Tele/Data) are specified in Division 20. To avoid repetition, they are not repeated in each relevant Division of the Specifications. However, these requirements are applicable to the work of this Division, and are hereby incorporated by reference.

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

1.2 RELATED WORK

A. Related Work Specified Elsewhere, Amplified Elsewhere or Included in Other Contracts:

1. Embodied Carbon Reporting: Section 013329

1.3 SUMMARY

A. Section Includes:

1. Sheet metal materials.
2. Rectangular ducts and fittings.
3. Round ducts and fittings.
4. Transfer Air Duct liner.
5. Sealant and gaskets.
6. Hangers and supports.
7. Backdraft and pressure relief dampers.
8. Manual volume dampers.
9. Duct-mounted access doors.
10. Flexible connectors.
11. Flexible ducts.
12. Duct accessory hardware.
13. Diffusers, registers and grilles.
14. Duct leakage testing and allowable duct leakage rate calculations

B. Related Sections:

1. Division 08 for fixed and adjustable louvers and wall vents whether or not they are connected to ducts.
2. Division 28 for duct-mounted fire and smoke detectors not provided as integral option with smoke and fire-smoke dampers.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following products:
1. Liners and adhesives.
2. Sealants and gaskets.
3. Adhesives.
4. Diffusers, registers and grilles.
5. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
6. Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.
7. Duct silencers, provide pressure drop, dynamic insertion loss data and breakout noise characteristics.

B. Samples: for the smallest indicated size of each exposed diffuser, register and grille:
1. Each factory applied color finish.
2. Each texture.

C. Shop Drawings: For air distribution systems - metal ducts:
1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on approved equipment submittals.
11. Locations for duct accessories, including dampers, full length splitter vanes, access doors and panels.

12. Hangers and supports, including methods for duct and building attachment and vibration isolation.
13. Fabrication, assembly and installation including plans, elevations sections, components and attachments to other work for wall mounted canopy hoods.
14. Detail metal duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
    a. Special fittings.
    b. Manual volume damper installations.
    c. Control-damper installations.
    d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
    e. Wiring Diagrams: For power, signal, and control wiring for smoke and fire-smoke dampers.

D. Delegated-Design Submittal:
1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.
5. Design Calculations:
    a. For each system provide calculation of duct leakage class and allowable duct leakage required to meet specified system leakage in accordance with ASHRAE recommendations.
    b. Calculations for selecting hangers and supports.

1.5 INFORMATIONAL SUBMITTALS

A. Air Distribution System Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Duct installation, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.

6. Items penetrating finished ceiling including the following:
    a. Lighting fixtures.
    b. Air outlets and inlets (diffusers, registers and grilles).
    c. Speakers.
    d. Sprinklers.
    e. Ceiling and duct access panels.
    f. Perimeter moldings.
    g. Ceiling suspension assembly members
    h. Methods of attaching hangers to building structure
    i. Size and location of initial access modules for acoustical tile.
    j. Duct accessories requiring ceiling-mounted access panels and access doors with input from Installers of the items involved.
7. Refer to Division 20 for additional coordination drawing requirements.
8. Duct Cleanliness Verification Report.

B. Welding certificates.

C. Duct leakage factors and duct leakage fraction calculations based on installed duct sizes and final routing.

D. Field quality-control reports.

E. Source quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

B. Final duct leakage test reports

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
    1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 AIR DISTRIBUTION SYSTEM GENERAL REQUIREMENTS

A. Only as referenced in this Section, comply with SMACNA Duct Construction Manual requirements for acceptable materials, material thicknesses, duct sealing methods, and duct construction methods unless otherwise indicated in the Articles of this Section or on the Drawings.

1. All metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 SHEETMETAL MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A653/A653M.

1. Galvanized Coating Designation: G90.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.
3. Minimum Thickness for Factory-Applied PVC Coating: 4 mils thick on sheet metal surface of ducts and fittings exposed to corrosive conditions, and minimum 1 mil thick on opposite surface.
4. Coating Materials: Acceptable to authorities having jurisdiction for use on ducts listed and labeled by an NRTL for compliance with UL 181, Class 1.

B. Stainless-Steel Sheets: Comply with ASTM A480/A480M, Type 304L or 316L, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be as indicated in the "Duct Schedule" Article.

C. Aluminum Sheets: Comply with ASTM B209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

D. Extruded Aluminum: Comply with ASTM B221, Alloy 6063, TemperT6.

E. Reinforcement Shapes and Plates: ASTM A36/A36M, steel plates, shapes, and bars; black and galvanized.

1. 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.

F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

G. Welding of sheetmetal shall be in accordance with AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

H. Welding of steel supports shall comply with AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.

I. Welding of Aluminum supports shall comply with WS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.

2.3 RECTANGULAR DUCTS AND FITTINGS

A. General Material Thickness Requirements for Rectangular Duct: Unless otherwise indicated in the Articles of this Section or on the drawings, comply with SMACNA Duct Construction Manual, Tables 2-1 through 2-33 inclusive of the associated details and notes as they relate to acceptable material thicknesses based on duct dimension, static pressure class, reinforcement code and reinforcement spacing

1. Materials shall be as indicated in the Article “Duct Schedule” in Part 3 of this Section.

2. The thicknesses indicated in Tables 2-1 through 2-33 in the SMACNA Duct Construction Manual shall be acceptable for galvanized steel, carbon steel, stainless steel, and PVC coated galvanized steel.

3. If aluminum duct is specified, the thickness of the material shall be adjusted according to Tables 2-50 through 2-52 of the SMACNA Duct Construction Manual.

4. In addition to the basic requirements of SMACNA Duct Construction Manual, minimum sheet metal thickness for welded section of ductwork shall be 16 gage and minimum metal thickness for welded elbows shall be 14 gage. All welded duct construction shall be air and liquid tight. Provide SMACNA thickness where duct pressure class requires heavier gage.

5. Minimum sheet metal thickness, joint construction and supports for fire-wrap insulated ductwork shall comply with fire-wrap NTRL listing requirements. Coordinate requirements with fire-wrap insulation provided.

B. General Fabrication Requirements: Except as otherwise noted, comply with Sub-Chapter 2.1 “Introduction to the Rectangular Duct Construction Schedules” of the SMACNA Duct Construction Manual.

1. Coordinate duct wall thickness, seams, joints, joint spacing, support intervals, sealing requirements, reinforcement code, and reinforcement spacing based on the static pressure class, duct material, and duct dimensions indicated in the design documents.

2. Joints and seams shall be formed and assembled with dimensions and proportions for a tight and secure assembly.

C. Transverse Joints (Non-Welded):

1. For pressure class less than 3 inches of water column, select and fabricate joint types according to Figure 2.1, Tables 2-31 through 2-33 and Sub-Chapter 2.4 (except reference to Chapter 11) of the SMACNA Duct Construction Manual.

2. For pressure classes 3 inches of water column and greater, mechanical joints shall be pre-manufactured joint systems.

D. Longitudinal Seams (Non-Welded):

1. For duct pressure class of 2 inches water column or less, select seam type and fabricate according to Figure 2.2 and Sub-Chapter 2.3 of the SMACNA Duct Construction Manual.

2. For duct pressure classes 3 inches water column or greater provide Type L-1 Pittsburg Lock seams fabricated according to Figure 2.2 of the SMACNA Duct Construction Manual.

E. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Unless otherwise indicated, select types and fabricate according to Figures 4.2 through 4.9 and Chart 4.1 of the SMACNA Duct Construction Manual.

1. Provide only the SMACNA fittings described in Part 3 of this specification, without substitution, as these fittings are the basis of design used to calculated system

static pressure losses and motor horsepower requirements. Substitutions from indicated fittings will not be accepted.

2. The following fittings, shown in Figures 4.2 through 4.9 and Chart 4.1 of the SMACNA Duct Construction Manual noted above, shall NOT be used.
   a. Figure 4-2
      1) Type RE-2, RE-4, RE-7, RE-9 and R-10 elbows shall not be used.
   b. Figure 4-3
      1) Turning vanes are not acceptable.
   c. Figure 4-4
      1) Turning vanes are not acceptable.
   d. Figure 4-5
      1) Type 2 is not acceptable.
      2) Optional square throat with turning vanes shown for Type 4A and 4B branch connections are not acceptable.
   e. Figure 4-6
      1) Straight tap, butt flange or cinch-lick branch connections are not acceptable.
      2) Flanged or spin-in round connections without a bell-mouth or conical form are not acceptable.
   f. Figure 4-8
      1) Figure D is not acceptable. Figure B is preferable, however, if an offset of this type (I.E. four 90 degree elbows) is needed, use type RE-3 or RE-8 elbows and short radius elbows with full length splitter vanes in accordance with Chart 4-1 and Figure 4-9.

2.4 ROUND DUCTS AND FITTINGS

A. General Material Thickness Requirements for Round Duct: Unless otherwise indicated in the Articles of this Section or the drawings, comply with SMACNA Duct Construction Manual, Tables 3-4 through 3-13 for round duct inclusive of the associated details and notes as they relate to acceptable material thickness based on duct dimension, static pressure class, reinforcement class and stiffener spacing.
   1. Materials shall be as indicated in the Article “Duct Schedule” in Part 3 of this Section.
   2. The thicknesses indicated in Tables 3-4 through 3-13 for round duct in the SMACNA Duct Construction Manual shall be acceptable for galvanized steel, carbon steel, stainless steel, and PVC coated galvanized steel.
   3. If aluminum duct is specified, the thickness of the material shall be adjusted according to Table3-14 of the SMACNA Duct Construction Manual.

B. General Fabrication Requirements: Except as otherwise noted in the Articles of this Section or the Drawings, round duct fabrication shall comply with Sub-Chapter 3.1 (excluding sections S3.0, S3.3, S3.4, S3.5, S3.9 and S3.10) shall comply with Sub-Chapter 3.3 (the reference to Chapter 11 in section S3.17 applies only as referenced and for the purposes of the requirements of section S3.17 in Sub-Chapter 3.3) of the SMACNA Duct Construction Manual.

1. Duct wall thickness, seams, joints, joint spacing, stiffener spacing, support intervals, sealing requirements and reinforcement class shall be coordinated by the Contractor, based on the static pressure class, duct material, and duct dimensions indicated in the design documents, to ensure a proper assembly.

2. Joints and seams shall be formed and assembled with proper dimensions and proportions for a tight and secure assembly.

C. Transverse Joints: Select and fabricate according to Figure 3.1 of the SMACNA Duct Construction Manual with the exception that draw-band joints and crimp type joints (RT-3 and RT-5 respectively) are not permitted.

1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

D. Longitudinal Seams: Select and fabricate seam types shown Figure 3-2 of the SMACNA Duct Construction Manual.

1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.

E. Tees and Laterals: Unless otherwise noted, select types and fabricate according to Figures 3-5 and 3-6 for round duct of the SMACNA Duct Construction Manual.

1. The following Tees and Laterals shown in Figures 3.5 through 3.7 shall not be used

a. Figure 3-5

1) 90 degree tee fitting

2) 90 degree tap

3) 90 degree saddle fitting

4) Rectangular tap straight

2.5 TRANSFER AIR DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, to the following:

a. CertainTeed Corporation.

b. Johns Manville; a Berkshire Hathaway company.

c. Knauf Insulation.

d. Owens Corning.

2. Maximum Thermal Conductivity:
   a. Type I, Flexible: 0.27 Btu x in./h / sf / deg F at 75 deg F mean temperature.
   b. Type II, Rigid: 0.23 Btu x in./h /sf / deg F at 75 deg F mean temperature.
3. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
4. Water-Based Liner Adhesive: Comply with NFPA 90A and with ASTM C 916.
   a. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Insulation Pins and Washers:
1. Cupped-Head: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized steel, aluminum or stainless steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

C. Shop Application of Duct Liner: Comply with SMACNA Duct Construction Manual, Figure 7-11, "Flexible Duct Liner Installation”.
1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps, and coat joint with adhesive.
4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
7. Secure transversely oriented liner edges facing the airstream with metal nosing that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
   a. Fan discharges.
   b. Intervals of lined duct preceding unlined duct.

8. Terminate inner ducts with build-outs attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated build-outs (metal hat sections) or other build-out means are optional; when used, secure build-outs to duct walls with bolts, screws, rivets, or welds.

2.6 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 4 inches.
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Water-Based Joint and Seam Sealant For Duct Air Temperatures Above 0 deg F:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Service Temperature: 0 to plus 200 deg F.
10. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

11. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
12. Sealant 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."
13. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
14. Service: Indoor or outdoor.
15. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Solvent-Based Joint and Seam Sealant For Duct Air Temperatures Below 0 deg F (e.g. outside air ductwork in cold climates):

1. Application Method: Brush on.
2. Base: Synthetic rubber resin.
3. Solvent: Toluene and heptane.
4. Solids Content: Minimum 60 percent.
5. Shore A Hardness: Minimum 60.
6. Water resistant.
7. Mold and mildew resistant.
8. Sealant shall have a VOC content of 420 g/L or less.
9. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.
10. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
11. Service: Indoor or outdoor.
12. Service Temperature: Minus 20 to plus 200 deg F.
13. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

E. **F**ume Hood Connection Sealant:

1. Sealant compatible with fume hood connector and ductwork materials.
2. Sealant shall not degrade under long term exposure to chemicals (chemically stable).

F. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.

3. Grade: NS.
4. Class: 25.
5. Use: O.
6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

G. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

H. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sf at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.

2.7 HANGERS AND SUPPORTS

A. Hanger Rods for Non-corrosive Environments: Cadmium-plated steel rods and nuts.

B. Strap and Rod Sizes: Comply with SMACNA Duct Construction Manual, Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

D. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

E. 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.

F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

G. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

H. Outdoor Ductwork Supports: Coordinate connections to structure and base supports with project roofing construction. Ductwork supports shall be hot-dipped galvanized, wind load rated, shall prevent uplift and shall comply with one of the following:

1. Provide outdoor ductwork supports in accordance with SMACNA Figure 6-3 "Rooftop Duct installation" and Figure 6-4 “Equipment and Duct Support Flashing” when supported by curbs or posts. Flashed into the roofing system when roof mounted.

2.8 BACKDRAFT AND PRESSURE RELIEF DAMPERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, to the following:

1. Greenheck Fan Corporation.
2. Nailor Industries, Inc.
3. Ruskin Company

B. Description: Commercial grade, gravity balanced.

C. Maximum Air Velocity:

1. For duct systems that do not include air volume control terminals and ductwork between room inlets or outlets and associated air volume terminals, provide backdraft damper with a minimum velocity rating of 1250 fpm.
2. For ductwork between air volume control terminals and equipment (e.g. fan or air handling unit) provide backdraft damper with a minimum velocity rating of 2000 fpm.
3. For fan inlets or outlets provide backdraft damper with a minimum velocity rating of 3000 fpm.

D. Maximum System Back Pressure:

1. Backdraft Dampers
   a. For duct systems that do not include air volume control terminals and ductwork between room inlets or outlets and associated air volume terminals, provide backdraft damper with a maximum system backpressure rating of 2 inch water column (0.5 kPa).
   b. For ductwork between air volume control terminals and equipment (e.g. fan or air handling unit) and for fan inlets or outlets provide backdraft damper with a maximum system backpressure rating of 10 inch water column (2.5 kPa).
2. Pressure Relief Dampers
   a. For pressure relief dampers with a setpoint of 0.1 to 2 inches water column, dampers shall be rated for a maximum backpressure of 8.5 inches water column.
   b. For pressure relief dampers with a setpoint of 2.1 to 4 inches water column, dampers shall be rated for a maximum backpressure of 13.5 inches water column.
   c. For pressure relief dampers with a setpoint of 4.1 to 6 inches water column, dampers shall be rated for a maximum backpressure of 20 inches water column.

E. Backdraft Damper Maximum Start-Open Pressure:

1. For duct systems that do not include air volume control terminals and ductwork between room inlets or outlets and associated air volume terminals, provide backdraft damper with a maximum start open pressure of 0.05 inch water column

when installed vertically and when installed horizontally with upward airflow. Provide damper with 0.075 inch water column maximum start-open pressure for dampers mounted horizontally with downward airflow.

2. For ductwork between air volume control terminals and equipment (e.g. fan or air handling unit) and for fan inlets or outlets provide backdraft damper with a maximum start open pressure of 0.05 inch water column when installed vertically and when installed horizontally with upward airflow. Provide damper with 0.075 inch water column maximum start-open pressure for dampers mounted horizontally with downward airflow.

F. Maximum Leakage Rate:

1. Exhaust and relief applications in buildings with fewer than 3 stories only: 20 cfm per square foot at 1 inch water column.

2. Outside air applications in ASHRAE 90.1 Climate Zones 1, 2 and 3 only: 20 cfm per square foot at 1 inch water column.

3. Provide motorized control dampers in all other applications.

G. Frame: Manufacturer standard shape, minimum 0.05-inch- thick (18 gage), galvanized sheet steel, minimum 0.063-inch- thick extruded aluminum (14 gage) or minimum 0.05-inch- thick stainless steel (18 gage), with welded corners or mechanically attached and mounting flange. Material to match associated duct material.

H. Blades: Multiple single-piece blades, center pivoted or end pivoted, maximum 6-inch width, minimum 0.03-inch- thick, roll-formed aluminum with sealed edges. Orientation of blades for backdraft dampers located on fan discharge shall be selected to minimize system effect pressure drop.

I. Blade Action: Parallel.

J. Blade Seals: Extruded vinyl, mechanically locked or neoprene, mechanically locked.

K. Blade Axles:

1. Material: Nonferrous metal, galvanized steel, plated steel, stainless steel or aluminum and shall be compatible with blade material and frame material.

2. Diameter: Minimum 0.20 inch.

L. Tie Bars and Brackets: Aluminum or galvanized steel and shall be compatible with blade and frame material.

M. Return Spring: Adjustable tension.

N. Bearings: Steel ball or synthetic pivot bushings.

O. Accessories:

1. Provide adjustment device to permit setting of varying differential static pressure.

2. Provide counterweights or spring-assist to assist in opening damper blades.

3. 90-degree stops.

2.9 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers: Dampers shall be shop or factory fabricated.

1. Shop Fabricated Volume Dampers:

   a. Dampers shall meet the requirements of SMACNA Duct Construction Manual Section 7.1.

2. Factory Fabricated Volume Dampers:

   a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, to the following:

      1) Greenheck Fan Corporation.

      2) Nailor Industries Inc.

      3) Ruskin Company.

3. Provide dampers that meet the following requirements:

   a. Standard leakage rating, with linkage outside airstream.

   b. Minimum differential pressure rating: 1 inch water column.

   c. Minimum velocity rating: 2000 fpm.

   d. Suitable for horizontal or vertical applications.

   e. Frames:

      1) Frame: Manufacturer standard shape, minimum 0.0396-inch thick, galvanized sheet steel or stainless steel. Material shall match connecting duct materials.

      2) Corners shall be mitered, welded or shall be provided with gusset reinforcements.

      3) Flanges for attaching to walls or flanged ductwork. For other application provide flangeless frames for installing in ducts.

   f. Blades:

      1) Multiple or single blade.

      2) Opposed-blade design for multiple blade dampers.

      3) Stiffen damper blades for stability.

      4) Galvanized or stainless-steel, minimum 0.0635-inch thick. Material shall match connecting duct materials

   g. Blade Axles: Galvanized steel, plated steel or stainless steel.

   h. Bearings:

      1) Oil-impregnated bronze or oil-impregnated stainless-steel sleeve.

i. Dampers in ducts with pressure classes of 3-inch w.g. or less shall have axle length that matches full length of damper blades and bearings at both ends of operating shaft.

j. Tie Bars and Brackets: Galvanized steel.

k. Provide with locking quadrant arm and standoff bracket. For ductwork requiring Seal Class A, provide sealed end bearing and regulator arms assembly to prevent leakage through the shaft core.

1) Air tight regulator arm.

a) For solid core shafts, where the damper shaft penetration of duct is not air tight, provide a shaft seal assembly similar to a Ventlok Model 617 air seal.

B. Standard, Aluminum, Manual Volume Dampers:

1. Dampers shall meet the requirements of SMACNA Duct Construction Manual Section 7.1 and shall meet the following requirements.

a. Standard leakage rating, with linkage outside airstream.

b. Minimum differential pressure rating: 1 inch water column.

c. Minimum velocity rating: 2000 fpm.

d. Suitable for horizontal or vertical applications.

e. Frames: Hat-shaped, minimum 0.10-inch thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.

f. Blades:

1) Multiple or single blade.

2) Parallel- or opposed-blade design.

3) Stiffen damper blades for stability.

4) Roll-formed aluminum blades: minimum 0.10-inch thick sheet or extruded-aluminum blades: minimum 0.050-inch thick sheet.

g. Blade Axles: Galvanized steel or stainless steel.

h. Bearings: Oil-impregnated bronze or stainless-steel sleeve.

i. Dampers in ducts with pressure classes of 3-inch wg or less shall have axle length that matches full length of damper blades and bearings at both ends of operating shaft.

j. Tie Bars and Brackets: Aluminum.

k. Provide with locking quadrant arm and standoff bracket. For ductwork requiring Seal Class A, provide sealed end bearing and regulator arm assembly to prevent leakage through the shaft core.

1) Air tight regulator arm.

a) For solid core shafts, where the damper shaft penetration of duct is not air tight, provide a shaft seal assembly similar to a Ventlok Model 617 air seal.

2.10 DUCT-MOUNTED ACCESS DOORS

A. Duct Mounted Sandwich (Clamp) Type Access Doors – Ductwork and Plena Greater Than 2 inch Pressure Class.

1. Available Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, the following:
   a. Aire Technologies.
   b. Ductmate Industries, Inc.
   c. Nailor Industries Inc.
   d. Ward Industries; a brand of Hart & Cooley, Inc.
2. Duct-Mounted Access Doors: Factory fabricated, leak free insulated sandwich (clamp) type access door with minimum pressure rating equal to or greater than the attached ductwork. Material shall match connecting ductwork.
3. Provide with manufacturer standard gasket, bolts and springs between inner and outer door.
4. Provide wing nuts or molded knobs for low temperature applications and wing nuts for high temperature applications.

B. SMACNA Access Doors – Ductwork and Plena 2” and Lower Pressure Class.

1. Fabricate access panels according to SMACNA Duct Construction Manual, Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."
   a. Door:
      1) Double wall, rectangular.
      2) Galvanized sheet metal with insulation fill and thickness for duct pressure class.
      3) Vision panel.
      4) Hinges and Latches: 1-by-1-inchbutt or piano hinge and cam latches.
      5) Fabricate doors airtight and suitable for duct pressure class.
   b. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
   c. Number of Hinges and Locks:
      1) Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
      2) Access Doors up to 18 Inches Square: Continuous hinge and two sash locks.

3) Access Doors up to 24 by 48 Inches: Continuous hinge and two compression latches with outside and inside handles.

4) Access Doors Larger than 24 by 48 Inches: Continuous hinge and two compression latches with outside and inside handles.

2.11 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 with the following minimum dimensions: 3-1/2 inches wide attached to two strips of 2-3/4 inch wide, 0.028 inch thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.

D. Indoor System, Flexible Connector Fabric:

1. Unless noted otherwise fan discharge connections shall be glass fabric double coated with neoprene.

a. Minimum Weight: 26 oz./sq. yd..

b. Minimum Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.

c. Service Temperature: Minus 40 to plus 200 degrees F.

2. Discharge flexible connections on fans serving systems that connect to fume hoods, ventilated chemical storage cabinets and biological safety cabinets shall be round chlorobutyl elastomeric duct expansion joint type with 304L stainless steel flanges, back up bars, nuts and bolts.

a. Flexible element shall be minimum 2 ply with minimum length of 6 inches between flanges

b. Joints shall have an absolute air-tight seal with up to a minimum of 10 inch w.g., minimum 1.5 inches compression, minimum 0.5 inches extension and minimum 0.75 inches lateral offset.

c. Aligning and pre-compress connectors 0.5 inches.

d. Service Temperature: Minus 40 to plus 200 deg F

E. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.

1. Minimum Weight: 24 oz./sq. yd..

2. Minimum Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.

3. Service Temperature: Minus 50 to plus 250 deg F.

2.12 FLEXIBLE DUCTS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, the following:

1. Flexmaster U.S.A., Inc.
2. McGill AirFlow LLC.
3. Thermaflex; a Flex-Tek Group company.
4. Ward Industries; a brand of Hart & Cooley, Inc.

B. Non-Insulated Flexible Duct

1. Performance:
   a. UL 181, Class 1.
   b. Pressure Rating: Minimum 4-inch wg positive and 0.5-inch wg negative.
   c. Maximum Air Velocity: 4000 fpm.
   d. Temperature Range: Minus 20 to plus 175 deg F.

C. Insulated Flexible Ducts

1. Performance:
   a. UL 181, Class 1, fibrous-glass insulation, vapor-barrier film.
   b. Pressure Rating: Minimum 4-inch wg positive and 0.5-inch wg negative.
   c. Maximum Air Velocity: 4000 fpm.
   d. Temperature Range: Minus 20 to plus 175 deg F.
   e. Insulation R-Value: Comply with ASHRAE/IES 90.1.

D. Flexible Duct Connectors:

1. 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.

2.13 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.

2.14 DIFFUSERS, REGISTERS & GRILLES

A. Available Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, the following:

1. Anemostat Products; a Mestek Company.
2. Carnes Company.
3. Hart & Cooley Inc.
4. Kreuger.

5. Metalaire, Inc.
6. Nailor Industries Inc.
7. Price Industries.
8. Titus.
9. Tuttle & Bailey.

B. Provide diffusers, registers, and grilles for supply, return and exhaust outlets of size, type and, material of construction matching the basis of design devices scheduled on the drawings.

C. Equipment shall be tested and rated according to ASHRAE Standard 70-2006 (RA 2011), “Method of Testing for Rating the Performance of Air Outlets and Inlets”.

D. Room air velocities shall be determined in accordance with ASHRAE Standard 113-2013.

E. Equipment shall handle air quantities at operating velocities:

1. With maximum diffusion within space supplied or exhausted.
2. Without objectionable air movement as determined by Architect.
3. With rated sound level not to exceed NC30.

F. Supply, return and exhaust outlets shall have opposed blade volume dampers operable from front.

G. Supply registers shall have two sets of directional control blades.

H. Diffusers within same room or area shall be of same type and style to provide uniformity of appearance.

I. Surface mount diffusers, registers and grilles shall be furnished with gaskets and installed with faces set level and plumb, tightly against mounting surface.

J. Coordinate diffusers, registers and grilles with ceiling and wall construction. Refer to Architectural Drawings for exact lengths and for framing and mitering arrangements that may differ from those shown on Division 23 Drawings.

K. General Construction and Performance Requirements

1. Supply diffusers shall be specifically designed for variable-air-volume flows.
2. Material: Steel, aluminum or stainless steel consistent with basis of design scheduled diffuser, register or grille.
3. Finish: Steel and aluminum diffusers, registers and grilles shall have a baked enamel finish with color selected by Architect. Stainless steel diffusers and grilles shall have a brushed finish.
4. Mounting: Coordinate selections with ceiling grid indicated on the architectural drawings.
5. Pattern: Provide fully adjustable or fixed pattern consistent with scheduled basis of design diffuser, register or grille.
6. Dampers: Opposed blade or butterfly.

7. Accessories:
   a. Equalizing grid where run out branch to the device is less than 18 inches long.
   b. Plaster ring for devices mounted in dry wall construction.
   c. Safety chain for devices with a face area equal to or larger than 3 square feet.

L. Specialized Diffusers, Registers and Grilles.
   1. Radial Pattern Diffusers:
      a. Provide diffusers with radial pattern dispersion.
      b. The air diffuser shall provide a non-aspirating radial air pattern, projecting air horizontally, vertically, and all directions in between, to provide optimum ventilation of the space.
         1) The unit shall be configured with a manufacturer air supply plenum to provide a uniform discharge velocity over the face of the unit. Provide with an aluminum distribution plenum and internal face velocity equalizing grid and an inlet collar with size as shown on the drawings.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts and specified fittings in accordance with procedures outlined in SMACNA Duct Construction Manual unless otherwise indicated.

C. Examine areas and ductwork to receive wind-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

D. Install ducts in maximum practical lengths to minimize quantity of joints in the system.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where supply, return, makeup air and non-hazardous exhaust ducts pass through fire-rated assemblies identified on the architectural drawings including but not limited to interior partitions, floors and exterior walls, install fire dampers. Where supply, return, makeup air and non-hazardous exhaust pass through a fire rated shaft enclosure provide fire and smoke dampers or combination fire-smoke dampers except where a code acceptable alternate 22-inch sub-duct assembly is indicated on the drawings (e.g. hazardous exhaust duct risers or some toilet exhaust risers in hospitality occupancies).

K. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

L. Duct Sleeves and Prepared Openings

1. Provide galvanized-steel sheet duct sleeves for round ducts 15 inches and smaller. Provide prepared, framed openings for round ducts larger than 15 inches and for square, rectangular ducts, except as specified otherwise. Sleeves shall meet SMACNA requirements.

2. Provide galvanized-steel sheet duct sleeves for ducts through 1-, 2- or 3-hour fire-rated construction and smoke partitions, regardless of size and shape of ducts. Sleeves shall maintain fire rating of construction penetrated. Sleeve and seal materials, construction and clearances shall meet requirements of SMACNA Fire Damper and Heat Stop Guide for Air Handling Systems.

3. Prepared openings shall be framed to provide 1-inch clearance between framing and duct or duct insulation.

4. Provide 4 incheswide 20-gauge galvanized sheet metal collars at sleeves and prepared openings, sized to cover entire duct penetration including sleeve and seal, and to accommodate duct and insulation as necessary. Edges shall have milled lips ground smooth. Paint to match finish of duct or as directed by Architect.

5. All duct penetrations through concrete floors in mechanical rooms shall be provided with 2 inches high water stopped curbs surrounding the openings. This applies to mechanical rooms located above the lowest floor level.

M. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view in finished spaces, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

N. 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 for materials.

O. Verify final equipment locations for roughing-in.

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 2B, 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 SUPPLEMENTAL REQUIREMENTS FOR EXHAUST SYSTEMS SERVING LABORATORY EQUIPMENT, FUME HOODS, CHEMICAL STORAGE CABINETS AND BIOLOGICAL SAFETY CABINETS

A. Ducts shall be supported at intervals not exceeding 10 feet (3048 mm). Supports shall be constructed of non-combustible material matching duct construction.

B. Duct Joints. Ducts shall be made tight with lap joints having a minimum lap of 1 inch (25 mm). Joints used in ANSI/SMACNA Round Industrial Duct Construction Standards and ANSI/SMACNA Rectangular Industrial Duct Construction Standards are also acceptable.

C. Clearance to combustibles. Ducts shall have a minimum clearance to combustibles of 6 inches.

D. Ductwork system serving laboratory equipment, fume hoods, chemical storage cabinets and biological safety cabinets shall have minimum thickness as follows:

E. Diameter of Duct or Maximum Side Dimension	F. Minimum Nominal Thickness G. (Non-Abrasive Material Exhaust)
H. 0-8 inches	I. 0.028 inch (24 gage)
J. 9-18 inches	K. 0.034 inch (22 gage)
L. 19-30 inches	M. 0.040 inch (20 gage)
N. Over 30 inches	O. 0.052 inch (18 gage)

3.4 HANGER AND SUPPORT INSTALLATION

A. Provide hangers and supports in compliance with SMACNA Duct Construction Manual, Chapter 5, "Hangers and Supports" And Chapter 6, Section 6.2 “Rooftop Equipment Installation.”

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

C. Hanger Spacing: Comply with SMACNA Duct Construction Manual, Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for

Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum interval of 16 feet.

F. 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.

G. Install outdoor duct supports. Comply with support manufacturer installation instructions.

3.5 INSTALLATION OF METAL DUCT ACCESSORIES

A. Install duct accessories according to applicable details in SMACNA Duct Construction Manual for metal ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel ductwork, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install backdraft and control dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated. Refer drawings for applicable damper types.

D. Install volume dampers in accessible locations at all points on supply, return, and exhaust systems where branch ductwork extends to points of air collection or delivery (grilles, registers, diffusers). Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Install steel volume dampers in steel ducts.

2. 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 and smoke dampers according to UL listing.

H. Installation of sound attenuators (silencers):

1. Rigidly connect ducts to sound attenuators.

2. Sound attenuator manufacturer basic installation instructions shall not be compromised to ensure pressure drops and self-generated sound power levels do exceed scheduled values. Install sound attenuators with baffles oriented in plane of turn when distance to nearest change in direction is less than attenuator manufacturer optimal distance.

3. Duct sound attenuator supplier or qualified representative shall provide supervision to ensure correct installation of duct sound attenuators.

4. Resiliently isolate sound attenuators from building construction at points of penetration of building structure with 0.75 inch minimum of 3 pound per cubic foot density fibrous glass. Seal penetration ends airtight with non-hardening caulk.
5. Multiple attenuators grouped together in parallel within duct system shall be sealed airtight with the same sealant used on the attached ductwork.

I. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. On both sides of duct coils.
2. Upstream and downstream from duct mounted filters.
3. At outdoor-air intakes and mixed-air plenums.
4. At drain pans and seals.
5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
7. At each change in direction and at maximum 50-foot spacing.
8. Upstream and downstream from splitter vanes.
9. Upstream or downstream from sound attenuators (silencers).
10. Control devices requiring inspection.
11. Elsewhere as indicated.
12. Install access doors with swing against duct static pressure.
13. Minimum Access Door Sizes:
    a. One-Hand or Inspection Access: 8 inches by 5 inches.
    b. Two-Hand Access: 12 inches by 6 inches.
    c. Head and Hand Access: 18 inches by 10 inches.
    d. Head and Shoulders Access: 21 inches by 14 inches.
    e. Body Access: 25 inches by 14 inches.
    f. Body Plus Ladder Access: 25 inches by 17 inches.
    g. Access doors for fire dampers shall be located so that the spring catch and fusible links are accessible when the damper is closed. Fire damper access doors shall be no smaller than 12 inches by 12 inches. Where duct size does not permit the minimum size access door, provide a minimum 12-inch long removable duct section to allow access for reset of fusible link. As duct size increases beyond 16 inches in any one direction, access door shall be no less than 2 inches smaller than the larger duct dimension by a

minimum of 12” long. As the shorter dimension increases above 16 inches the length of the damper shall be no less than 2 inches smaller that the duct in each dimension but shall not exceed 18 inches x 16 inches. For dampers that are too large for an ordinary person's arms to reach from outside the duct to reset the damper and replace the fusible link, the minimum size for the access door shall be increased to 24 inches x 16 inches to allow the entrance of an individual.

J. Label access doors according to Division 23 to indicate the purpose of access door.

K. Install flexible connectors to connect ducts to equipment.

L. For fans developing static pressures of 5 inches water column and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

M. Connect terminal units with fans to supply and return ducts with flexible connectors. Do not use flexible connectors to change directions.

N. Connect diffusers or light troffer boots to ducts directly or with maximum 6 foot lengths of flexible duct clamped or strapped in place.

O. Connect flexible ducts to metal ducts with ty-wrap tool or reusable stainless steel draw bands.

P. Install duct test holes where required for testing and balancing purposes.

3.6 INSTALLATION OF DIFFUSERS, REGISTERS AND GRILLES

A. Prior to installation, 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.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Install diffusers, registers and grilles level and plumb.

C. Outlets and Inlets Locations: 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 practical. 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.

3.7 CONNECTIONS TO EQUIPMENT

A. Comply with SMACNA Duct Construction Manual for branch, outlet and inlet, and terminal unit connections.

B. Make connection to motorized equipment with flexible connectors.

3.8 PAINTING

A. Paint interior of metal ducts that are visible through diffusers, registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09.

3.9 START UP AND ADJUSTING

A. Air Balance: Comply with requirements in other Sections of Division 23.

B. After installation, adjust diffusers, registers and grilles to air patterns indicated or as directed, before the start of air balancing.

3.10 DUCT SCHEDULE

A. Duct Construction: Duct system construction shall be in accordance with M-600 series drawings Duct Materials Schedule:

B. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.

2. Stainless-Steel Ducts:

a. Exposed to Airstream: Match duct material.

b. Not Exposed to Airstream: Galvanized.

3. Aluminum Ducts: Aluminum.

C. Transfer Air Duct Liner:

1. Provide the following liner material:

a. **T**ransfer Ducts: Fibrous glass, Type I or Natural fiber.

2. Thickness of liner shall meet the following requirements:

a. For transfer ducts: 1 inch

b. For acoustical duct lining provide the following thicknesses:

1) Transfer Ducts: 1 inch thick.

D. Ductwork Fittings:

1. Use only the following fittings, shown in Figures 4.2 through 4.9 and Chart 4.1 of the SMACNA Duct Construction Manual.

a. Rectangular Elbows - Figure 4.2

1) Type RE-1

2) Type RE-3. See also Chart 4-1 and Figure 4-9

3) Type RE-5

4) Type RE-6

5) Type RE-8

b. Round Elbows – Figure 3-4

1) Round Mitered Elbows Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA Duct Construction Manual, Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

a) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.

b) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.

c) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.

2) Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.

3) Round Elbows, 14 Inches and Larger in Diameter: Standing seam for non-welded ductwork. Provide welded elbows where welded ductwork is provided.

c. Divided Flow Branches - Figure 4-5

1) Type 1

2) Type 3

3) Type 4A (optional mitered elbow not acceptable)

4) Type 4B (optional mitered elbow not acceptable)

d. Branch Connections from Rectangular Duct - Figure 4-6

1) 45 Degree Entry

2) 45 Degree Lead In

3) Conical

4) Bellmouth

e. Branch Connections From Round Duct - Figure 3-5 and 3-6

1) Velocity 1000 fpm or Lower: 90-degree tap.

2) Velocity 1000 to 1500 fpm : Conical tap.

3) Velocity 1500 fpm or Higher: 45-degree lateral.

f. Offsets & Transitions - Figure 4-7

1) Any type shown.

g. Obstructions – Figure 4-8

1) Figure A, B, C and E.

2) Figure D only if mitered elbows with vanes are replaced with short radius elbows with full length splitter vanes.

3.11 DUCT SEALING

A. Seal ducts for duct systems indicated in schedule below in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Duct Sealant and Leakage Class: Seal ducts to the following seal and leak classes.

1. For purposes of this specification seal class identified shall be used only to define specific seams and joints to be sealed and applies to all duct pressure classes.
2. Openings for rotating shafts shall be sealed with bushings or other devices that seal off air leakage.
3. Pressure-sensitive tape shall not be used as the primary sealant unless it has been certified to comply with UL-181A or UL-181B by an independent testing laboratory, and the tape is used in accordance with that certification.
4. All connections shall be sealed, including but not limited to spin-ins, taps, other branch connections, access doors, access panels, and duct connections to equipment. Sealing that would void product listings is not required. Spiral lock seams need not be sealed.

Duct System	Seal Class	Leakage Class
Hazardous Exhaust: Fume Hood to Exhaust Fan	A	1
Hazardous Exhaust GRD to EF-1 to Outdoor Discharge	A	1
See Field Quality Control Article, Duct System Leakage Tests for applicable of leakage test criteria.		

3.12 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect splitter vanes for proper and secure installation.
5. Operate remote damper operators to verify full range of movement of operator and damper.

B. Leakage Tests:

1. Test ducts for leakage classes specified in Duct Sealing table where leakage classes are indicated, and in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
3. Test the following systems:
   a. Indoor ducts with a pressure class higher than 3-Inch wg, where indicated on duct construction schedule, ducts in risers, and supply ducts upstream of terminal units (e.g. VAV boxes, reheat coils, etc.):
      1) Test representative duct sections totaling no less than 25 percent of total installed duct area for each designated pressure class.
      2) If any of the representative duct sections fail leak testing, then an additional representative duct section totaling no less that 25 percent of total installed duct area shall be tested.
      3) If any section of the second 25 percent fails, then the entire system shall be leak tested.
   b. Outdoor ducts, product-conveying exhaust ducts, and pressurization-critical exhaust ducts:
      1) Test 100 percent of total installed duct area for each designated pressure class.
   c. Leakage test requirements are intentionally more stringent than standard SMACNA requirements.
4. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
5. Test for leaks before applying external insulation.
6. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
7. Give seven days' advance notice for testing.

END OF SECTION

SECTION 233400 - HVAC FANS AND VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Certain requirements common to all the mechanical and electrical trades (Fire Suppression, Plumbing, HVAC, Electrical, and Tele/Data) are specified in Division 20. To avoid repetition, they are not repeated in each relevant Division and Section. However, these requirements are applicable to the work of this Section and are hereby incorporated by reference.

B. 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. Centrifugal Fans
   a. Square in-line centrifugal fans.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes for fans.
2. Rated capacities, operating characteristics, and furnished specialties and accessories.
3. Certified fan performance curves with system operating conditions indicated.
4. Certified fan sound-power ratings.
5. Motor ratings and electrical characteristics, plus motor and electrical accessories.
6. Material thickness and finishes, including color charts.
7. Dampers, including housings, linkages, and operators.
8. Prefabricated roof curbs.
9. Fan speed controllers.

B. Shop Drawings:

1. Include plans, elevations, sections, and attachment 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 diagrams for power, signal, and control wiring.

4. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.

5. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

C. Delegated Design Submittal: For vibration isolation, hangers and supports, indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate requirements for selecting vibration isolators, and supports,

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Fan room layout and relationships between components and adjacent structural and mechanical elements, drawn to scale, and coordinated with each other, using input from installers of the items involved.

B. Product Certificates: Submit certificates that specified equipment will withstand required wind forces, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of wind force and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Startup service reports.

D. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fans to include:

1. Operation in normal and emergency modes.

2. Operation, and maintenance manuals with replacement parts listing.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified nationally recognized testing laboratory (NRTL), and marked for intended location and application.

B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of unit components.

C. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Startup."

D. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

E. Wind Performance: Fans shall withstand the effects of wind determined in accordance with to ASCE/SEI 7. See Division 23 for vibration and seismic requirements where applicable.

F. Capacities and Characteristics: Refer to schedules on drawings.

2.2 GENERAL

A. Source Limitations: Obtain each individual fan type from single manufacturer.

B. Refer to Division 23 for duct silencer requirements.

C. Motors

1. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Division 23.

2. 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.

3. Where variable-frequency drives are indicated or scheduled, provide fan motor compatible with variable-frequency drive.

D. Bearings:

1. Heavy-duty regreasable ball or roller type in a cast iron self-aligning pillow block housing.

2. Ball-Bearing Rating Life: ABMA 9, L (50) of 200,000 hours.

3. Roller-Bearing Rating Life: ABMA 11, L (50) of 200,000 hours.

4. Extend grease fitting to accessible location outside of unit.

5. Where fans are required to be spark resistant, bearing shall be located outside the airstream.

E. Source Quality Control

1. AMCA Certification for Fan Sound Performance Rating: Test, rate, and label in accordance with AMCA 311.

2. AMCA Certification for Fan Energy Index (FEI): Test, rate, and label in accordance with AMCA 211.

3. Operating Limits: Classify fans in accordance with AMCA 99, Section 14.

4. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.

2.3 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Greenheck Fan Corporation.

2. Loren Cook Company.

3. Twin City Fan Companies

2.4 SQUARE IN-LINE CENTRIFUGAL FANS

A. Description: Square in-line centrifugal fans.

B. Housings:

1. Housing Material: Reinforced Galvanized steel.

2. Housing Coating: None.

3. Housing Construction: Side panels shall be easily removable for service. Include inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.

C. Direct-Drive Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing.

D. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosures around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.

E. Fan Wheels: Aluminum airfoil blades welded to aluminum hub.

F. Motor Enclosure: Totally enclosed, fan cooled.

G. Accessories:

1. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE 62.1.

2. Companion Flanges: For inlet and outlet duct connections.
3. Fan Guards: 1/2- by 1-inch mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
4. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install fans level and plumb.

B. Disassemble and reassemble units, as required for moving to the final location, according to manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

D. Equipment Mounting:

1. Install floor- or roof-mounted centrifugal fans on roof system equipment curbs.. Comply with requirements for equipment bases and foundations specified in Division 03.

2. Ceiling Units: Suspend units from structure; use steel wire or metal straps.

3. Support duct-mounted and other hanging fans directly from the building structure, using suitable hanging systems as specified in Division 23.

E. Curb Support, Field Built-Up: Install roof curb on roof structure, level and secure, according to "The NRCA Roofing and Waterproofing Manual," detail "Equipment Support Curb," number "SPF-9" (page 1409) and detail "Equipment Support Curb," number "SPF-9S" (page 1410). Install and secure centrifugal fans on curbs, and coordinate roof penetrations and flashing with roof construction. Secure units to curb support with anchor bolts.

F. Curb Support, Prefabricated: Rail-type wood support provided by fan manufacturer.

G. Unit Support: Install fans level on structural curbs. Coordinate with duct connections. Secure units to structural support with anchor bolts.

H. Install units with clearances for service and maintenance.

I. Label fans according to requirements specified in Division 23.

3.2 DUCTWORK AND PIPING CONNECTIONS

A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23.

B. Install ducts adjacent to fans to allow service and maintenance.

3.3 ELECTRICAL CONNECTIONS

A. Connect wiring according to Division 26.

B. Ground equipment according to Division 26.

C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.

D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Division 26.

2. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.4 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect wiring in accordance with Division 26.

C. Connect control wiring according to Division 26.

3.5 STARTUP SERVICE:

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks in accordance with manufacturer's written instructions.

2. Verify that shipping, blocking, and bracing are removed.

3. 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.

4. Verify that cleaning and adjusting are complete.

5. For direct-drive fans, verify proper motor rotation direction and verify fan wheel free rotation and smooth bearing operation.

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. Disable automatic temperature-control operators, energize motor and confirm proper motor rotation and unit operation, adjust fan to indicated rpm, and measure and record motor voltage and amperage.

10. Shut unit down and reconnect automatic temperature-control operators.

11. Remove and replace malfunctioning units and retest as specified above.

3.6 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Lubricate bearings.

C. Comply with requirements in Division 23.

3.7 CLEANING

A. After completing system installation and testing, adjusting, and balancing and after completing startup service, clean fans internally to remove foreign material and construction dirt and dust

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections with the assistance of a factory-authorized service representative.

1. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3. Fans and components will be considered defective if they do not pass tests and inspections.

B. Prepare test and inspection reports.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fans.

END OF SECTION

SECTION 238239.13 - CABINET UNIT HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Certain requirements common to all the mechanical and electrical trades (Fire Suppression, Plumbing, HVAC, Electrical, and Tele/Data) are specified in Division 20. To avoid repetition, they are not repeated in each relevant Division of the Specifications. However, these requirements are applicable to the work of this Division and are hereby incorporated by reference.

B. 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 cabinet unit heaters with centrifugal fans and hot-water coils.

1.3 DEFINITIONS

A. BAS: Building automation system.

B. CWP: Cold working pressure.

C. PTFE: Polytetrafluoroethylene plastic.

D. TFE: Tetrafluoroethylene plastic.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. 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.
8. Wiring Diagrams: Power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified.

D. Samples for Initial Selection: Finish colors for units with factory-applied color finishes.

E. Samples for Verification: Finish colors for each type of cabinet unit heater indicated with factory-applied color finishes.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Suspended ceiling components.
2. Structural members to which cabinet unit heaters will be attached.
3. Method of attaching hangers to building structure.
4. Size and location of initial access modules for acoustical tile.
5. Items penetrating finished ceiling, including the following:
   a. Lighting fixtures.
   b. Air outlets and inlets.
   c. Speakers.
   d. Sprinklers.
   e. Access panels.
6. Perimeter moldings for exposed or partially exposed cabinets.

B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For cabinet unit heaters to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

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. Cabinet Unit-Heater Filters: Furnish one spare filter(s) for each filter installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide or product by one of the following:

1. Chromalox, Inc.
2. Indeeco.
3. International Environmental Corporation.
4. Daikin McQuay International.
5. QMark; Marley Engineered Products.
6. Trane Inc.

2.2 DESCRIPTION

A. Factory-assembled and -tested unit complying with AHRI 440.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with UL 2021.

2.3 PERFORMANCE REQUIREMENTS

A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

B. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

2.4 COIL SECTION INSULATION

A. Insulation Materials: ASTM C 1071; surfaces exposed to airstream shall have aluminum-foil facing to prevent erosion of glass fibers.

1. Thickness: 1/2 inch.
2. Thermal Conductivity (k-Value): 0.26 Btu x in./h x sq. ft. at 75 deg F mean temperature.
3. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
4. Adhesive: Comply with ASTM C 916 and with NFPA 90A or NFPA 90B.
5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

2.5 CABINETS

A. Material: Steel with factory prime coating, ready for field painting, baked-enamel finish with manufacturer's standard paint, in color selected by Architect.

1. Vertical Unit, Exposed Front Panels: Minimum 0.0528-inch- thick galvanized sheet steel, removable panels with channel-formed edges secured with tamperproof cam fasteners.
2. Horizontal Unit, Exposed Bottom Panels: Minimum 0.0528-inch- thick galvanized sheet steel, removable panels secured with tamperproof cam fasteners and safety chain.
3. Recessed Flanges: Steel, finished to match cabinet.
4. Control Access Door: Key operated.
5. Base: Minimum 0.0528-inch- thick steel, finished to match cabinet, 4 inches high with leveling bolts.
6. Extended Piping Compartment: 8-inch- wide piping end pocket.
7. False Back: Minimum 0.0428-inch- thick steel, finished to match cabinet.

2.6 FILTERS

A. Minimum Arrestance: According to ASHRAE 52.1 and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.

1. Pleated: 90 percent arrestance and MERV 8.

2.7 COILS

A. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and hum, mounted in ceramic inserts in galvanized-steel housing; with fuses in terminal box for overcurrent protection and limit controls for high-temperature protection. Terminate elements in stainless-steel machine-staked terminals secured with stainless-steel hardware.

2.8 CONTROLS

A. Fan and Motor Board: Removable.

1. Fan: Forward curved, double width, centrifugal, directly connected to motor; thermoplastic or painted-steel wheels and aluminum, painted-steel, or galvanized-steel fan scrolls.
2. Motor: Permanently lubricated, multispeed; resiliently mounted on motor board. Comply with requirements in Division 23, Common Motor Requirements for HVAC Equipment.
3. Wiring Terminations: Connect motor to chassis wiring with plug connection.

B. Basic Unit Controls:

1. Unit-mounted thermostat with the following features:

a. Heat-off switch.

b. Fan on-auto switch.

c. Manual fan-speed switch.

d. Adjustable deadband.

e. Concealed set point.

f. Concealed indication.

g. Deg F indication.

2. Unit-mounted temperature sensor.

3. Unoccupied period override push button.

4. Data entry and access port.

a. Input data includes room temperature and occupied and unoccupied periods.

b. Output data includes room temperature, supply-air temperature, entering-water temperature, operating mode, and status.

2.9 CAPACITIES AND CHARACTERISTICS

A. Cabinet:

1. Vertical, Surface Mounted: Upflow.

a. Top: Flat.

b. Air Inlet: Front, punched louver.

c. Air Outlet: Top, extruded-aluminum bar grille.

2.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive cabinet unit heaters 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 wall boxes in finished wall assembly; seal and weatherproof. Joint-sealant materials and applications are specified in Division 07, Joint Sealants.

B. Install cabinet unit heaters to comply with NFPA 90A.

C. Suspend cabinet unit heaters from structure with elastomeric hangers. Vibration isolators are specified in Section 23, Vibration and Seismic Controls for HVAC Piping and Equipment.

D. Install wall-mounted thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.

E. Install new filters in each fan-coil unit within two weeks of Substantial Completion.

3.3 CONNECTIONS

A. Piping installation requirements are specified in Division 23, Hydronic Piping and Division 23, Heating Piping. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Connect piping to cabinet unit heater's factory, hot-water piping package. Install the piping package if shipped loose.

D. Connect supply and return ducts to cabinet unit heaters with flexible duct connectors specified in Division 23, Air Duct Accessories.

E. Comply with safety requirements in UL 1995.

F. Ground equipment according to Division 26, Grounding and Bonding for Electrical Systems.

G. Connect wiring according to Division 26, Low-Voltage Electrical Power Conductors and Cables.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

B. Units will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 ADJUSTING

A. Adjust initial temperature set points.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain cabinet unit heaters.

END OF SECTION

SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Certain requirements common to all the mechanical and electrical trades (Fire Suppression, Plumbing, HVAC, Electrical, and Tele/Data) are specified in Division 20. To avoid repetition, they are not repeated in each relevant Division and Section. However, these requirements are applicable to the work of this Section and are hereby incorporated by reference.

1. For example, prior to requesting an occupancy permit, the MEP documentation listed in Part 3 of Division 20 (in paragraph “MEP and Fire Protection Completion Requirements”, subparagraph “Occupancy Permit” must be submitted and approved so the Engineer can certify that the MEP systems and life safety provisions are completed.

B. 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 equipment coordination and installation.
2. Sleeves for raceways and cables.
3. Sleeve seals.
4. Grout.
5. Common electrical installation requirements.

1.3 DEFINITIONS

A. Emergency Systems: Loads defined by NFPA 70, Article 700 “Emergency Systems”. Those systems intended to supply egress lighting.

B. Optional Standby Systems: Loads defined by NFPA 70, Article 702 “Optional Standby Systems”. Those systems intended to supply loads such as laboratory equipment.

C. Feeder: All circuit conductors between the service equipment, the source of a separately derived system, or other power supply source and the final branch-circuit overcurrent. Feeders may be identified in the “Legend of Feeder Sizes” identified on the drawings. All feeders are required to be in conduit. MC cable is not permitted unless specifically approved by the Engineer via an RFI or substitution request form. Submittal reviews of product does not permit use of MC cable for feeders.

D. Branch Circuit: The circuit conductors between the final overcurrent device protecting the circuit and the outlet(s) device. Branch circuits may be identified in the "Branch Circuit Schedule" on the drawings.

E. EPDM: Ethylene-propylene-diene terpolymer rubber.

F. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For sleeve seals.

1.5 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.

2. To provide for ease of disconnecting the equipment with minimum interference to other installations.

3. To allow right of way for piping and conduit installed at required slope.

4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08.

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07.

1.6 MATERIALS AND WORKMANSHIP

A. Work shall be neat and rectilinear. Install material and equipment in accordance with manufacturers written instructions. Installation shall operate safely and without noise, vibration or corrosion. Work shall be properly and effectively protected, and raceway openings shall be temporarily closed to prevent obstruction and damage before completion.

B. Except as specified otherwise, material and equipment shall be new, factory tested and delivered ready for field installation. Provide supplies, accessories and connections necessary for complete and operational installation. Provide components required or recommended by OSHA and applicable NFPA documents. Equipment damaged during installation shall be repaired to new condition or replaced with new material. The contractor shall be responsible for all costs associated with testing, replacing to repair, including but not limited to, all replacement or repair costs, preparations prior to testing, all testing costs, extended warranties, re-commissioning of the equipment, etc. with no additional cost to the contract.

C. The contractor shall take steps necessary to ensure that all materials and equipment can be delivered and installed in sections sufficiently small to fit within openings in the building and that the weight and size of all equipment pieces so not exceed the capacity of the hoisting and/or elevator system.

D. Owner will not be responsible for material and equipment before testing, commissioning, and acceptance.

1.7 EQUIPMENT LOCATION

A. Location of all wall outlets shall be verified with the Architect prior to roughing in. Refer to details and elevations on the architectural drawings. Mounting heights indicated on the architectural drawings shall take precedence over information indicated on the electrical drawings.

B. If discrepancies regarding the locations of outlet boxes exist between the electrical drawings and any other drawings associated with the project, notify the Architect. Any reasonable change in location of outlets shall not involve additional expense to Owner. The term “reasonable” shall be interpreted as moving outlet 10’-0” in any direction from the location indicated on the Electrical drawings. Refer to specifications 230000 for additional information.

1.8 CABLE TERMINATION TEMPERATURE RATINGS

A. All equipment terminations connecting to wire and cable, rated 600V or less shall be rated for 75 deg. C for conductors 1 AWG and smaller and/or where conductor ampacities are 100 A or less.

PART 2 - PRODUCTS

2.1 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 and no side more than 16 inches, thickness shall be 0.052 inch.

b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and 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. Metraflex Co.
   d. 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.

2.3 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.4 CORDS AND CAPS

A. Attachment Plug Configuration: Match receptacle configuration at outlet with plug provided for equipment.

B. Cord Construction: Oil-resistant thermoset insulated Type SO multiconductor flexible cord with identified equipment grounding conductor, suitable for extra hard usage in damp locations.

C. Cord Size: Suitable for connected load of equipment and rating of branch circuit overcurrent protection.

2.5 ACCESS AND ACCESS PANELS

A. This Section supplements requirements of Division 08.

B. Description: Interior construction access panels,

C. Available Manufacturers:
   1. Milcor.
   2. Knapp.
   3. Nystorm.
   4. Inland Steel.

D. Coordinate selection with other Sections supplying similar access panels.

E. Access panels shall have same fire rating classification as surface penetrated.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Avoid interference with structure and with work of other trades, preserving adequate headroom and clearing doors and passageways, to satisfaction of Architect and in accordance with code requirements. Installation shall permit clearance for access to equipment for repair, servicing and replacement.

C. Install equipment so as to properly distribute equipment loads on building structural members provided for equipment support under other Sections. Roof-mounted equipment shall be installed and supported on structural steel provided under other Sections.

D. Provide suspended platforms, strap hangers, brackets, shelves, stands or legs as necessary for floor, wall or ceiling mounting of equipment as required.

E. Provide steel supports and hardware for proper installation of hangers, anchors, guides, etc.

F. Provide cuts, weights, and other pertinent data required for proper coordination of equipment support provisions and installation.

G. Structural steel and hardware shall conform to Standard Specifications of ASTM; use of steel and hardware shall conform to requirements of Section Five of Code of Standard Practice for Steel Buildings and Bridges.

H. Verify site conditions and dimensions of equipment to ensure access for proper installation of equipment without disassembly which may void warrantee. Report in writing to Architect, prior to purchase or shipment of equipment involved, on conditions which may prevent proper installation.

I. The Electrical Contractor shall not allow any equipment, ductwork, or piping foreign to the electrical installation to be installed or pass through any room in which electrical systems or equipment is located, such as electrical room, electric closets telephone or data closets. The Electrical Contractor shall notify the Construction Manager of such violations and request removal of such equipment, ductwork, or piping.

J. Coordinate location of motor control centers, panelboards, and transformers installed in mechanical rooms with the HVAC, Plumbing and Fire Protection subcontractors. No piping, ductwork or other mechanical equipment shall be allowed to pass through the area of the electrical equipment equal to the width and depth of the electrical equipment extending from floor to structural ceiling above. A hung or gypsum board ceiling is not considered structure.

K. Give right of way to piping systems installed at a required slope and/or specific mounting height or elevation.

L. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

M. 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.

N. 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.

O. Right of Way: Give to piping systems installed at a required slope.

3.2 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. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

E. Cut sleeves to length for mounting flush with both surfaces of walls.

F. Extend sleeves installed in floors 2 inches above finished floor level.

G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry

1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07.

J. 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.

K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

A. Install to seal exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07.

3.5 HVAC, PLUMBING AND FIRE PROTECTION CONNECTIONS

A. General

1. Provide all power wiring including all circuitry carrying electrical energy from panelboard or other source through starters and disconnects to motors or to packaged control panels. Packaged control panels may include disconnects and starters and overcurrent protection. Provide all wiring between packaged control panels and motors.

2. HVAC, Plumbing and Fire Protection equipment is defined as products provided under other divisions that require power 120 volts and higher.

3. Unless otherwise specified, all electrical control devices such as aquastats, float and pressure switches, electro pneumatic switches, solenoid valves and damper motors requiring mechanical connections shall be furnished and installed and wired by the Contractor supplying the devices.

4. Provide conduit and power wiring for connection to alarm panels, remote alarms, etc. Refer to HVAC, Plumbing and Fire Protection drawings for location and quantity of panels/alarms to be connected. Provide connections from local 120-volt panel via 20 ampere circuit breaker.

5. All control wiring shall be provided by the contractor, unless noted otherwise in the specification or drawings.

B. Coordination

1. Review equipment submittals prior to installation and electrical rough-in. Verify location, size, and type of connections. Coordinate details of equipment connections with supplier and installer.

C. Examination

1. Examine the areas and conditions under which the equipment is to be installed.

2. Verify that equipment is ready for electrical connection, wiring, and energization.

D. Installation

1. Use wire and cable with insulation suitable for temperatures encountered in heat-producing equipment.
2. Make conduit connections to vibrating equipment using flexible conduit. Use liquid tight flexible conduit in damp or wet locations.
3. Install pre-finished cord set where connection with attachment plug is indicated or specified, or use attachment plug with suitable strain-relief clamps.
4. Provide suitable strain-relief clamps for cord connections to outlet boxes and equipment connection boxes for vibrating equipment.
5. Make wiring connections in control panel or in wiring compartment of pre-wired equipment in accordance with manufacturer's instructions. Provide interconnecting wiring where indicated.
6. Install disconnect switches, controllers, control stations, and control devices such as limit switches and temperature switches as indicated. Connect with conduit and wiring as indicated.
7. Each motor terminal box shall be connected with a minimum 12 inches, maximum 24 inches piece of flexible conduit to a fixed junction box. A green wire run through the flexible conduit shall interconnect the motor frame and the branch circuit ground wire. Use liquid tight flexible metal conduit for connection. Conduit must be installed perpendicular to direction of equipment vibration to allow conduit to freely flex.
8. Check for proper rotation of each motor.

E. Building Management Panels

1. Provide conduit and power wiring (120 volt) to all Building Management System Panels, Direct Digital Control panels, Utility Monitoring System (UMS) panels, etc. Provide connection from local 120 volt panel via 20 ampere circuit breaker. Provide one branch circuit for every panel, unless directed otherwise.

3.6 ACCESS PANELS

A. Provide access panels in accordance with this Section and requirements of Division 08.

B. Access panels are generally not shown on the drawings but shall be provided to allow access to system components.

C. Provide proper access to materials and equipment that require inspection, replacement, repair or service, and coordinate their delivery with the installing Trade. If proper access cannot be provided, confer with Architect as to best method of approach for minimizing effect of reduced access which may result.

D. Coordinate and prepare a location, size, and function schedule of access panels required to fully service equipment and deliver to a representative of the installing Trade. Furnish and install distinctively colored buttons (color as selected by Architect) in finished ceiling to identify all access panels.

E. Provide access panels to all items requiring maintenance including at fire dampers, volume dampers, controls, shut-off valves, control valves, check valves, or other items that require access and are concealed in floor, wall, furred space or above ceiling.

F. Ceilings consisting of lay-in or removable splined tiles do not require access panels and dampers, splitters, or test hole openings above ceiling shall have location marked with thumb tack on finished ceiling panel. Location shall be noted on record drawings.

G. Access panels shall have same fire rating classification as surface penetrated.

H. Panels within 8” of the surface being penetrated shall be the sized for the greater of 12”x12” or size required to allow removal of the component being maintained; panels further than 8” from the surface being penetrated and access at all equipment requiring service (including disconnects) shall be a minimum of 24”x24”. Access doors to fire dampers shall be a minimum of 18”x16” if fire damper is within ordinary person’s arms reach of the access panel or 24”x24” if beyond arms reach as required by NFPA 90A-2002.

3.7 CONNECTIONS TO OWNER AND ARCHITECT EQUIPMENT

A. General

1. Provide all power wiring including all circuitry carrying electrical energy from panelboard or other source to owner and architectural equipment for complete and operational equipment.

2. Owner and Architectural equipment is defined as products provided under other divisions that operate at voltages 110 and above. Equipment may include but not be limited to the following:

   a. Coffee machines

   b. Vending machines

   c. Microwaves

   d. Refrigerators

   e. Dishwashers

   f. Copy machines

   g. Projector screens

   h. Electric hand dryers

3. All control wiring shall be provided by the contractor, unless noted otherwise in the specification or drawings.

B. Coordination

1. Coordinate location of equipment with Architect and Owner.

2. Review equipment submittals prior to installation and electrical rough-in. Verify location, size, and type of connections. Coordinate details of equipment connections with supplier and installer.

3. Obtain wiring diagrams and installation methods from equipment manufacturers.

C. Examination

1. Examine the areas and conditions under which the equipment is to be installed.
2. Verify that equipment is ready for electrical connection, wiring, and energization.

D. Installation

1. Make conduit connections to vibrating equipment using flexible conduit. Use liquid tight flexible conduit in damp or wet locations.
2. Install pre-finished cord set where connection with attachment plug is indicated or specified, or use attachment plug with suitable strain-relief clamps.
3. Provide suitable strain-relief clamps for cord connections to outlet boxes and equipment connection boxes for vibrating equipment or for cord drops from ceilings.
4. Make wiring connections in control panel or in wiring compartment of pre-wired equipment in accordance with manufacturer's instructions. Provide interconnecting wiring where indicated.
5. Install disconnect switches, controllers, and control stations, as indicated. Connect with conduit and wiring as indicated.
6. Each motor terminal box shall be connected with a minimum 12", maximum 24" piece of flexible conduit to a fixed junction box. A green wire run through the flexible conduit shall interconnect the motor frame and the branch circuit ground wire. Use liquid tight flexible metal conduit for connection. Conduit must be installed perpendicular to direction of equipment vibration to allow conduit to freely flex.
7. Check for proper rotation of each motor.

3.8 LABORATORY EQUIPMENT CONNECTIONS

A. General

1. Provide all power wiring including all circuitry carrying electrical energy from panelboard or other source to laboratory equipment for complete and operational equipment.
2. Laboratory equipment is defined as products provided under other divisions that require power 110 volts and higher.
3. All control wiring shall be provided by the contractor, unless noted otherwise in the specification or drawings.

B. Coordination

1. Review equipment submittals prior to installation and electrical rough-in. Verify location, size, and type of connections. Coordinate details of equipment connections with supplier and installer.
2. Obtain wiring diagrams and installation methods from equipment manufacturers.

C. Examination

1. Examine the areas and conditions under which the equipment is to be installed.

2. Verify that equipment is ready for electrical connection, wiring, and energization.

D. Installation

1. Make conduit connections to vibrating equipment using flexible conduit. Use liquid tight flexible conduit in damp or wet locations.
2. Install pre-finished cord set where connection with attachment plug is indicated or specified, or use attachment plug with suitable strain-relief clamps.
3. Provide suitable strain-relief clamps for cord connections to outlet boxes and equipment connection boxes for vibrating equipment or for cord drops from ceilings.
4. Make wiring connections in control panel or in wiring compartment of pre-wired equipment in accordance with manufacturer's instructions. Provide interconnecting wiring where indicated.
5. Install disconnect switches, controllers, and control stations, as indicated. Connect with conduit and wiring as indicated.
6. Each motor terminal box shall be connected with a minimum 12", maximum 24" piece of flexible conduit to a fixed junction box. A green wire run through the flexible conduit shall interconnect the motor frame and the branch circuit ground wire. Use liquid tight flexible metal conduit for connection. Conduit must be installed perpendicular to direction of equipment vibration to allow conduit to freely flex.
7. Check for proper rotation of each motor.

3.9 CLEANING

A. Cleaning shall be performed on a day-to-day basis and a final cleaning prior to commissioning.

B. Equipment

1. All electrical equipment shall be cleaned inside and out prior to initial energizing.
2. Cleaning shall consist of vacuuming busses, windings, enclosures (inside and out), etc. After vacuuming is complete, the equipment shall be wiped down.
3. If equipment is wet or contains moisture, it shall be thoroughly dried out and inspected by the manufacturer’s representative before energizing.

C. Raceways

1. All raceways shall be blown out and dried prior to installation of conductors.
2. Raceways installed in or below the slab shall have a mandrel pulled through to clear any dirt and debris.

D. Pull, Junction, Work and Floor Boxes

1. All boxes shall be cleaned of debris such as plaster and concrete residue prior to installation of conductors.
2. Vacuum all dirt and debris from floor boxes prior to installing inserts.

E. Electrical Rooms

1. Upon completion of cleaning equipment, raceways and boxes, but before energizing equipment, the entire room shall be swept clean with all garbage removed from the area.
2. When the room is clean and equipment energized, the area shall remain clean and the doors to the room shall remain closed until completion of project.
3. If the room or equipment is subjected to dust or moisture after energizing the equipment shall be de-energized and re-cleaned as outlined above.

F. Final Cleaning

1. All light fixtures, devices, device plates, etc., shall be cleaned and left in new condition to the satisfaction of the Architect, prior to final occupancy.
2. All rubbish, discarded materials and unused materials shall be removed from site.

END OF SECTION

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Certain requirements common to all the mechanical and electrical trades (Fire Suppression, Plumbing, HVAC, Electrical, and Tele/Data) are specified in Division 20. To avoid repetition, they are not repeated in each relevant Division of the Specifications. However, these requirements are applicable to the work of this Division, and are hereby incorporated by reference.

B. 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
2. Variable frequency drive cable
3. Connectors and splices
4. Cable supports

B. Related Sections include the following:

1. Division 27 for cabling used for voice and data circuits.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

C. Feeder: All circuit conductors between the service equipment, the source of a separately derived system, or other power supply source and the final branch-circuit overcurrent device.

D. Branch Circuit: The circuit conductors between the final overcurrent device protecting the circuit and the outlet(s).

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Field quality-control test reports.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

1.6 COORDINATION

A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alcan Products Corporation; Alcan Cable Division.
2. American Insulated Wire Corp.; a Leviton Company.
3. General Cable Corporation.
4. Senator Wire & Cable Company.
5. Southwire Company.

B. Copper Conductors: Comply with NEMA WC 70 and ASTM B-496. Copper conductors shall be soft drawn annealed copper, having a conductivity of not less than 98 percent of that of pure copper.

1. Conductor Insulation:

a. Comply with NEMA WC 70 for Types THHN-THWN

b. All copper conductor insulation shall be Type “THHN” or “THHN/THWN”, except as specified hereinafter in subparagraph c, below.

c. All conductors within lighting fixtures shall be temperature rated as required by National Electrical Code, latest edition. Branch circuit conductors within 3 inches of fluorescent ballast shall be Type “THHW” or “XHHW”.

2.2 VARIABLE FREQUENCY DRIVE CABLE

A. Basis-of-Design Product: Subject to compliance with requirements, provide Belden, Inc. or comparable product by one of the following:

1. AmerCable Inc.
2. Belden
3. Draka

4. General Cable Corporation
5. LAPP USA
6. Southwire

B. General

1. The cable shall be 600V/1000V rated, with stranded tinned copper conductors, shielded, suitable for use with Variable Frequency Drives.
2. The insulation shall be rated for 90 deg C wet/dry operating temperature.
3. Accessories (terminations) shall have ratings that are at least equal to those of the cable.
4. Cable shall be free from material and workmanship defects.
5. All cables shall be round.
6. Cable shall be suitable for use in wet/dry locations, indoors and outdoors, in cable trays, in conduits, trenches, and in underground ducts and direct burial.

C. Material/Construction

1. Conductors shall be annealed stranded copper per ASTM B3, B8, and B33. Cable shall include three symmetrical placed ground wires.
2. UL Listed Type TC-ER cable.
3. Insulation
   a. The insulation thickness shall have a minimum average wall thickness of 30 mils. The insulation material must be XLPE with a XHHW-2 listing per UL 44. Each insulated conductor shall be identified in accordance with ICEA Method 4 color coding.
   b. The insulated conductors are to be cabled together with three symmetrical bare copper ground wires. The ground wires are to have a minimum circular mil area equivalent to one circuit conductor. Fillers shall be included as necessary to make the cable round.
4. Shielding
   a. The cabled assembly shall be shielded using one of two methods:
      1) Applying helically two 2-mil copper tapes. The shield shall provide 100 percent coverage over the assembly. Shield shall be in contact with the ground wires.
      2) Applying an 80 percent minimum coverage tinned copper braid shield used in conjunction with an aluminum foil shield tape. Shield shall be in contact with the ground wires.
5. Jacket
   a. All cables shall have a continuous overall outer sheath of Polyvinyl Chloride (PVC), suitable for 90 deg C use.
   b. The jacket shall be resistant to abrasion, rated for direct burial, oil resistant, sunlight resistant and flame resistant in accordance with UL 1277.

6. Identification
   a. The following permanent legend shall be clearly embossed or printed at approximately 2 foot intervals on the outer jacket for the entire length of the cable:
      1) Manufacturer's name and or Trade Mark
      2) Number of conductors and size (-- AWG)
      3) Type of insulation (XLPE) or NEC Listed Conductor Type (XHHW-2)
      4) Voltage rating
      5) TC-ER rating
      6) 1000V Flexible Motor Supply Cable rating
      7) Sequential footage marking at 2 ft intervals

2.3 MULTI-CONDUCTOR CABLE

A. Multiconductor Cable: Comply with NEMA WC 70 for metal-clad cable, Type MC and mineral-insulated, metal-sheathed cable, Type MI with ground wire.

B. Multiconductor cables run in parallel shall include full size grounding conductor in accordance with NFPA 70 Article 250.122

C. MC Cable
   1. Available Manufacturers: The design is based on AFC Cable Systems, Inc. to establish standards of quality for materials and performance. The naming of a specific manufacturer or catalog number does not waive any requirements or performance of individual components described in the specifications.
   2. Acceptable alternate manufacturers are
      a. Southwire Company
      b. Allflex
      c. Alliance
      d. or approved equal.
   3. General
      a. Cable shall be multi-conductor Metal Clad (UL-Type MC) Power cable that meets or exceeds the requirements of UL Standard 83, UL Standard 1063, UL Standard 1569 for Type MC, Federal Specification A-A59544, IEEE 1202 (70,000 Btu/hr) Vertical Cable Tray Flame Test, and the National Electrical Code.
      b. Cable assemblies shall be prefabricated at the factory and shipped to the job site on cable reels.
   4. Material
      a. Conductors shall be minimum No. 12 AWG, soft drawn copper with 90°C, THHN, 600 V rated insulation. Where the length of MC cable exceeds 65

feet for 120 volt circuits and 145 feet for 277 volt circuits provide No. 10 AWG conductor with same properties as listed above. For branch circuits longer than 100 feet for 120 volt and 230 feet for 277 volt refer to the Branch Circuit Schedule on the drawings for the conductor size.

b. Each length of MC cable shall have a dedicated neutral conductor for each phase conductor. Each length shall include a full size equipment grounding conductor. Where isolated ground receptacles are indicated on plans provide an isolated ground conductor (green with yellow strip) with each length of cable.

c. Cable shall be UL Classified 1, 2, and 3 hour Through Penetration Firestop Systems: W-J-3037, W-L-3110, W-L-3113, W-L-3117, W-L-3120, W-L-3121, W-L-3160, C-AJ-3115, C-AJ-3140, C-AJ-3142, C-AJ-3145, C-AJ-3173, C-AJ-3202, C-AJ-4065, C-AJ-4066, F-C-3038.

d. Sheath shall be continuous welded, corrugated aluminum sheath.

D. Mineral Insulated (MI) Cable

1. Available Manufacturers:

a. The design is based on Tyco Thermal Controls/Pyrotenax to establish standards of quality for materials and performance. The naming of a specific manufacturer or catalog number does not waive any requirements or performance of individual components described in the specification.

b. The listing of a manufacturer as "acceptable" does not imply automatic approval. It is the sole responsibility of the electrical contractor to ensure that any price quotations received, and submittals made are for products/systems that meet or exceed the specifications included herein.

2. Materials

a. MI cables and components shall not contribute to flame or smoke spread and shall not generate toxic, hazardous or flammable products when subjected to the UL 2196 fire test. Cables shall maintain complete circuit integrity when subjected to a 100 psi, 2-1/2 inch hose stream at the end of the UL 2196 fire test without the loss of any phase, neutral, equipment grounding conductor while under full load.

b. Manufacturer’s MI cable compressive strength testing shall yield 80,000 psi minimum to 120,000 psi before circuit failure while under full load.

c. MI Cable and components shall be as follows:

1) Conductors: Copper

2) Insulation Voltage Rating: 600 volts

3) Cable Temperature Rating: 75 deg C application, 90 deg C maximum

4) Termination Temp. Rating: 75 deg C application, 105 deg C maximum

5) Insulation Material: Inorganic magnesium oxide refractory mineral.

6) Metal-sheath Material: Seamless soft-drawn copper.

7) Fire Rating: 2-hour fire rating, completed cable assembly

8) Overjacket: None, except PVC where directly buried.

9) Cable Sheath Marking: Conductor size, voltage, and UL fire resistive classification number.

10) Cable Termination:

a) Conductors No. 10 AWG and smaller – Tyco Thermal Controls / Pyrotenax Model Pyro-Pak Installation Sheet 545.

b) Conductors No. 8 AWG and larger – Tyco Thermal Controls / Pyrotenax Model Quick-Term Installation Sheet 638.

11) Cable Splice: Tyco Thermal Controls / Pyrotenax Model Installation Sheet 550

12) Supporting Hardware: As approved by MI cable manufacturer.]

2.4 CONNECTORS AND SPLICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of 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 indicated.

C. Copper: All No. 6 AWG and larger copper conductors shall be connected with bolt-on compression connectors by Thomas & Betts (or approved equal) sized as required by codes and specifically intended to connect copper wire and cable to panelboards, substations, disconnect switches, and other equipment. Install with hydraulic crimping tool as required by manufacturer's recommendations, to ensure permanent high conductivity connection.

1. Terminations: Thomas & Betts Series 54200 (or approved equal) two hole connectors shall be used. Exceptions are as follows:

a. Where equipment or device cannot be provided by the manufacturer to accept two hole connectors, T&B Series 54100 (or approved equal) single hole connectors with anti-rotation lug or restraint shall be used.

b. Where equipment or devices cannot be provided by the manufacturer to accept either two-hole or single hole compression connectors, set screw type connectors may be submitted. For a set screw connector to be considered by the Engineer, the manufacturer shall provide deviation with his/her equipment submittals that his/her equipment will not accommodate

the required compression connectors. See Division 20 for deviation requirements.

2. Copper to Copper Splices, if allowed, shall be with T&B Series 54500 (or approved equal) compression connectors.

3. Tapping of Copper Conductors shall be with T&B Series 54700 (or approved equal) compression taps.

4. All No. 8 AWG and smaller solid conductors shall be spliced with pre-insulated spring connectors. Connectors shall be Skotch-lok, or Buchanan B-Cap.

5. For NEC Class 1, 2 or 3 wiring, No. 10 AWG and smaller stranded conductors and terminated with AMP, Inc. “PIDG”, UL listed premium grade insulated compression fork connectors or approved equal and shall be spliced in a junction box with AMP, Inc. “Plastic-Grip” UL listed, standard grade insulated butt splices or approved equal. All motor branch circuit conductors terminating at the motor termination box shall be spliced with compression type connectors.

2.5 CABLE SUPPORTS

A. Available Manufacturers:

1. The design is based on O.Z./Gedney to establish standards of quality for materials and performance. The naming of a specific manufacturer or catalog number does not waive any requirements or performance of individual components described in the specification.

2. Acceptable alternate manufacturers are Cross Hinds or Kellem.

B. 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.

C. Provide split wedge cable supports with clamps for cable without metallic sheath. Provide basket weave or approved equal cable supports approved by cable manufacturer for cable with metallic sheath.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Stranded Copper.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

C. VFD to motor Wiring

1. Ampacity of input wiring to VFDs shall be at least 125 percent of the VFD input rating.

2. Wiring from variable frequency drive output to the motor terminals, shall be in grounded metallic conduit, or a specialty multi conductor cable specifically designed for VFD applications.

3. VFD rated cable shall be used for 15 Hp, three phase, 480V AC or 208V AC motors and above, when used in conjunction with a VFD.

3.2 CONDUCTOR INSULATION AND MULTI-CONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type XHHW, single conductors in raceway.

B. Exposed Feeders: Type THHN-THWN, single conductors in raceway .

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-THWN, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.

E. Exposed Branch Circuits, Including in Crawlspaces: Type THHN-THWN, single conductors in raceway.

F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway or Metal-clad cable, Type MC Mineral-insulated, metal-sheathed cable where specifically allowed.

G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.

H. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

I. Class 1 Control Circuits: Type THHN-THWN, in raceway.

J. Class 2 Control Circuits: Type THHN-THWN, in raceway.

3.3 INSTALLATION OF CONDUCTORS

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. 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.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Division 26.

F. Identify and color-code conductors and cables according to Division 26.

G. Provide cable supports and boxes for vertical feeders as required by NEC.

H. Wire from point of service connection to receptacles, lighting fixtures, devices, equipment, outlets for future extension, and other electrical apparatus as shown on Drawings. Provide slack wire for connections. Tape ends of wires and provide blank covers for outlet boxes designated for future use. Mark future conductors as such with panel and circuit designation.

I. Conductors No. 10 and smaller in branch circuit panelboards, signal cabinets, signal control boards, switchboards and motor control centers shall be bundled. Conductors larger than No. 10 in switchboards, motor control centers and pull boxes shall be cabled in individual circuits.

J. Two or more conduits installed instead of single conduit shall contain duplicate conductors, including neutrals and ground conductors where required; total capacity of duplicate conductors shall be at least equal to capacity of conductors replaced.

K. Follow homerun circuit numbers shown on Drawings to connect circuits to panelboards. Where homerun circuit numbers are not shown on Drawings, divide similar types of connected loads among phase buses so that currents are approximately equal in normal usage. Connect each branch circuit homerun with two or more circuits to circuit breaker or switch in three-wire or four-wire branch circuit panelboard so that no two circuits are fed from same bus. Where panelboard cabinets are recessed, provide conduits with sufficient capacity for future conductors for spare branch circuit protective devices and spaces in panelboard; stub up concealed to junction box. Provide extensions above ceiling.

L. Where conductors have been oversized for voltage drop provide reducers on feeders and branch circuits to accommodate wire size at terminations.

M. Conductors entering panels, junction boxes, equipment cabinets, etc. shall be neatly formed, laced and supported around the equipment or devices. Adhesive glues or tapes shall not be used to support conductors.

3.4 MULTI-CONDUCTOR CABLE APPLICATIONS AND WIRING METHODS:

A. Uses Permitted

1. Branch circuit conductors in EMT shall be provided to a junction box located above the ceiling in the room that the branch circuit serves. MC cable shall be permitted from this junction box for lighting fixtures, lighting control devices, general use receptacles and for other similar 20A branch circuits where run concealed above ceilings or within a wall or partition.

B. Uses not permitted

1. Branch circuit homerun from panelboard.
2. Feeders.
3. In open spaces such as finished areas.
4. Underground or embedded within concrete.
5. Where subject to physical damage.
6. Where exposed at “floating” or hung ceilings.

C. MC Cable Management:

1. Electric Rooms and Electric Closets:
   a. Provide cable tray for MC cable management within electric rooms and electric closets.
2. Other than Electric Rooms and Electric Closets:
   a. At a minimum provide independent Unistrut support for MC cables
      1) Supports shall be installed such that MC cable length is free of sags.
   b. Where more than eight MC cables are bundled together, provide cable tray for MC cable management.
   c. Contractor shall develop cable management plans for review with Owner, Architect, and Engineer indicating:
      1) Locations of rigid raceway
      2) Locations of MC cable including:
         a) Locations of cable tray for MC cable management
         b) Indicate locations where field conditions cannot accommodate cable tray.
         c) Where cable tray is not required or cannot be installed due to field conditions, indicate method of support such as Unistrut, hanger support etc.
   d. Metal clad cable shall be secured using mechanical fasteners. Tie wraps shall not be used to secure cables unless installed in cable tray.

3.5 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

D. No modifications to any connector or fitting shall be permitted.

E. The approved connector manufacturer's recommended installation tool and procedures shall be used.

F. Water chilling unit motor terminations shall be made with compression connectors, which accommodate the conductor size indicated on the Drawings and have a hole size to fit the water chilling unit motor connection stud. Subcontractor shall coordinate the compression connector with the water chilling unit manufacturer’s termination requirements. Field modification to the compression lug or the motor stud will not be permitted.

G. All bolt and screw connections shall be torqued in accordance with the manufacturer's recommendations. Subcontractor shall include a copy of the manufacturer's recommendations with all applicable submittals.

H. Where conductors are oversized for voltage drop, provide cable reducing adapters for cable terminations. Cable reducers shall be manufactured by Greaves or equal.

I. All exterior wiring connections, and those made at or below grade shall be waterproof with UL listed waterproof connectors.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors, and conductors feeding critical equipment and services for compliance with requirements.

2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

C. Test Reports: Prepare a written report to record the following:

1. Test procedures used.

2. Test results that comply with requirements.

3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

D. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Certain requirements common to all the mechanical and electrical trades (Fire Suppression, Plumbing, HVAC, Electrical, and Tele/Data) are specified in Division 20. To avoid repetition, they are not repeated in each relevant Division and Section. However, these requirements are applicable to the work of this Section and are hereby incorporated by reference.

B. 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 methods and materials for grounding systems and equipment.

B. Equipment grounding system shall be designed so metallic structures, enclosures, raceways, cable tray, junction boxes, outlet boxes, cabinets, machine frames, portable equipment and other conductive items in close proximity with electrical circuits operate continuously and ground potential and provide low impedance path for possible ground fault currents.

1.3 REFERENCES

A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form part of this specification to the extent referenced. Publications are referenced in the text by the basic designations only.

1. NFPA 70 National Electrical Code
2. UL 467 Grounding and Bonding Equipment
3. UL 486A Wire Connectors and Soldering Lugs for Use with Copper Conductors
4. IEEE/ANSI 142 Latest Edition Recommended Practice for Grounding of Industrial and Commercial Power Systems
5. IEEE 837 Standard for Qualifying Permanent Connections Used in Substation Grounding
6. ASTM B3 Solid Conductors
7. ASTM B8 Assembly of Stranded Conductors
8. ASTM B33 Tinned Conductors

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in Part 3 "Field Quality Control" Article, including the following:

1. Grounding arrangements and connections for separately derived systems.

C. Qualification Data: For testing agency and testing agency's field supervisor.

D. Field quality-control test reports that include the following.

1. Test procedures used.

2. Test results that comply with the requirements.

3. If applicable, results of failed tests and corrective action taken to achieve test results that comply with the requirements.

E. Operation and Maintenance Data: For grounding to include the following in emergency, operation, and maintenance manuals:

1. Instructions for periodic testing and inspection of grounding features at grounding connections for separately derived systems based on NETA MTS.

a. Tests shall be to determine if ground resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if they do not.

b. Include recommended testing intervals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Feeder and Branch Circuit Equipment Ground Conductors: Copper stranded conforming to ASTM B8 and B33 wire or cable insulated for 600 V sized as shown on drawings, specifications or as required by NFPA 70, whichever is larger. Insulation class other than 600V shall only be provided where otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Grounding Electrode Conductors: Bare, stranded cable of size shown on drawings, specifications or as required by NFPA 70, whichever is larger.

1. Stranded Conductors: ASTM B 8.

2. Solid Conductors: ASTM B 3.

C. Grounding Bus: Provide ground bus where specified and required.

1. Grounding Bus Material: Rectangular bars of bare copper, (1/4 by 2 inches in cross section, minimum 24 inch length unless otherwise indicated; with insulated standoffs and stainless steel fasteners.

2. Ground Bus shall be UL 467 listed.

3. Field modification or cut bus shall not be acceptable.

2.2 CONNECTORS

A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

B. Mechanical Connectors: Provide mechanical connectors of the two bolt type, listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

1. Pipe Connectors: Clamp type, sized for pipe.

2. Materials: The mechanical connector bodies shall be manufactured from high strength, high conductivity cast copper alloy material. Bolts, nuts, washers and lockwashers shall be made of Silicon Bronze and supplied as a part of the connector body and shall be of the two bolted pressure type. Split bolt connector types shall NOT be accepted.

3. The connectors shall meet or exceed UL 467 and be clearly marked with the catalog number, conductor size and manufacturer.

C. Compression Connectors: Provide compression connectors that meet or exceed the performance requirements of IEEE 837, latest revision. Compression connectors shall be listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

1. Materials: The compression connectors shall be manufactured from pure wrought copper. The conductivity of this material shall be no less than 99% by IACS standards.

a. The installation of the connectors shall be made with a compression tool and die system as recommended by the manufacturer of the connectors.

b. The connectors shall be clearly marked with the manufacturer, catalog number, conductor size and the required compressions tool settings.

c. Each connector shall be factory filled with an oxide-inhibiting compound.

D. Welded Connectors: Provide exothermic connections for copper to copper and copper to steel connections to ground rods, ground buses, ground wires, steel beams, rebar, etc.

1. The supplier of the equipment shall provide with no additional charge and information or supervision required for the proper installation of the equipment and training of operating personnel

2. Materials: Conductors spliced with an exothermic welded connection shall be considered as a continuous conductor, as stated in the notes accompanying NEC articles 250.50, 250.64 and IEEE Standard 80 (latest edition).
   a. Procedures outlined in the Manufacturer's installation instruction shall be followed. Molds shall not be modified during installation in field applications.
   b. Weld metal shall be a mixture of copper oxide and aluminum. Only one weld metal mixture shall be required for each grounding connection.
   c. Grounding connections shall be tested and certified in accordance with IEEE 837, UL 486A and UL 467.
3. All exothermic Connections shall:
   a. Prove to carry more current than the conductor.
   b. Not deteriorate during the life of the connection.
   c. Will not loosen or corrode during the life of the connection.
   d. Resist repeated fault currents without failure.
   e. Be of high visually discerned quality.
   f. Eliminate electrolytic penetration of conductors (strands).

PART 3 - EXECUTION

3.1 GENERAL

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

B. Mechanical connections shall be accessible for inspection and checking. No insulation shall be installed over mechanical ground connections.

C. Ground connection surfaces shall be cleaned prior to connections.

D. Attach grounds permanently before building service is energized.

E. Provide bonding to meet Regulatory Requirements.

F. Examine raceway, equipment or area to receive grounding to provide adequate sizes, placement and materials for a complete installation.

G. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

H. Determine numbers and sizes of screw terminals for equipment grounding bars in panelboards and other electrical equipment. Provide screw terminals for active circuits, spares and spaces.

I. Provide equipment ground conductor in same raceway with associated phase conductors.

3.2 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.

B. Provide green insulated grounding conductor in nonmetallic conduits or ducts unless specified otherwise.

C. Transformers: Step down transformers secondary's shall be grounded to the building steel, if available, or the main building service ground.

D. Feeders: Bond all conduits carrying individual grounding or grounding electrode conductors with grounding bushing to ground bus in panel with a copper grounding conductor sized per NEC 250.102 (D). Where a panel such as a distribution panel has multiple feeders, a common ground conductor is permitted to be run from ground bushing to ground bushing and then to ground bus in panel.

E. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus on insulated spacers 1 inch, minimum, from wall 6 inches above finished floor, unless otherwise indicated.

2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, down to specified height above floor, and connect to horizontal bus.

F. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.

2. Underground Connections: Welded connectors, except at test wells and as otherwise indicated.

3. Connections to Ground Rods at Test Wells: Bolted connectors.

4. Connections to Structural Steel: Welded connectors.

3.3 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits. Terminate each end on suitable lug, bus, enclosure or bushing, per NEC. Provide a ground wire from each device to the respective enclosure.

B. Install equipment ground conductor in common conduit with related phase or neutral conductors, or both. Parallel feeders installed in more than one raceway shall have individual full size green insulated equipment ground conductors.

C. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.

2. Lighting circuits.

3. Receptacle circuits.

4. Single-phase motor and appliance branch circuits.

5. Three-phase motor and appliance branch circuits.
6. Flexible raceway runs.
7. Armored and metal-clad cable runs.

D. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

E. Water Heater and Heat-Tracing Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

F. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.

1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch grounding bus.
2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
3. All riser ground wire connections to ground bus shall be exothermic. All equipment ground connections to ground bus shall be mechanical connectors.
4. Use minimum No. 6 AWG copper conductor, or as indicated on the plans, for communications system grounding conductor.

3.4 MEDIUM VOLTAGE SYSTEM GROUNDING

A. General

1. Provide insulated grounding conductor in nonmetallic conduits or ducts unless specified otherwise.
2. Bond all conduits containing medium voltage conductors or secondary service conductors penetrated enclosures using grounding bushing and No. 4 AWG copper conductor. Attach to penetrated enclosures using grounding bushing and No. 4 AWG copper conductor. Attach to penetrated enclosure using compression lug on stud or bolt and Belleville washers.
3. Bond all conduits carrying individual grounding or grounding electrode conductors with grounding bushing and separate No. 4 AWG copper grounding conductor to ground bus.

B. Equipment Ground Conductor

1. Provide full size 600V copper THW, THHN, THWN or XHHW grounding conductor in each conduit, raceway or enclosure which contains medium voltage conductors. Terminate at ground bus of equipment containing medium voltage terminations. Connect to ground rod and present grounding conductors in manhole.

C. Shield Ground

1. Provide No. 10 AWG stranded wire from each termination shield drain wire to ground bus within enclosure. Connect to nearest grounded conductor if ground bus is not within 24 inches. Route shield drains away from energized parts. Make connections with “Sta-Kon” type terminals or tool applied tap connectors.

3.5 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. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.

2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.

3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.

C. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.

3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

3.6 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:

1. Visual inspection of all systems, raceway and equipment grounds shall be made to determine the adequacy and integrity of the grounding. All ground testing results shall be properly recorded, witnessed, and reported to the Contractor.

2. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.

3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal. Make tests at ground rods before any conductors are connected.

a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.

4. Where ground test results indicate the need for additional grounding conductors or rods that are not indicated on drawings or specified, design changes will be initiated to obtain the acceptable values. The Subcontractor is responsible for the proper installation of the grounding shown on drawings or specified and for the correction of improper installations as determined by inspections and tests.

5. Prepare dimensioned drawings locating each grounding electrode. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

B. Grounding system resistance shall be 10 ohms or less.

C. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.

2. Substations and Pad-Mounted Equipment: 5 ohms.

D. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Certain requirements common to all the mechanical and electrical trades (Fire Suppression, Plumbing, HVAC, Electrical, and Tele/Data) are specified in Division 20. To avoid repetition, they are not repeated in each relevant Division of the Specifications. However, these requirements are applicable to the work of this Division, and are hereby incorporated by reference.

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

1.2 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Steel slotted support systems.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:

1. Trapeze hangers. Include Product Data for components.
2. Steel slotted channel systems. Include Product Data for components.
3. Equipment supports.

C. Welding certificates.

1.6 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Comply with NFPA 70.

1.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allied Tube & Conduit.
b. Cooper B-Line, Inc.; a division of Cooper Industries.
c. ERICO International Corporation.
d. GS Metals Corp.
e. Thomas & Betts Corporation.
f. Unistrut; Tyco International, Ltd.
g. Wesanco, Inc.

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
3. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      1) Hilti Inc.

      2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.

      3) MKT Fastening, LLC.

      4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.

2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      1) Cooper B-Line, Inc.; a division of Cooper Industries.

      2) Empire Tool and Manufacturing Co., Inc.

      3) Hilti Inc.

      4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.

      5) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.

4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.

5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.

6. Toggle Bolts: All-steel springhead type.

7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Division 05 for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where its Table 1 lists maximum spacings less than stated in NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slottedsupport system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with two-bolt conduit clamps.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.

2. To New Concrete: Bolt to concrete inserts.

3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.

4. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.

5. To Light Steel: Sheet metal screws.

6. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

D. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Division 05 for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03.

C. Anchor equipment to concrete base.

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.

3.5 PAINTING

A. Touchup: Comply with requirements in Division 09 for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Certain requirements common to all the mechanical and electrical trades (Fire Suppression, Plumbing, HVAC, Electrical, and Tele/Data) are specified in Division 20. To avoid repetition, they are not repeated in each relevant Division of the Specifications. However, these requirements are applicable to the work of this Division, and are hereby incorporated by reference.

B. 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:

1. Metal conduit and tubing
2. Non-metallic conduit and tubing
3. Metal wireways
4. Boxes, enclosures, and cabinets

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. RGS: Rigid Steel Conduit.

C. EPDM: Ethylene-propylene-diene terpolymer rubber.

D. FMC: Flexible metal conduit.

E. LFMC: Liquid tight flexible metal conduit.

F. LFNC: Liquid tight flexible nonmetallic conduit.

G. NBR: Acrylonitrile-butadiene rubber.

H. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.

1. Custom enclosures and cabinets.

C. Coordination Drawings: Conduit routing 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. Structural members in the paths of conduit groups with common supports.

2. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.

D. Manufacturer Seismic Qualification Certification: Submit certification that enclosures and cabinets and their mounting provisions, including those for internal components, will withstand seismic forces defined in Division 26. Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the cabinet or enclosure will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will retain its enclosure characteristics, including its interior accessibility, after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Source quality-control test reports.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:

1. Allied Tube & Conduit; a Tyco International Ltd. Co.

2. Wheatland Tube Company.

3. O-Z Gedney; a unit of General Signal.

4. AFC Cable Systems, Inc.

5. Greenfield.

6. Anamet Electrical, Inc.; Anaconda Metal Hose.

7. Electri-Flex Co.

8. Permacote.
9. Robroy.

B. Rigid Steel Conduit: ANSI C80.1; zinc-coated steel.

C. EMT: ANSI C80.3; zinc-coated steel.

D. FMC: Spiral wrapped zinc-coated steel with insulated throats.

E. LFMC: Highly flexible, hot-dipped galvanized steel conduit with PVC jacket with insulated throats.

F. Fittings for Conduit (Including all Types and Flexible and Liquid tight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.

1. RSC: Threaded steel insulated bushings and throats. Locknuts shall be steel/zinc plated.

2. EMT: Steel, set-screw or compression type with insulated bushings and throats.

G. Combination Expansion/Deflection Fittings

1. Fittings shall be threaded, hot dipped galvanized malleable iron or steel with internal bonding jumper.

2. Fittings shall include bonding jumper, insulated bushing and short nipple.

H. Sealing Fittings

1. Threaded sealing fittings for rigid steel conduits shall be zinc- or cadmium-coated, cast or malleable iron; sealing fittings for aluminum conduit shall be threaded cast aluminum. Fittings that prevent passage of water vapor shall be continuous drain.

2. Sealing fittings shall be filled with a UL listed sealing compound.

I. Cable Terminators

1. Provide cable terminator assemblies by O-Z/Gedney or equal.

2. Assemblies shall have bakelite discs, neoprene rings and sealing compound within a fitting for attachment to raceway.

J. Joint Compound for Rigid Steel Conduit: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 NONMETALLIC CONDUIT AND TUBING

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:

1. Carlon Electrical Products.

2. CANTEX Inc.
3. Electri-Flex Co.
4. RACO; a Hubbell Company.
5. Thomas & Betts Corporation.

B. RNC: NEMA TC 2, Type EPC-40-PVC, and Type EPC-80-PVC, unless otherwise indicated. Conduit shall be 100% virgin polyvinyl chloride (PVC), 90°C UL-rated that conforms to industry standards. Conduit, fittings and solvent cement shall be approved by raceway manufacturer to assure system integrity. Material shall have minimum tensile strength of 5,000-6,500 psi at 73.4 deg. F, minimum flexural strength of 12,500 psi, and minimum compressive strength of 9,000 psi.LFNC: UL 1660.

C. Fittings for RNC: NEMA TC 3; match to conduit or tubing type and material.

D. Fittings for LFNC: UL 514B.

2.3 METAL WIREWAYS

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. Cooper B-Line, Inc.
2. Hoffman.
3. Square D; Schneider Electric.

B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1, unless otherwise indicated.

C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Hinged type.

E. Finish: Manufacturer's standard enamel finish.

2.4 SURFACE RACEWAYS

A. Surface Metal Raceways: Aluminum with snap-fit covers. Manufacturer's standard clear anodized finish.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Wiremold Company.
b. Hubbell Wiring Systems.
c. Mono-Systems, Inc.

2.5 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. EGS/Appleton Electric.
3. Erickson Electrical Equipment Company.
4. Hoffman.
5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
6. O-Z/Gedney; a unit of General Signal.
7. RACO; a Hubbell Company.
8. Robroy Industries, Inc.; Enclosure Division.
9. Scott Fetzer Co.; Adalet Division.
10. Spring City Electrical Manufacturing Company.
11. Thomas & Betts Corporation.
12. Walker Systems, Inc.; Wiremold Company (The).
13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, aluminum, Type FD, with gasketed cover.

D. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

E. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.

F. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

G. Cabinets:

1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:

1. Exposed Conduit: Rigid steel conduit
2. Concealed Conduit, Aboveground: Rigid steel conduit.
3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
4. Device boxes, Aboveground: Cast metal.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Comply with the following indoor applications, unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage within Mechanical, Electrical and unfinished areas defined by architect: EMT.
2. Exposed and Subject to Severe Physical Damage: Rigid steel conduit with cast metal device boxes. Includes raceways in the following locations:
   a. Loading docks.
   b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
   c. Mechanical and Electrical rooms, below 10’-0” AFF.
3. Underground Below Slab on Grade Conduit: RNC, Type EPC-40-PVC, direct buried.
4. Underground Below Slab on Grade, under areas of structural loading: RNC, Type EPC- 80-PVC, if approved by local authorities.
5. Concealed in Ceilings and Interior Walls and Partitions: EMT.
6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
7. Damp or Wet Locations: Rigid steel conduit with cast metal device boxes.
8. Raceways for Optical Fiber or Communications Cable in Spaces Used for Environmental Air: EMT.
9. Raceways for Optical Fiber or Communications Cable Risers in Vertical Shafts: EMT.
10. Raceways for Concealed General Purpose Distribution of Optical Fiber or Communications Cable: EMT.
11. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations.

C. Raceways Installed Within Slabs (where approved by Project Structural Engineer)

1. Feeders, branch circuits and low voltage system: RNC, Type EPC-40-PVC.

2. Penetrations from concrete slabs and elbows shall be made with galvanized RSC and RSC fittings only.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.

3.2 RACEWAY INSTALLATION

A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

B. General

1. Check raceway sizes to determine that green equipment ground conductor fits in same raceway with phase and neutral conductors to meet NEC percentage of fill requirements. Increase duct, conduit, tubing and raceway sizes shown or specified as required to accommodate conductors.

2. Install raceway systems complete before drawing in conductors. Blow through and swab after plaster is finished and dry, and before conductors are installed. Wire shall not be pulled into raceway until building roof and walls are weather-tight.

3. Install connectors and couplings as recommended by manufacturers. Compression fittings shall not be used with rigid steel conduit. Set screw fittings shall not be used with rigid conduit. Set-screw connectors for EMT shall be tightened to embed screws in conduit.

4. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200 lb. Tensile strength. Provide at least 12” of slack at each end of pull wire with labels.

5. Galvanized rigid steel conduit installed in corrosive environments shall have all field cut threads coated with an approved, electrically conductive, corrosion resistant compound so that the current carrying ability of the conduit is not compromised.

6. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.

7. Penetrate waterproof walls of structural slabs and foundation walls only where approved by Construction Manager. Submit proposed penetration points, size openings and penetration methods to Construction Manager for approval.

8. All conduit penetrations through exterior foundation walls shall be sealed. Provide sealing assemblies between conduit and sleeve. Provide cable terminators in conduit for cable seal. Provide appropriate sleeve through wall for conduit required. Assembly shall be tightened to seal out water.

9. Raceways shall be installed in such a way as to not block exit and equipment service space. Raceway on or adjacent to equipment shall be located to allow free access to all removable panels and equipment service.

10. Minimum Raceway Size: 3/4-inch trade size.

11. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

12. Complete raceway installation before starting conductor installation.

C. Support raceways as specified in Division 26.

D. Raceways Installed Underground Below Slab on Grade

1. Raceways shall be located on undisturbed earth. Where the earth has been disturbed or is of poor quality excavate a trench to proper subgrade elevation. Place bedding material and compact trench bottom.

2. Stagger conduit couplings so that couplings on adjacent conduits do not lie in same transverse plane. Provide conduit spacers every five feet.

3. Elbows transitioning from underground to exposed shall be galvanized RSC. Provide appropriate transition fittings.

4. Connections between conduits of different types shall be made in approved manner, using adapters and other materials and methods recommended by conduit manufacturers.

5. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

E. Install no more than the equivalent of four 90-degree bends in any conduit run except for communications conduits, for which two 90-degree bends are allowed.

F. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

G. 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.

H. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.

I. Terminations

1. Raceway shall enter and be secured to cabinet, junction box, pull box or outlet box with locknut outside and bushing inside, or with liquid-tight, threaded, self-locking, cold-weld wedge adapter.

2. Provide additional locknut for rigid conduit and wrench- tighten locknut for EMT or flexible conduit where circuit voltage exceeds 250 V. Locknuts and bushings or self-locking adapters will not be required where conduits are screwed into tapped connections.

3. Vertical conduit runs that terminate in bottoms of wall boxes or cabinets shall be protected from entrance of foreign material before installation of conductors.

4. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

5. Provide insulated bushings on raceways entering all panels, switchboards, motor controllers, VFDs, etc. and all boxes 12” x 12” and larger to protect conductors.

J. Raceways for Optical Fiber and Communications Cable:

1. 3/4-Inch Trade Size and Smaller: Install raceways in maximum lengths of 50 feet.

2. 1-Inch Trade Size and Larger: Install raceways in maximum lengths of 75 feet.

3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.

K. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.

2. In garages, loading docks and other areas in which flammable gases or vapors may be present to prevent transmission of gases or vapors through conduits.

3. Where otherwise required by NFPA 70.

L. Expansion/Deflection Fittings

1. Raceway buried or secured rigidly on opposite sides of building expansion joints and long runs of exposed raceway subject to stress due to thermal expansion shall have expansion/deflection fittings. Fittings shall safely deflect and expand to twice distance of structural movement.

2. Provide separate external copper bonding jumper secured with grounding straps on each end of fitting, when integral ground is not provided.

3. Raceways buried in concrete shall cross building expansion joints at right angles; provide expansion fittings as required by manufacturer's instructions. Provide insulated bushings at ends of raceways.

4. Coordinate location of expansion/deflection fittings with the structural and architectural drawings.

M. Expansion-Joint Fittings for RNC: Install in each run of aboveground conduit that is located where environmental temperature change may exceed 30 deg F, and that has straight-run length that exceeds 25 feet.

1. Install expansion-joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location:

   a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.

   b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.

   c. Indoor Spaces: Connected with the Outdoors without Physical Separation: 125 deg F temperature change.

2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change.

3. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.

N. Flexible Conduit Connections: Use maximum of 72 inches of flexible conduit for recessed and semi-recessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.

2. Use LFMC in damp or wet locations not subject to severe physical damage.

O. 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.

P. Box installation:

1. Determine from the drawings and by actual field conditions, the exact location of each outlet. The outlet locations shall be modified from those shown to accommodate changes in door swings or to clear other interferences that may arise from job construction details, as well as modifications to center them within the room spaces. These modifications shall be made with no change in contract price and shall be a matter of job coordination that gets reflected on the as-built drawings.

2. Check these conditions throughout the entire job and notify the Architect/Engineer or discrepancies, as they may occur, to verify the modifications, if any, before proceeding with the installation.

3. Install boxes where indicated, in accordance with manufacturer's written instructions, guidelines and the applicable requirements of the NEC, local codes, the National Electrical Contractors Association's "Standard of Installation" and in accordance with recognized industry practices to ensure that products serve the intended function.

4. Coordinate location of boxes with millwork, counters, benches and back-splashes denoted on the Architectural and Electrical Drawings.

5. Coordinate box installation with electrical raceway and cable work, as necessary for proper interface.

6. Coordinate cutting of masonry walls and drywalls to achieve neat openings for boxes.

7. Provide all necessary hardware to secure boxes in place.

8. Sheet metal pull boxes shall be supported adequately to maintain shape. Larger boxes shall have structural steel bracing welded into rigid assembly formed adequately to maintain alignment in shipment and installation. Secure covers with corrosion-resistant screws or bolts.

9. Provide clamps, grids and other appurtenances to secure cables within pull boxes. No cable shall be unsupported for more than 30 inches.

10. Provide cable troughs of special shapes, design and construction required to install, support and enclose feeder cable throughout indicated routing. Troughs shall be as specified above for junction and pull boxes, with reinforcing, insulating supports and clamping for cable installation. Cables shall be continuous throughout troughs, and shall be racked in distributed phase groupings arranged with phase cables surrounding neutral conductors.

11. Location

    a. Do not install boxes back to back in same wall.

    b. For boxes mounted in exterior walls install insulation behind the box to prevent condensation in box.

    c. Mount boxes flush with wall in all areas unless noted otherwise on the drawings. Boxes in mechanical rooms may be surface mounted where flush mounting is not possible due to construction.

    d. Where boxes are positioned back to back on opposite sides of walls or partitions, and are less than 24 inches apart in wall cavities of fire rated partitions, provide firestop products suitable for the installation. Boxes shall not be installed on opposite side of walls or partitions of staggered stud construction unless a Wall Opening Protective Material is installed with the box in accordance with classification requirements for the protective materials.

    e. Junction and pull box covers shall be readily accessible. Do not install junction or pull boxes above suspended ceilings except where ceiling is removable or where access panel is provided.

    f. No pull box shall be within 2 feet of another.

g. Pull boxes connected to concealed conduits shall be mounted with covers flush with finished wall or ceiling. No aluminum pull box shall be embedded in concrete.

h. Location of boxes shall be verified with Architect prior to rough-in. Refer to architectural details and elevations.

12. Application

a. Provide weatherproof outlets for interior and exterior locations exposed to weather or moisture.

b. Junction or pull boxes exposed to rain or in wet locations shall be weatherproof.

c. Junction or pull boxes used with aluminum conduit shall be metal compatible with aluminum.

13. Painting

a. Exposed conduit, junction boxes and equipment back boxes shall be painted to be as inconspicuous as possible. The Design Professional shall approve the paint color selected. The Electrical Contractor shall prepare color samples for inspection by the Design Professional prior to painting.

3.3 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.

3.4 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.

END OF SECTION

SECTION 260548 - VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Certain requirements common to all the mechanical and electrical trades (Fire Suppression, Plumbing, HVAC, Electrical, and Tele/Data) are specified in Division 20. To avoid repetition, they are not repeated in each relevant Division of the Specifications. However, these requirements are applicable to the work of this Division, and are hereby incorporated by reference.

B. 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. Isolation pads.
2. Spring isolators.
3. Restrained spring isolators.
4. Channel support systems.
5. Restraint cables.
6. Hanger rod stiffeners.
7. Anchorage bushings and washers.

1.3 DEFINITIONS

A. The IBC: International Building Code.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:

1. Not required.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Restrained-Isolation Devices: Include ratings for horizontal, vertical, and combined loads.

B. Delegated-Design Submittal: For vibration isolation details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation.

a. Coordinate design calculations with wind-load calculations required for equipment mounted outdoors. Comply with requirements in other Division 26 Sections for equipment mounted outdoors.

2. Indicate materials and dimensions and identify hardware, including attachment and anchorage devices.

3. Field-fabricated supports.

C. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints.

D. Welding certificates.

E. Qualification Data: For professional engineer and testing agency.

F. Field quality-control test reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ace Mountings Co., Inc.

2. Amber/Booth Company, Inc.

3. California Dynamics Corporation.

4. Isolation Technology, Inc.

5. Kinetics Noise Control.

6. Mason Industries.

7. Vibration Eliminator Co., Inc.
8. Vibration Isolation.
9. Vibration Mountings & Controls, Inc.

B. Pads: Arrange in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.

1. Resilient Material: Oil- and water-resistant neoprene.

C. Spring Isolators: Freestanding, laterally stable, open-spring isolators.

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig.
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

D. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch- thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
2. Restraint: Seismic or limit-stop as required for equipment and authorities having jurisdiction.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.2 FACTORY FINISHES

A. Finish: Manufacturer's standard prime-coat finish ready for field painting.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.

2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless post-connection testing has been approved), and with at least seven days' advance notice.

3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.

4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.

5. Test to 90 percent of rated proof load of device.

6. Measure isolator restraint clearance.

7. Measure isolator deflection.

8. Verify snubber minimum clearances.

9. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

C. Remove and replace malfunctioning units and retest as specified above.

D. Prepare test and inspection reports.

3.4 ADJUSTING

A. Adjust isolators after isolated equipment is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust active height of spring isolators.

D. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.5 ELECTRICAL VIBRATION-CONTROL SCHEDULE

A. Supported or Suspended Equipment.

1. Generator.
2. Transformers.

END OF SECTION

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Certain requirements common to all the mechanical and electrical trades (Fire Suppression, Plumbing, HVAC, Electrical, and Tele/Data) are specified in Division 20. To avoid repetition, they are not repeated in each relevant Division of the Specifications. However, these requirements are applicable to the work of this Division, and are hereby incorporated by reference.

B. 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. Power raceway identification materials
2. Power and control cable identification materials
3. Conductor identification materials
4. Underground line warning tape
5. Warning labels and signs
6. Instruction signs
7. Equipment identification labels
8. Cable ties
9. Miscellaneous identification products

1.3 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

1.4 QUALITY ASSURANCE

A. Comply with ANSI A13.1 and IEEE C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 POWER RACEWAY IDENTIFICATION MATERIALS

A. Colors for Raceways Carrying Circuits at More Than 600 V:

1. Black letters on an orange field.
2. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch- high letters on 20-inch centers.

B. Self-Adhesive Vinyl Labels for Feeder Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

C. Tape and Stencil for Raceways Carrying Circuits More Than 600 V: 4-inch- wide black stripes on 10-inch centers diagonally over orange background that extends full length of raceway or duct and is 12 inches wide. Stop stripes at legends.

D. Write-On Tags: Polyester tag, 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.

1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

2.2 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

C. Write-On Tags: Polyester tag, 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.

1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

2.3 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

C. Write-On Tags: Polyester tag, 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.

1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

2.4 UNDERGROUND-LINE WARNING TAPE

A. Tape:

1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.

2. Printing on tape shall be permanent and shall not be damaged by burial operations.

3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing:

1. Comply with ANSI Z535.1 through ANSI Z535.5.

2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.

3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

2.5 TRACE WIRE

A. Per SUNY Binghamton University standards, all underground utilities require the use of Kris-Tech Wire Company #12 AWG PE-45 tracing wire 600V (UL) E-98017, color coded according to the American Public Works Association Uniform Color Code.

2.6 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. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."

D. Arc Flash Warning Label

1. Provide arc flash and electrocution hazard warning labels for switchgear, transformers, panelboards, motor starters, motor control centers, disconnect switches, and other locations as required by the NEC.

2. Warning labels shall comply with ANSI Z535.4 and the NEC. Labels shall be printed on self-adhesive polyester with pressure sensitive adhesive back and covered with a clear polyester film. Outdoor labels shall be suitable for high UV environment.

2.7 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.

1. Engraved legend with black letters on white face.

2. Punched or drilled for mechanical fasteners.

3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.8 EQUIPMENT IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

2.9 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch.

2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.

3. Temperature Range: Minus 40 to plus 185 deg F.

4. Color: Black except where used for color-coding.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch.

2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.

3. Temperature Range: Minus 40 to plus 185 deg F.

4. Color: Black.

C. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.

1. Minimum Width: 3/16 inch.

2. Tensile Strength at 73 deg F, According to ASTM D 638: 7000 psi.

3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F.
5. Color: Black.

2.10 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. 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.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

F. 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.

G. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.

3.2 IDENTIFICATION SCHEDULE

A. Concealed Raceways, Ductbanks, more than 600 V, within Buildings: Tape and stencil 4-inch- wide black stripes on 10-inch centers over orange background that extends full length of raceway or duct and is 12 inches wide. Stencil legend "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch- high black letters on 20-inch centers. Stop stripes at legends. Apply to the following finished surfaces:

1. Floor surface directly above conduits running beneath and within 12 inches of a floor that is in contact with earth or is framed above unexcavated space.

B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:

1. Emergency Power.

C. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.

a. Color shall be factory applied or field applied color coding conductor tape for sizes larger than No. 8 AWG.

b. Colors for 208/120-V Circuits:

1) Phase A: Black.

2) Phase B: Red.

3) Phase C: Blue.

c. Colors for 480/277-V Circuits:

1) Phase A: Brown.

2) Phase B: Orange.

3) Phase C: Yellow.

d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

D. Power-Circuit Conductor Identification, More than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use write-on tags.

E. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

F. Conductors to Be Extended in the Future: Attach write-on tags or marker tape to conductors and list source.

G. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.

2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.

3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

H. Locations of Underground Lines:

1. Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.

a. Install underground-line warning tape for both direct-buried cables and cables in raceway.

2. Install tracing wire for all underground utilities.
   a. Terminations at ends will be as directed by University personnel specify.
   b. Not required for streetlights.

I. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.
   1. Comply with 29 CFR 1910.145.
   2. Identify system voltage with black letters on an orange background.
   3. Apply to exterior of door, cover, or other access.
   4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
      a. Power transfer switches.
      b. Controls with external control power connections.

J. Panelboard Circuit Identification:
   1. For each panel provide typewritten directory of circuits that identifies the circuiting as well as breaker size. The directory shall be a full 8.5 inches x 11 inches sheet behind a plastic pocket that is secured to the panelboard.
   2. Panel directories shall identify the panel name, their source of power and voltage.
   3. Each circuit directory shall include load name and load location.
   4. In addition to the hard copy panel directory, the electrical contractor shall provide the electronic version in its native (word or excel) format as well as PDF format as part of the as-built documentation.

K. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
   1. Labeling Instructions:
      a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.
      b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
      c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
      d. Fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
   2. Equipment to Be Labeled:

a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be engraved, laminated acrylic or melamine label.

b. Enclosures and electrical cabinets.

c. Access doors and panels for concealed electrical items.

d. Switchgear.

e. Switchboards.

f. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.

g. Substations.

h. Emergency system boxes and enclosures.

i. Motor-control centers.

j. Enclosed switches.

k. Enclosed circuit breakers.

l. Enclosed controllers.

m. Variable-speed controllers.

n. Push-button stations.

o. Power transfer equipment.

p. Contactors.

q. Remote-controlled switches, dimmer modules, and control devices.

r. Battery-inverter units.

s. Battery racks.

t. Power-generating units.

u. Monitoring and control equipment.

v. UPS equipment.

w. Lighitng fixtures (label inside fixture and remote control location)

x. All junction boxes shall be labeled with circuit information and panelboard designation, marked on inside of cover in finished spaces, or on outside of cover in unfinished spaces.

END OF SECTION

SECTION 260573 - OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Certain requirements common to all the mechanical and electrical trades (Fire Suppression, Plumbing, HVAC, Electrical, and Tele/Data) are specified in Division 20. To avoid repetition, they are not repeated in each relevant Division and Section. However, these requirements are applicable to the work of this Section and are hereby incorporated by reference.

B. 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:

1. Computer software developers
2. Computer software program requirements

B. Computer-based, fault-current, overcurrent protective device coordination, and arc flash hazard studies. Protective devices shall be set based on results of the protective device coordination and arc flash hazard study.

C. The studies shall be submitted to the Design Engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment for manufacture. If formal completion of the studies may cause delay in equipment manufacture, approval from the Engineer may be obtained for a preliminary submittal of sufficient study data to ensure that the selection of device ratings and characteristics will be satisfactory.

D. The studies shall include all portions of the electrical distribution system (i.e., panels, motors 10 HP and larger, VFDs, disconnects 100A and larger, etc.) from the power source or sources down to and including the smallest adjustable trip circuit breaker in the distribution system. Normal system operating connections and those which result in maximum fault conditions, such as paralleled service, shall be adequately covered in the study.

1. The power source shall be the connection to the existing 15kV source including the upstream distribution breaker settings and the existing 480V generators.

E. Overcurrent protective devices in distribution equipment associated with Article 700, 701, and 708 of NFPA 70 are required to be selectively coordinated. The coordination study must include confirmation that equipment provided serving those systems are selectively coordinated in accordance with NFPA 70.

1.3 SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Product Certificates: For coordination-study and fault-current-study computer software programs, certifying compliance with IEEE 399.

C. Qualification Data: For coordination-study specialist.

D. Other Action Submittals: The following submittals shall be made after the approval process for system protective devices has been completed. Submittals shall be in digital form.

1. Coordination-study input data, including completed computer program input data sheets.
2. Study and Equipment Evaluation Reports.
3. Coordination-Study Report.
4. Short Circuit Report.
5. Arc Flash Analysis Report

E. Studies shall include the following outline:

1. Table of Contents
2. Executive Summary
3. Calculation methods and tabulations.
4. System input Data
5. One-line diagrams and impedance diagrams.
6. Results of the study.
7. Conclusions and recommendations.
8. Arc flash hazard

1.4 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.

B. Coordination-Study Specialist Qualifications: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. Professional engineer, licensed in the state where Project is located, shall be responsible for the study. All elements of the study shall be performed under the direct supervision and control of engineer.

C. Comply with IEEE 242 for short-circuit currents and coordination time intervals.

D. Comply with IEEE 399 for general study procedures.

E. As recommended in ANSI/NFPA 70B, Recommended Practice for Electrical Equipment Maintenance, short circuit studies and overcurrent protective device coordination studies should be performed when the facility electrical system is designed and these studies should be updated whenever a major modification or renovation takes place.

F. In addition, the protection of electrical systems against damage due to short circuit faults is required in NFPA 70, National Electric Code Sections 110.9 “Interrupting Rating” and 110.10 “Circuit Impedance and Other Characteristics.” Proper coordination of protective devices improves system reliability and prevents major blackouts by isolating short circuit faults with the protective device immediately on the source side of the fault. NFPA 70 and various IEEE standards contain requirements and suggested practices to coordinate electrical systems.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Basis-of-Design Product: Subject to compliance with requirements, utlize software from SKM Systems Analysis, Inc. or a comparable product by one of the following:

1. CGI CYME.
2. EDSA Micro Corporation.
3. ESA Inc.
4. Operation Technology, Inc.
5. SKM Systems Analysis, Inc.

2.2 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

A. Comply with IEEE 399.

B. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.

1. Optional Features:
   a. Calculating arcing fault is a requirement.
   b. Simultaneous faults.
   c. Explicit negative sequence.
   d. Mutual coupling in zero sequence.

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.

1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

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. The power system study analysis shall include existing equipment and system information for the equipment affected by the scope of work. Refer to the one line and riser diagrams for existing equipment.

3. Impedance of utility service entrance.

4. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:

a. Circuit-breaker and fuse-current ratings and types.

b. Relays and associated power and current transformer ratings and ratios.

c. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.

d. Generator kilovolt amperes, size, voltage, and source impedance.

e. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.

f. Motor horsepower and code letter designation according to NEMA MG 1.

1) Individually model motors 10 hp and greater.

2) Where model motors less than 10 hp are fed from common distribution equipment, the motor horsepowers shall be combined into a single load.

5. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:

a. Special load considerations, including starting inrush currents and frequent starting and stopping.

b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.

c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.

d. Generator thermal-damage curve.

e. Ratings, types, and settings of utility company's overcurrent protective devices.

f. Special overcurrent protective device settings or types stipulated by utility company.

g. Time-current-characteristic curves of devices indicated to be coordinated.

h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.

i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.

j. Panelboards, switchboards, motor-control center ampacity, and interrupting rating in amperes rms symmetrical.

3.3 FAULT-CURRENT STUDY

A. Calculate the maximum available short-circuit current in amperes rms symmetrical at circuit-breaker positions of the electrical power distribution system. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at each of the following:

1. Switchgear and switchboard bus.
2. Motor-control center.
3. Distribution panelboard.
4. Branch circuit panelboard.

B. There are two levels of fault current to be studied as follows:

1. Level 1: Maximum fault current based on infinite bus and limited by the transformer impedance

   a. In the case of maximum fault current, the study shall be run using the nominal transformer impedance of 5.75%. Another study shall be run when the actual impedance is known upon delivery of the building transformer.

2. Level 2: Minimum fault current based on the actual available fault current.

C. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.

D. Calculate momentary and interrupting duties on the basis of maximum available fault current.

E. Include fault contribution of all motors 10 hp and above in the study. Variable frequency drives shall be included in the study.

F. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 141, IEEE 241, and IEEE 242.

1. Transformers:

a. IEEE C57.96.

2. Medium-Voltage Circuit Breakers: IEEE C37.010.

3. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1.

4. Low-Voltage Fuses: IEEE C37.46.

G. Study Report:

1. Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.

2. Show interrupting (5-cycle) and time-delayed currents (6 cycles and above) on medium-voltage breakers as needed to set relays and assess the sensitivity of overcurrent relays.

H. Equipment Evaluation Report:

1. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

2. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.

3. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

I. Note that Contract Documents indicate general requirements for equipment, etc., but additional specific characteristics of equipment furnished shall be determined in accordance with results of short circuit study.

1. Equipment design discrepancies and proposed corrective modifications, if required, shall be submitted with short circuit study with variations clearly noted on subsequent shop drawings.

3.4 COORDINATION STUDY

A. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.

1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.

2. Calculate the maximum and minimum interrupting duty (5 cycles to 2 seconds) short-circuit currents.

3. Calculate the maximum and minimum ground-fault currents.

B. Comply with IEEE 241 recommendations for fault currents and time intervals.

C. Provide a ground fault current study for the system, including the associated zero sequence impedance data. Include all adjustable settings for ground fault protective devices. Include manufacturing tolerance and damage bands in plotted fuse characteristics. For 480Y/277V volt systems a TCC curve shall be produced showing the coordination of a 20A single phase load with the ground fault settings of upstream breakers.

D. The studies shall include all portions of the electrical distribution system from the power source or sources down to and including the smallest adjustable trip circuit breaker in the distribution system. TCC curves shall be provided for each section of the distribution system that contains an adjustable setting.

E. 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.

F. 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.

G. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:

1. Tabular Format of Settings Selected for Overcurrent Protective Devices:

a. Device tag.

b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.

c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.

d. Fuse-current rating and type.

e. Ground-fault relay-pickup and time-delay settings.

2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility

company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:

a. Device tag.

b. Voltage and current ratio for curves.

c. Three-phase and single-phase damage points for each transformer.

d. No damage, melting, and clearing curves for fuses.

e. Cable damage curves.

f. Transformer inrush points.

g. Maximum fault-current cutoff point.

h. Motor starting curves.

H. Completed data sheets for setting of overcurrent protective devices.

3.5 ARC FLASH STUDY

A. Provide an electrical arc flash hazard analysis on the Facility to determine incident energy, arc flash protection boundaries, and required personal protection equipment (PPE) for all electrical equipment in the facility. The calculations shall comply with NFPA-70E 2004, and IEEE-1584-2002. Labels shall be provided for equipment modified as a result of the scope of work for this project.

1. Equipment shall include but not be limited to individually mounted disconnects, individually mounted circuit breakers, panelboards, HVAC equipment control panels operating at 240V or above, variable frequency drives, switchboards, switchgear, UPS units, automatic transfer switches, power distribution units, etc.

2. Equipment with multiple vertical sections such as switchboards, switchgear, multi-tab panels, etc. shall be provided with an arc flash label for each vertical section.

3. For equipment having multiple access points (front, rear, side) a label shall be provided at each side of access.

B. The purpose of this study is to provide a comprehensive software model of the Facility electrical distribution system, which will document facility compliance with NFPA 70E mandates as described below. This model will serve as an integral part of an ongoing safety program by providing integral work permits and arc flash calculations in compliance with NFPA-70E Article 130.1(A)(2) for each electrical equipment in the facility. The goal of this study shall be limit to arc flash incident energy to 8 calories per square centimeter or less at all locations. The study may require multiple iterations to achieve this goal by modifying settings and/or by suggesting different protective equipment. If required, the study report shall summarize and compare different scenarios where the arch flash goal maybe achieved. Consider the loss of coordination (only if not life safety) and equipment with different ratings or settings as possible ways to mitigate higher levels of incident energy.

C. The analysis and procedures shall comply with the following standards and recommended practices for power system studies.

1. NFPA-70E, 2012 Standard for Electrical Safety in the Workplace
2. IEEE-1584-2002
3. IEEE-242 “Buff Book” Protection and Coordination of Industrial Power Systems
4. IEEE-399 “Brown Book” Power System Analysis
5. IEEE-141 “Red Book” Electric Power Distribution for Industrial Plants

D. Method

1. A detailed arc flash study shall be performed to determine potential arc flash incident energies, arc flash boundaries, shock hazard boundaries and proper personal protective equipment (PPE) for all energized electrical system equipment tasks for the electrical system studied. The calculations shall comply with NFPA-70E 2004, and IEEE-1584. Bolted short circuit calculations used in the above standards shall comply with ANSI C37.010, C37.13, C37.5, IEEE-141, and IEEE-399. The purpose of this study is to determine arc flash hazards in conformance with NFPA-70E, and to provide a comprehensive software model of the electrical distribution system, which provides integral work permits and arc flash calculations in compliance with NFPA 70E Article 130.1(A)(2) for all equipment in the facility. The software program used in this study shall comply with the above standards. No substitutions in calculation methods will be allowed.
2. The arc flash study shall determine the following results. The results shall be provided in spreadsheet format for each mode and electrical system location to provide easy viewing and comparison. Worst-case arc flash energy levels shall be flagged and the spreadsheet comparison table shall be capable of providing its output directly to high quality vinyl label printers. The calculations shall, as a minimum, include a comparison of both 100% and 85% arcing currents for low voltage equipment for each electrical system configuration or operating mode, indicating worst-case arc flash hazards. The spreadsheet results shall include:
   a. Equipment name and voltage.
   b. Upstream equipment device name and ANSI function, i.e. 51/50, etc.
   c. Equipment type, i.e. switchgear, MCC, Panel, VFD, etc.
   d. Equipment arc gap.
   e. Bolted and estimated arcing fault current at the fault point (equipment) in symmetrical amperes. The estimated arcing current should be based on the arcing current equations used.
   f. Trip time, opening time, and total clearing time (total Arc time) of the protective device.
   g. Worst-case arc flash boundary for each bus/equipment in the model.
   h. Worst-case arc flash hazard incident energy in cal/cm2 for each bus/equipment in the model.

i. Worst-case personal protective equipment (PPE) for each bus/equipment in the model.

j. Working distances for up to five different distances showing items worst-case arc flash boundary, worst-case arc flash hazard incident energy, and worst-case personal protective equipment (PPE) for each distance.

k. Indicate “Danger/Hazardous” areas where incident energy is greater than 40 cal/cm2 and provide recommendations to reduced arc flash energy levels for these areas.

3. Flag results where 85% arcing current provided worst-case results.

4. Each mode of operation shall include a detailed write-up indicating areas where incident energy calculations and PPE requirements are higher than calculated in the normal operating mode.

5. The overcurrent protection trip delay time used in the arc flash evaluation study shall be the clearing time of the circuit breaker or 2 seconds, whichever is greater as recommended by IEEE 1584 (section B1).

E. Provide a detailed arc flash analysis report including as a minimum:

1. Introduction.

2. Methodology.

3. Information Sources.

4. Key Assumptions.

5. Arc Flash Energy and other consideration for various System Modes of Operation (maintenance mode, bus-tie, co-gen on/off, etc.).

6. Arc Energy at 100% and reduced currents.

7. IEEE 1584-2002 Considerations.

8. Overcurrent Protective Device Changes, Replacements or Setting Changes implemented in study to reduce arc flash hazard exposure.

9. Explanation of Data in Arc Flash Hazard Report Tables.

10. NFPA 70E Information.

11. Shock Hazards with covers removed.

12. Shock Hazard Approach Boundaries.

13. Limited Approach Boundary.

14. Restricted Approach Boundary.

15. Prohibited Approach Boundary.

16. Arc Flash Hazard Boundaries.

17. Results of Arc flash Hazard Analysis for high voltage, medium voltage and low voltage systems, including:

a. Working distances.

b. Energy Levels.

c. PPE Requirements.

d. Recommendations to reduce arc flash hazard energy and exposure. For equipment listed in category 3, category 4 and dangerous, verify if the breaker instantaneous setting can be reduced without compromising coordination. If after adjusting instantaneous settings, for equipment in the category 3, category 4 and dangerous provide a brief narrative explaining why the category is so high

e. Arc Flash Hazard Report.

f. Electronic Copy in Adobe Acrobat format (6.0 or later)

F. Provide and install print labels for all equipment in the system from the project study file. Assume three labels per equipment/bus using 4 inch x 6 inch labels or one 6 inch x 8 inch label per equipment bus. The labels shall be UV resistant vinyl labels (white with orange warning strip and black letters) conforming to ANSI-Z535. The labels shall be printable directly from the power system software utilized for the study. Labels shall include available fault current.

1. Transfer switches shall be provided with a label for each source.

2. Distribution equipment served from a generator shall be provided with a label for each source.

3. All controllers (i.e., starters, variable frequency drives, etc.) shall be provided with a label.

a. Self adhesive arc flash labels containing study result information. One label shall be provided for each piece of electrical distribution equipment including switchgear, switchboards, distribution panelboards, branch circuit panelboards, and disconnects. Label information shall include the following, at a minimum.

b. Name of Equipment

c. “Warning” or “Danger” reference as appropriate

d. Equipment Voltage Rating (Volts)

e. Limited Approach Boundary Distance (Inches)

f. Restricted Approach Boundary Distance (Inches)

g. Prohibited Approach Boundary Distance (Inches)

h. Flash Hazard Boundary (inches)

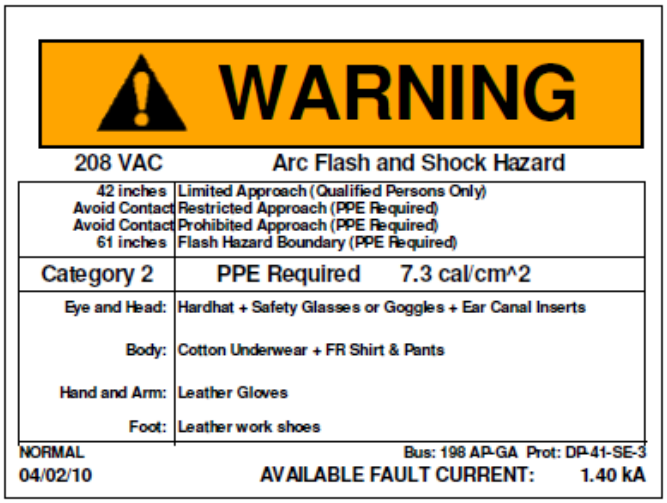
i. Arc Flash Hazard Category

j. Incident Energy (cal/cm^2)

k. Description of PPE for head, eye, body, hand/arm, and foot protection

l. Date of study

4. Refer to sample label below:



5. For equipment with arc reduction provide a second blue label that notes the arc reduction levels when using the arc flash reduction feature

3.6 ADJUSTMENTS, SETTINGS AND MODIFICATIONS

A. Provide necessary field settings, adjustments, minor modifications, for conformance with the study, without any additional cost to owner. Examples of minor modifications would be trip sizes within the same frame, the time curve characteristics of inductions relays, CT ranges, etc.

B. Proposed corrective modifications will be taken under advisement and the Construction Manager will be given further instructions.

END OF SECTION

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Certain requirements common to all the mechanical and electrical trades (Fire Suppression, Plumbing, HVAC, Electrical, and Tele/Data) are specified in Division 20. To avoid repetition, they are not repeated in each relevant Division and Section. However, these requirements are applicable to the work of this Section and are hereby incorporated by reference.

B. 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 lighting control devices:

1. Time switches.
2. Indoor occupancy sensors.
3. Outdoor motion sensors.
4. Lighting contactors.
5. Emergency shunt relays.

1.3 DEFINITIONS

A. LED: Light-emitting diode.

B. PIR: Passive infrared.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show installation details for occupancy and light-level sensors.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For each type of product 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.

1.6 COORDINATION

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 system, and partition assemblies.

PART 2 - PRODUCTS

2.1 TIME SWITCHES

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings: Wattstopper or a comparable product by one of the following:

1. Acuity nlight
2. Lutron Athena
3. Cooper Lighting Controls, ILC
4. Leviton
5. Crestron
6. TORK.

B. Electronic Time Switches: Electronic, solid-state programmable units with alphanumeric display; complying with UL 917.

1. Program: 2 on-off set points on a 24-hour schedule, allowing different set points for each day of the week and an annual holiday schedule that overrides the weekly operation on holidays].
2. Programs: additional programs to be determined during submittal review process.

2.2 OUTDOOR PHOTOELECTRIC SWITCHES

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. TORK.
2. Touch-Plate, Inc.
3. Watt Stopper (The)
4. Grasslin Controls Corporation; a GE Industrial Systems Company.
5. Lithonia Lighting; Acuity Lighting Group, Inc.
6. Novitas, Inc.
7. Paragon Electric Co.; Invensys Climate Controls.
8. Square D; Schneider Electric.
9. WattStopper.

B. Description: Solid state, with SPST dry contacts rated for 1800-VA tungsten or 1000-VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.

1. Light-Level Monitoring Range: 1.0 to 10 fc, with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of photocell to prevent fixed light sources from causing turn-off.

2. Time Delay: 15-second minimum, to prevent false operation.

3. Surge Protection: Metal-oxide varistor, complying with IEEE C62.41.1, IEEE C62.41.2, and IEEE 62.45 for Category A1 locations.

4. Mounting: Twist lock complying with IEEE C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.

2.3 INDOOR PHOTOELECTRIC SWITCHES

A. Basis of design for system is based on Wattstopper DLM system to establish standard of performance.

B. Acceptable Manufacturers: Subject to compliance with requirements and comparable product by one of the following

1. Acuity nlight

2. Lutron Athena

3. Cooper Lighting Controls, ILC

4. Leviton

5. Crestron

C. Ceiling-Mounted Photoelectric Switch: Solid-state, light-level sensor unit, with separate relay unit to detect changes in lighting levels that are perceived by the eye. Cadmium sulfide photoresistors are not acceptable.

1. Sensor Output: Contacts rated to operate the associated relay, complying with UL 773A. Sensor shall be powered from the relay unit.

2. Relay Unit: Dry contacts rated for 20A ballast load at 120- and 277-V ac, for 13A tungsten at 120-V ac, and for 1hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.

3. Light-Level Monitoring Range: 1 to 200 FCwith an adjustment for turn-on and turn-off levels within that range.

4. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling, with dead band adjustment.

5. Indicator: Two LEDs to indicate the beginning of on-off cycles.

2.4 INDOOR OCCUPANCY SENSORS

A. Basis of design for system is based on Wattstopper DLM system to establish standard of performance.

B. Acceptable Manufacturers: Subject to compliance with requirements and comparable product by one of the following

1. Acuity nlight
2. Lutron Athena
3. Cooper Lighting Controls, ILC
4. Leviton
5. Crestron

C. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.

1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
4. Mounting:
   a. Sensor: Suitable for mounting in any position on a standard outlet box.
   b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
   c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
6. Bypass Switch: Override the on function in case of sensor failure.
7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; keep lighting off when selected lighting level is present.
8. BAS Interface: Provide all sensors with an auxiliary contact to enable the BAS to monitor the occupancy sensor status within each room. Interface shall be in a separate junction box with the wires labeled.

D. Dual-Technology Type: Ceiling mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s

3. Detection Coverage: Detect occupancy anywhere within a circular area of 1000 sfwhen mounted on a 96-inch-high ceiling.
4. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sf when mounted on a 96-inch-high ceiling.
5. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sf when mounted on a 96-inch- high ceiling.
6. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sf when mounted on a 96-inch-high ceiling.
7. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet when mounted on a 10-foot-high ceiling in a corridor not wider than 14 feet.

2.5 LIGHTING CONTACTORS

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. Allen-Bradley/Rockwell Automation.
2. ASCO Power Technologies, LP; a division of Emerson Electric Co.
3. ABB-General Electric Industrial Systems; Total Lighting Control.
4. Grasslin Controls Corporation
5. Hubbell Lighting.
6. Lithonia Lighting; Acuity Lighting Group, Inc.
7. MicroLite Lighting Control Systems.
8. Square D; Schneider Electric.
9. TORK.
10. Touch-Plate, Inc.
11. Watt Stopper (The).

B. Description: Electrically operated and electrically held, combination type with fusible switch, complying with NEMA ICS 2 and UL 508.

1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
3. Enclosure: Comply with NEMA 250.
4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

C. BAS Interface: Provide hardware interface to enable the BAS to monitor and control lighting contactors.

1. Monitoring: On-off status.
2. Control: On-off operation.

2.6 EMERGENCY SHUNT RELAY

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. Lighting Control and Design, Inc.

B. Description: Normally closed, electrically held relay, arranged for wiring in parallel with automatic switching contacts; complying with UL 924.
   1. Coil Rating: 277 V.

2.7 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26, 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 Division 26, Low-Voltage Electrical Power Conductors and Cables.

C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Division 26, Low-Voltage Electrical Power Conductors and Cables.

EXECUTION

2.8 SENSOR INSTALLATION

A. 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.

2.9 CONTACTOR INSTALLATION

A. Mount electrically held lighting contactors with elastomeric isolator pads, to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

2.10 WIRING INSTALLATION

A. Wiring Method: Comply with Division 26, Low-Voltage Electrical Power Conductors and Cables. Minimum conduit size shall be 1/2 inch.

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.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

2.11 IDENTIFICATION

A. Identify components and power and control wiring according to Division 26, Identification for Electrical Systems.

1. Identify controlled circuits in lighting contactors.

2. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

2.12 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.

2. Operational Test: Verify operation of each lighting control device and adjust time delays.

B. Lighting control devices that fail tests and inspections are defective work.

2.13 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two visits to the Project during other-than-normal occupancy hours for this purpose.

2.14 DEMONSTRATION

A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control system specified in Division 26.

B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices. Refer to Division 01.

END OF SECTION

SECTION 260943 - NETWORK LIGHTING CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Certain requirements common to all the mechanical and electrical trades (Fire Suppression, Plumbing, HVAC, Electrical, and Tele/Data) are specified in Division 20. To avoid repetition, they are not repeated in each relevant Division and Section. However, these requirements are applicable to the work of this Section and are hereby incorporated by reference.

B. Other related Sections:

1. Section 265000 - Interior Lighting

C. 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. Distributed Digital Lighting Control System: System includes:

1. Digital lighting and plug Load Control Modules.
2. Lighting and plug Load Control Modules.
3. Manually operated lighting controls.
4. Occupancy sensors.
5. Daylight sensors.
6. Emergency Lighting Control Relays

1.3 DEFINITIONS

A. BACnet: A networking communication protocol that complies with ASHRAE 135.

B. BAS: Building automation system.

C. LonWorks: A control network technology platform for designing and implementing interoperable control devices and networks.

D. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling and power-limited circuits.

E. Monitoring: Acquisition, processing, communication, and display of equipment status data, metered electrical parameter values, power quality evaluation data, event and alarm signals, tabulated reports, and event logs.

F. PC: Personal computer; sometimes plural as "PCs."

G. Power Line Carrier: Use of radio-frequency energy to transmit information over transmission lines whose primary purpose is the transmission of power.

H. RS-485: A serial network protocol, similar to RS-232, complying with TIA/EIA-485-A.

1.4 SUBMITTALS

A. Product Data: For control modules, power distribution components, manual switches and plates, and conductors and cables.

B. Shop Drawings: Detail assemblies of standard components, custom assembled for specific application on this Project.

1. Outline Drawings: Indicate dimensions, weights, arrangement of components, and clearance and access requirements.

2. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data communication paths and identify networks, data buses, data gateways, concentrators, and other devices to be used. Describe characteristics of network and other data communication lines.

3. Wiring Diagrams: Power, signal, and control wiring. Coordinate nomenclature and presentation with a block diagram.

C. Coordination Drawings: Submit evidence that lighting controls are compatible with connected monitoring and control devices and systems specified in other Sections.

1. Show interconnecting signal and control wiring and interfacing devices that prove compatibility of inputs and outputs.

2. For networked controls, list network protocols and provide statements from manufacturers that input, and output devices meet interoperability requirements of the network protocol.

D. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.

2. Program Software Backup: On a magnetic media or compact disc, complete with data files.

3. Device address list.

4. Printout of software application and graphic screens.

E. Field quality-control test reports.

F. Software licenses and upgrades required by and installed for operation and programming of digital and analog devices.

G. Operation and Maintenance Data: For lighting controls to include in emergency, operation, and maintenance manuals.

H. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain lighting control module and power distribution 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 47 CFR, Subparts A and B, for Class A digital devices.

D. Comply with protocol described in IEC 60929, Annex E, for DALI lighting control devices, wiring, and computer hardware and software.

E. Comply with NFPA 70.

1.6 COORDINATION

A. Coordinate lighting control components to form an integrated interconnection of compatible components.

1. Match components and interconnections for optimum performance of lighting control functions.

2. Coordinate lighting controls with BAS and or HVAC controls. Design display graphics showing building areas controlled; include the status of lighting controls in each area.

3. Coordinate lighting controls with that in Sections specifying distribution components that are monitored or controlled by power monitoring and control equipment.

4. Coordinate integration with other trades

B. Coordinate lighting control components specified in this Section with components specified in Division 26.

1.7 DELIVERAY STORAGE AND HANDLING

A. Store products in clean, dry space in the original manufacturer’s packaging in accordance with manufacturer’s written instructions until ready for installation

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of lighting controls that fail in materials or workmanship or from transient voltage surges within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure of software input/output to execute switching or dimming commands.

b. Failure of modular relays to operate under manual or software commands.

c. Damage of electronic components due to transient voltage surges.

2. Warranty Period: Five years from date of Substantial Completion.
3. Extended Warranty Period Failure Due to Transient Voltage Surges: Eight years.
4. Extended Warranty Period for Electrically Held Relays: 10 years from date of Substantial Completion.

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. System Management Software Updates: Five year.
   2. Control Module (Gateway): One of each type installed.
   3. Communication Bridge: One for every 10 of each type installed. Furnish at least one of each type
   4. Wall Switches and Dimmers: Equal to two percent of each type installed, but no fewer than fifteen.
   5. Graphic Wall Stations: Equal to two percent of each type installed, but no less than one.
   6. Scene Controllers: Equal to two percent of each type installed, but no less than one
   7. Occupancy Sensors Equal to two percent of each type installed, but no fewer than fifteen.
   8. Daylight Photocell and Or Dimming Sensors: Equal to two percent of each type installed, but no fewer than ten.
   9. Power (Relay) Packs: Equal to two percent of each type installed, but no fewer than fifteen.
   10. Auxiliary Input/Output Devices: Equal to two percent of each type installed, but no fewer than two.

1.10 SOFTWARE SERVICE AGREEMENT

A. Provide engineering assistance as needed during delivery and installation to assist Installing Contractor.

B. A qualified factory authorized technician or qualified agent shall provide a sufficient level of inspection prior to energizing the system to assure with a high level of confidence that passive and active lighting system components have been provided and installed in accordance with the contract documents and manufacturer's recommendations-whichever is more stringent. Inspections shall include: lighting fixtures, drivers, lamps, ballasts, fixtures wiring, grounding, network wire, connectors, connections, labeling, enclosures, and general workmanship. Printed inspection sheets for a minimum of five (5) of each fixture type and other system elements shall be created, filled in, dated, initialed, and included in the system O&M manual.

C. A qualified factory authorized technician shall supervise initial turn-on and shall cooperate with the installing CONTRACTOR in making any required adjustment or trimming of components to enable the system to function as specified.

D. As a portion of the final inspection, the technician will demonstrate the system in the presence of the Design Professional, OWNER and/or Controls Consultant, as directed, to prove that the system is operating properly as well as providing instruction in the use and OWNER maintenance of the system.

E. Provide a minimum of four (4) hour sessions (16 hours total) of formal operation and maintenance instruction separate from the demonstration and offered at the convenience of the OWNER'S schedule in the presence of the Controls Consultant.

F. Provide a minimum of forty (40) hours of formal demonstration of the system operation to the commissioning agent.

G. Technical Support: Beginning with Substantial Completion, provide software support for two years.

H. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system.

1. Upgrade shall include new or revise licenses for use of the software.
2. Provide 30-day notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment, if necessary.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of design for system is based on Wattstopper DLMsystem to establish standard of performance.

B. Lighting controls shall be low voltage devices with distributed control intelligence at individual room controllers for each space, which will dictate how local controls will operate local lighting.

C. The system shall be capable of interconnecting individual room controllers to create a building network. Control of network shall be provided as indicated in Division 26.

D. Acceptable alternate manufacturers are:

1. Wattstopper-DLM
2. Leviton Controls
3. Acuity- nlight
4. Cooper Lighting-ILC
5. Lutron Athena

2.2 SYSTEM REQUIREMENTS

A. Expandability: System shall be capable of increasing the number of control functions in the future by 25 percent of current capacity; to include equipment ratings, housing capacities, spare relays and terminals.

B. Performance Requirements (digital controllers): Manual switch operation, automatic occupancy sensor operation, and automatic daylight sensors will send signals to programmable-system room control module(s) that process the signals according to its programming and routes an open or close command to one or more relays, or variable commands to one or more dimmer relays in the power-supply circuits to groups of lighting fixtures or other loads.

C. BAS interface: Provide hardware and software to enable the BAS to monitor, control, display, and record data for use in processing reports.

1. Hardwired Points:

a. Monitoring: On-off status.

2. ASHRAE 135 (BACnet) or Modbus communication interface with the BAS shall enable the BAS operator to remotely control and monitor lighting from a BAS operator workstation. Control features and monitoring points displayed locally at lighting panel shall be available through the BAS.

2.3 CONTROL MODULE

1. Digital Room Control Module Description: Comply with UL 916 (CSA C22.2, No. 205); microprocessor-based, solid-state control unit. Unit shall be programmable for control of indicated number of output circuits. Output circuits shall be switched or dimmed as indicated on drawings by digital signals from external sources. Output circuits shall be switched or dimmed by relays. Modules shall include the following features:

a. Mulitchannel output with indicated number of channels.

b. Multiple inputs for indicated occupancy sensors, daylight sensors and hand-held programming device.

2. 0-10V dimming: where indicated, one 0-10V analog output per relay for control of compatible ballast and LED drivers. The 0-10 volt output shall automatically open upon loss of power to the room controller to assure the full light output from the controlled lighting. Capable of providing Class 1 or 2 wiring for 0-10V output signal.

3. Triac-based forward phase dimming: where indicated, one forward phase control line voltage output per relay for control of compatible two-wire or three-wire ballasts, LED drivers, MLV, forward phase compatible ELV, neon/cold cathode and incandescent loads. The forward phase output shall automatically open upon loss of power to the room controller to assure the full light output from the controlled lighting.

B. Control Module description: Programmable, PC-based unit with display and keyboard for graphic display and programming of system status and to override breaker status;

and to display status of local override controls and diagnostic information. If the control module is applied to emergency lighting units, control unit shall indicate failure of normal power and that the lighting units area or are not powered by the alternate source.

1. Display: Single graphic display for programming lighting control panelboards.
2. System memory: Nonvolatile. System shall reboot program and reset time automatically without errors after power outages up to 90 days' duration.
3. Automatic Time Adjustment: System shall automatically adjust for leap year and daylight-saving time and shall provide weekly routine and annual holiday scheduling.
4. Astronomic Control: Automatic adjustment of dawn and dusk switching.
5. Local Override Capability: Manual, low-voltage control devices shall override programmed shutdown of lighting and shall override other programmed control for intervals that may be duration programmed.
6. Automatic Control of Local Override: Automatic control shall switch lighting off if lighting has been switched on by local override.
7. Automatic battery backup shall provide power to maintain program and system clock operation for 90 days' minimum duration when power is off.
8. Programmed time signals shall change preset scenes and dimmer settings.
9. Daylight Balancing Dimming Control: Control module shall interpret variable analog signal from photoelectric sensor and shall route dimming signals to dimming control circuits. Signal shall control dimming of fixture so illumination level remains constant as daylight contribution varies.
10. Energy Conservation: dimming circuits to comply with local energy codes.
11. Flick Warning: Programmable momentary turnoff of lights shall warn that programmed shutoff will occur after a preset interval. Warning shall be repeated after a second preset interval before end of programmed override period.
12. Diagnostics: When system operates improperly, software shall initiate factory-programmed diagnosis of failure and display messages identifying problem and possible causes.
13. Additional Programming: In addition to system programming by the PC, individual control modules shall be programmable using data-entry and -retrieval (such as PCs, personal digital assistants (PDAs), hand-held infrared programming devices, wired Ethernet hubs, wireless IEEE 802.11 hubs).

2.4 MANUAL SWITCHES AND PLATES

A. Push-Button Switches: Modular, momentary-contact, low-voltage type.

1. Match color specified in Division 26
2. Integral Green LED pilot light to indicate when circuit is on.

B. Wall Box Dimmers: seven bi-level LEDs to indicate load levels using 14 steps.

C. Wall Plates: Single and multi-gang plates as specified in Division 26.

D. Legend: Engraved or permanently silk-screened on wall plate where indicated. Use designations indicated on Drawings.

2.5 OCCUPANCY SENSORS

A. General Description: Wall- or ceiling-mounting, solid state units with a separate relay unit.

1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum of 1 to 15 minutes.

2. Mounting: Suitable for mounting in any position on a standard outlet box.

3. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.

4. Bypass switch: Override the on function in case of sensor failure.

B. Dual-Technology Type: Wall or ceiling mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. One particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.

2. Detector Sensitivity: Detect occurrences if 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or vertical manner at an approximate speed of 12 inches/s.

3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sf when mounted on a 96-inch-high ceiling.

2.6 DAYLIGHTING SENSORS

A. Solid-state, light-level sensor unit to detect changes in lighting levels that are perceived by the eye. Cadmium sulfide photoresistors are not acceptable.

1. Light-Level Monitoring Range: based on min FC per space type as defined by ANSI/IES LP-6-20, LP16-20 and ANSI/IES Recommended Practice for Educational Facilities, with an adjustment for turn-on and turn-off levels within that range.

2. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling, with dead band adjustment.

3. Indicator: Two LEDs to indicate the beginning of on-off cycles.

2.7 EMERGENCY BYPASS RELAY

A. Emergency lighting control unit, UL 924 Listed, monitors a switched circuit providing normal lighting to an area. The unit provides normal on-off control of emergency lighting along with the normal lighting. Upon normal power failure, the emergency lighting circuit will close, forcing the emergency lighting on until normal power is restored.

2.8 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Class 2 Power Source: Not smaller than No. 12 AWG, complying with Division 26.

B. Classes 2 and 3 Control Cables: Multiconductor cable with copper conductors not smaller than No. 18 AWG, complying with Division 26.

C. Class 1 Control Cables: Multiconductor cable with copper conductors not smaller than No. 14 AWG, complying with Division 26.

D. Digital and Multiplexed Signal Cables: Unshielded, twisted-pair cable with copper conductors, complying with TIA/EIA-568-B.2, Category 5e for horizontal copper cable and with Division 27.

PART 3 - EXECUTION

3.1 WIRING INSTALLATION.

A. Comply with NECA 1.

B. Wiring Method: Install wiring in raceways. Comply with Division 26. Minimum conduit size shall be 1/2 inch.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and non-power-limited conductors according to conductor manufacturer's written instructions.

D. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.

E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in terminal cabinets, equipment enclosures, and in junction, pull, and outlet boxes.

F. Identify components and power and control wiring according to Division 26.

3.2 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Test for circuit continuity.

2. Verify that the control module features are operational.
3. Check operation of local override controls.
4. Test system diagnostics by simulating improper operation of several components selected by Architect.

3.3 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors and to assist Owner's personnel in making program changes to suit actual occupied conditions. Provide up to two visits to the Project during other than normal occupancy hours for this purpose.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting controls and software training for PC-based control systems. Refer to Division 01.

END OF SECTION

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Certain requirements common to all the mechanical and electrical trades (Fire Suppression, Plumbing, HVAC, Electrical, and Tele/Data) are specified in Division 20. To avoid repetition, they are not repeated in each relevant Division and Section. However, these requirements are applicable to the work of this Section and are hereby incorporated by reference.

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

1.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to the Building Code and SEI/ASCE 7. Refer to Division 26 for additional information.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.3 SUMMARY

A. Provide all labor, materials and equipment to furnish and install all of the items specified herein, indicated on the drawings and as necessary for the proper and complete performance of work.

B. Panelboards shall be fully rated for available fault currents. Series ratings shall not be accepted.

C. Emergency (NFPA 70 Article 700), legally required (NFPA 70 Article 701), panelboards shall be equipped with devices such that selective coordination is maintained. The design intent in this specification and on the contract drawings has generally accounted for selective coordination. Illustrate the selectivity of proposed devices via the coordination study specified in Division 26.

D. Section Includes:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.

1.4 REFERENCES

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form part of this specification to the extent referenced. Publications are referenced in the text by the basic designations only.

1. National Electrical Code (NEC)
2. National Electrical Manufacturer's Association (NEMA).
   a. PB-1 Panelboard
   b. PB1.1 General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less
3. Underwriter's Laboratories (UL)
   a. UL 50 Enclosures for Electrical Equipment
   b. UL 67 Panelboards
   c. UL 508 Standard for Safety Industrial Control Equipment
4. American National Standard Institute (ANSI)

1.5 DEFINITIONS

A. SVR: Suppressed voltage rating.

B. TVSS: Transient voltage surge suppressor.

1.6 SUBMITTALS

A. Panelboards shall be submitted subsequent to the fault current and coordination studies required in 260573. Equipment submittals prior to the required study shall not be reviewed by the Design Engineer and will be returned "rejected."

B. Panelboards shall be submitted in a logical fashion and follow the order scheduled on the drawings. Disorganized submittals shall not be reviewed by the Design Engineer and will be returned "rejected."

C. 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.

D. Shop Drawings: For each panelboard and related equipment.
   1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
   2. Detail enclosure types and details for types other than NEMA 250, Type 1.
   3. Detail bus material, configuration, current, and voltage ratings.
   4. Short-circuit current rating of panelboards and overcurrent protective devices confirming fully rated equipment (series rating of circuit breakers is not acceptable).
   5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
   6. Include wiring diagrams for power, signal, and control wiring.

7. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit selectable ranges for each type of overcurrent protective device.

E. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

F. Panelboard Schedules: For installation in panelboards.

G. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01, include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.7 QUALITY ASSURANCE

A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA PB 1.

D. Comply with NFPA 70.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products in conformance with manufacturer's recommended practices as outlined in applicable Installation and Maintenance Manuals.

B. Inspect and report concealed damage to carrier within their required time period.

C. Protect equipment throughout construction from damage, weather, excessive temperature, and construction operations.

1.9 PROJECT CONDITIONS

A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Owner no fewer than fourteen (14) days in advance of proposed interruption of electric service.
2. Do not proceed with interruption of electric service without Owner's written permission.
3. Comply with NFPA 70E.

1.10 COORDINATION

A. Coordinate layout and installation of panelboards and components with other trades and construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to dedicated equipment space and workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.11 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: One year from date of Substantial Completion.

1.12 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Keys: Two spares for each type of panelboard cabinet lock.
2. Circuit Breakers Including GFCI and Ground Fault Equipment Protection (GFEP) Types: Two spares for each panelboard.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Manufacturers

1. The design is based on Square D to establish standards of quality for materials and performance. The naming of a specific manufacturer or catalog number does not waive any requirements or performance of individual components described in the specification. Provide Square D Series NQOB and NF for 225A and below for receptacle and lighting panels and I-Line for distribution and panels above 225A.

2. Eaton Cutler-Hammer panelboards shall be Type PRL-1 for 225A and below for receptacle and lighting panels, Cutler-Hammer PRL-3 for distribution to 225A and Cutler-Hammer PRL-4 for distribution to 1200A.

3. Siemens panelboards Type P1, P2 or P3 for 225A and below for receptacle and lighting panels, Type P4 and P5 for panelboards and distribution panels above 225A.

B. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Division 26.

C. Enclosures: Flush- and surface-mounted cabinets as indicated in the contract documents.

1. Rated for environmental conditions at installed location.

a. Indoor Dry and Clean Locations: NEMA 250, Type 1.

2. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover (door in door type). Opening inner door shall expose circuit breaker operator handles and panelboard directory. Opening outer door shall expose terminals and circuit breakers in a single operation.

3. Where two section panels are required, bolt boxes together to form one unit. Trim shall be two-piece construction with doors of equal size over each section.

4. Power and lighting panels shall have heavy duty, continuous, section vertical-hinging to box section for access to wiring gutters in addition to trim door

5. Finishes:

a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.

b. Back Boxes: Galvanized steel.

6. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover. Directories shall be typed showing use of each circuit and the panelboard designation.

7. Panelboard designations shall be labeled on the front of the panel with a screw-on nameplate.

D. Incoming Mains Location: Top.

E. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.

2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.

F. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.

2. Main and Neutral Lugs: Mechanical type.

3. Ground Lugs and Bus-Configured Terminators: Mechanical type.

4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

H. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 PANELBOARDS

A. Panelboards shall meet or exceed requirements of NEMA Standard Publication PB-1 and UL-50 and 67. Provide cabinets with flush hinges and combination catch and lock. Provide wiring gutters to accommodate large multiplier feeder cables and lugs. Except as shown otherwise on drawings, wiring gutters shall be at least 4” for lighting and 208V panels and 6” for 480V panels.

B. Panelboards shall have short circuit current rating equal to or greater than circuit breaker AIC ratings schedule on drawings. Panelboards rated 240 volts shall have the following minimum ratings:

1. 10k AIC where shown fed via a 150 kVA transformer and less.

2. 22k AIC where shown fed via a 225 kVA and 300 kVA transformer.

3. 35k AIC where shown fed via a 500 kVA transformer.

C. Panelboards served from transformers shall have a main breaker, unless an enclosed circuit breaker or fused switch is shown.

D. Main bus bars shall be copper, sized as required by UL standards to limit temperature rise on current carrying parts to 50°C above ambient 40°C maximum. Main bus bars shall be sized at least to full rating of feeders overcurrent device that feeds the panelboard.

E. Provide molded case, bolt-on, thermal-magnetic trip, single, two or three pole branch circuit breakers as shown on drawings. Multiple pole breakers shall be single handle, common-trip. Circuit breakers shall be listed and labeled for 75°C conductor ampacities.

F. Provide bus connections for future overcurrent device with suitable insulation and bracing to maintain proper short circuit rating and voltage clearances, where required on drawings. Provide for ready insertion of future breaker.

G. Provide separate equipment ground bus for each panelboard.

H. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Main and Neutral Lugs: Mechanical type.

2. Ground Lugs and Bus-Configured Terminators: Mechanical type.

3. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

4. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

I. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. For all breakers Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Circuit breakers rated less than 250-amps: Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2. Main Circuit breakers and all breakers 250-amps or larger: Electronic trip circuit breakers with RMS sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:

a. Instantaneous trip.

b. Long- and short-time pickup levels.

c. Long- and short-time time adjustments.

d. Ground-fault pickup level, time delay, and I^2t response.

3. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

4. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).

5. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:

a. Standard frame sizes, trip ratings, and number of poles.

b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.

c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.

d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

e. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.

f. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.

2.4 PANELBOARD SURGE PROTECTION DEVICES

A. Surge Protection Device: Provide factory installed IEEE C62.41-compliant, integrally mounted, solid-state, parallel-connected, non-modular type, with sine-wave tracking suppression and filtering modules, UL 1449, second edition, short-circuit current rating matching or exceeding the panelboard short-circuit rating, in accordance with Division 26.

2.5 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.

B. Examine panelboards at delivery before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

C. Examine the areas and conditions under which panelboards are to be installed and notify engineer in writing of conditions detrimental to the proper and timely completion of work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install panelboards where indicated, in accordance with manufacturer's written instructions, guidelines and the applicable requirements of the NEC, local codes, the National Electrical Contractors Association's "Standard of Installation" and in accordance with recognized industry practices to ensure that products serve the intended function.

B. Install all flush mounted panelboards with one spare 1½ -inch and two ¾" conduits from panel to above accessible ceiling.

C. Location:

1. Maintain the minimum NEC clearances about the equipment.

2. Locate top of enclosures approximately 6'-6" above floor, at a masonry joint if applicable. Panelboard shall never be mounted such that the handle of the highest circuit breaker exceeds 6'-6" AFF.

3. Provide 1/2" spacers for panelboards mounted at exterior walls below grade to establish an air space behind panel.

D. Anchoring:

1. Provide all necessary hardware to secure panelboard in place. Anchor enclosure firmly to walls and structural surfaces, ensuring that they are permanently and mechanically secure.
2. Mount free standing distribution panels on 6-inch high concrete pads with 1-inch chamfered edges.
3. Comply with mounting and anchoring requirements specified in Division 26.

E. Branch circuit wiring shall be peeled out of the wiring gutters at 90 degrees to circuit breakers and terminal lugs for a neat installation.

F. Install overcurrent protective devices and controllers not already factory installed.

G. Set field-adjustable, circuit-breaker trip ranges.

H. Install filler plates in unused spaces.

I. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

3.3 BALANCING LOADS

A. After Substantial Completion, but not more than two months after Final Acceptance, conduct load balancing measurements and circuit changes as follows:

1. Perform measurements during period of normal working load as advised by the Owner.
2. Perform load-balancing circuit changes outside the normal occupancy/working schedule of the facility. Make special arrangements with the owner to avoid disrupting critical 24-hour services such as FAX machines, and on line data processing, computing, transmitting and receiving equipment.
3. Recheck loads after circuit changes during normal load period. Record all load readings before and after changes and submit test record.
4. Tolerance: Difference between phase loads exceeding 20 percent at any one panelboard is not acceptable. Rebalance and recheck as required to meet this minimum requirement.

3.4 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26.

B. Directories:

1. Fill out the enclosure circuit directory card upon completion of work and install in panelboard.
2. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
3. Incorporate Owner's final room designations. Obtain approval before installing.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26.

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.

2. Test continuity of each circuit.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

D. Panelboards will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Division 26

C. 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.

3.7 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Certain requirements common to all the mechanical and electrical trades (Fire Suppression, Plumbing, HVAC, Electrical, and Tele/Data) are specified in Division 20. To avoid repetition, they are not repeated in each relevant Division of the Specifications. However, these requirements are applicable to the work of this Division, and are hereby incorporated by reference.

B. 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. Straight blade receptacles
2. GFCI receptacles
3. Twist-locking receptacles
4. Pendant cord connector devices
5. Cord and plug sets
6. Snap switches
7. Wall plates
8. Floor service fittings
9. Multi-outlet assemblies
10. Finishes

B. Related Sections include the following:

1. Division 27 Section "Communications Horizontal Cabling" for workstation outlets.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

D. RFI: Radio-frequency interference.

E. TVSS: Transient voltage surge suppressor.

F. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.5 QUALITY ASSURANCE

A. 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. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.6 COORDINATION

A. Receptacles for Owner-Furnished Equipment: Match plug configurations.

1. Cord and Plug Sets: Match equipment requirements.

B. Coordinate the locations of outlet boxes between the electrical drawings and any other drawings associated with the project. Discrepancies shall be brought to the attention of the Architect by formal RFI procedure. Any reasonable change in location of outlets shall not involve additional expense to Owner. The term “reasonable” shall be interpreted as moving outlet 10’-0” in any direction from the location indicated on the Electrical drawings. Refer to specifications 20 00 00 for additional information regarding discrepancies in documents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).

2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).

3. Leviton Mfg. Company Inc. (Leviton).

4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Legrand).

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; 5361 (single), AH5352 (duplex).

b. Hubbell; HBL5361 (single), 5362 (duplex).

c. Leviton; 5891 (single), 5352 (duplex).

d. Legrand; 5361 (single), 5362 (duplex).

B. Convenience Receptacles – Decorator Style, 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; 6342 (duplex).

b. Hubbell; HBL2162 (duplex).

c. Leviton; 16362 (duplex).

d. Legrand; 26352 (duplex).

C. Convenience Receptacles with two USB type-A charging ports, 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; TR7756.

b. Hubbell; USB20A5.

c. Leviton; T5832.

d. Legrand; TR5362USB.

D. Hospital-Grade, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498 Supplement SD.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 8300 (duplex).

b. Hubbell; HBL8310 (single), HBL8300H (duplex).

c. Leviton; 8310 (single), 8300 (duplex).

d. Pass & Seymour; 8301 (single), 8300 (duplex).

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, Federal Specification W-C-596 and include indicator light that is lighted when device is tripped. The device must have Self-test feature (conducts an automatic test, ensuring ground fault protection). If ground fault protection is compromised, power to the receptacle must be discontinued.

B. Hospital-Grade, Duplex GFCI Convenience Receptacles, 125 V, 20 A: Comply with UL 498 Supplement SD, Federal Specification W-C-596 and UL943, Class A, and include indicator light that is lighted when device is tripped. The device must have Self-test feature (conducts an automatic test, ensuring ground fault protection). If ground fault protection is compromised, power to the receptacle must be discontinued.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; SGFH20.

b. Hubbell; GFRST83W.

c. Leviton; GFNT2-HG.

d. Pass & Seymour; 2097HG.

2.4 TWIST-LOCKING RECEPTACLES

A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; L520R.

b. Hubbell; HBL2310.

c. Leviton; 2310.

d. Pass & Seymour; L520-R.

2.5 PENDANT CORD-CONNECTOR DEVICES

A. Description: Matching, locking-type plug and receptacle body connector; NEMA WD 6 configurations L5-20P and L5-20R, heavy-duty grade.

1. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.

2. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.6 CORD REEL SET

A. Description: white industrial reel with yellow box and (2) 20A duplex receptacles.

1. UL Type 1

2. 45 feet cord, #12/3 SJO

3. Products: Subject to compliance with requirements, provide one of the following:

a. Basis of Design; Hubbell HBLI45123R220.

b. Cooper

c. Leviton

d. Pass & Seymour

2.7 CORD AND PLUG SETS

A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.

1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.

2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.8 SNAP SWITCHES

A. Comply with NEMA WD 1 and UL 20.

B. Switches, 120/277 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (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; PS20AC1 (single pole), PS20AC2 (two pole), PS20AC3 (three way), PS20AC4 (four way).

C. Pilot Light Switches, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 2221PL for 120 V and 277 V.

b. Hubbell; HBL1221PL for 120 V and 277 V.

c. Leviton; 1221-PLR for 120 V, 1221-7PLR for 277 V.

d. Pass & Seymour; PS20AC1-RPL for 120 V.

2. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."

2.9 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: Steel with white baked enamel, suitable for field painting where indicated by the Architect, 0.035-inch- thick, satin-finished stainless steel.
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. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable cover.

2.10 FLOOR SERVICE FITTINGS

A. Type: Modular, flush-type, dual-service units suitable for wiring method used.

B. Compartments: Barrier separates power from voice and data communication cabling.

C. Service Plate: Round, with satin finish as selected by the Architect.

D. Power Receptacle: NEMA WD 6 configuration 5-20R, gray finish, unless otherwise indicated.

E. Voice and Data Communication Outlet: Blank cover with bushed cable opening.

2.11 FINISHES

A. Color: Wiring device catalog numbers in Section Text do not designate device color.

1. Wiring Devices Connected to Normal Power System: White, or as selected by Architect, unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Emergency Power System: Red.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Coordination with Other Trades:

1. Take steps to ensure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or 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 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.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

H. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."

1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. 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.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

C. Test straight blade hospital-grade convenience outlets for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz..

END OF SECTION

SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Certain requirements common to all the mechanical and electrical trades (Fire Suppression, Plumbing, HVAC, Electrical, and Tele/Data) are specified in Division 20. To avoid repetition, they are not repeated in each relevant Division of the Specifications. However, these requirements are applicable to the work of this Division, and are hereby incorporated by reference.

B. 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. Cartridge fuses rated 600-V ac and less for use in enclosed switches and enclosed controllers.

1.3 REFERENCES

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form part of this specification to the extent referenced. Publications are referenced in the text by the basic designations only.

1. National Electrical Code (NEC)
2. Underwriter’s Laboratories (UL)
   a. UL 50 Enclosures for Electrical Equipment
   b. UL 508 Standard for Safety Industrial Control Equipment
   c. UL 977 Fused Power Circuit Devices
3. American National Standard Institute (ANSI)

1.4 SUBMITTALS

A. Product Data: For each type and rating of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
2. Current-limitation curves for fuses with current-limiting characteristics.

3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
4. Coordination charts and tables and related data.

B. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01, include the following:

1. Ambient temperature adjustment information.
2. Current-limitation curves for fuses with current-limiting characteristics.
3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
4. Coordination charts and tables and related data.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

1.6 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.7 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

1.8 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Three of each size and type for any fuses installed sized 400A or greater, or rated for more than 600V.

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 Fuse, Inc.
3. Ferraz Shawmut, Inc.
4. Littelfuse, Inc.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

A. Cartridge Fuses:

1. Service Entrance: Class L, time delay.
2. Feeders: Class RK1, time delay.
3. Motor Branch Circuits: Class RK1, time delay.
4. Other Branch Circuits: Class RK1, time delay.
5. Control Circuits: Class CC, time delay.

3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.4 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Division 26 and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Certain requirements common to all the mechanical and electrical trades (Fire Suppression, Plumbing, HVAC, Electrical, and Tele/Data) are specified in Division 20. To avoid repetition, they are not repeated in each relevant Division of the Specifications. However, these requirements are applicable to the work of this Division, and are hereby incorporated by reference.

B. 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. Fusible switches.
2. Nonfusible switches.
3. Molded-case circuit breakers (MCCBs).
4. Enclosures.

1.3 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.4 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).
4. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.

5. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

C. Field quality-control reports.

1. Test procedures used.

2. Test results that comply with requirements.

3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

D. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01, include the following:

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.

2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

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 NFPA 70.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.

2. Altitude: Not exceeding 6600 feet.

B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then

only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Architect and Owner no fewer than fourteen days in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without Owner's written permission.
4. Comply with NFPA 70E.

1.7 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.

1.8 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. ABB-General Electric; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Type GD, General Duty, Single Throw, 240-V ac, 800 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with cartridge fuse interiors to accommodate indicated fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
4. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
5. Hookstick Handle: Allows use of a hookstick to operate the handle.
6. Lugs: Mechanical type, suitable for number, size, and conductor material.
7. Accessory Control Power Voltage: Remote mounted and powered; 120-V ac.

2.2 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   2. ABB-General Electric; GE Consumer & Industrial - Electrical Distribution.
   3. Siemens Energy & Automation, Inc.
   4. Square D; a brand of Schneider Electric.

B. Type GD, General Duty, Single Throw, 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Accessories:
   1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
   2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
   3. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
   4. Hookstick Handle: Allows use of a hookstick to operate the handle.
   5. Lugs: Mechanical type, suitable for number, size, and conductor material.
   6. Accessory Control Power Voltage: Remote mounted and powered; 120-V ac.

2.3 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   2. ABB-General Electric; GE Consumer & Industrial - Electrical Distribution.

3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

D. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

E. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

1. Instantaneous trip.
2. Long- and short-time pickup levels.
3. Long- and short-time time adjustments.
4. Ground-fault pickup level, time delay, and I^2t response.

F. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

G. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

H. Ground-Fault, Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).

I. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
6. Accessory Control Power Voltage: Remote mounted and powered; 120-V ac.

2.4 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.

2. Outdoor Locations: NEMA 250, Type 3R.
3. Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

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 individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

C. Install fuses in fusible devices.

D. Comply with NECA 1.

3.3 IDENTIFICATION

A. Comply with requirements in Division 26.

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as indicated in final approved Coordination Study.

END OF SECTION

SECTION 262913 - ENCLOSED CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Certain requirements common to all the mechanical and electrical trades (Fire Suppression, Plumbing, HVAC, Electrical, and Tele/Data) are specified in Division 20. To avoid repetition, they are not repeated in each relevant Division of the Specifications. However, these requirements are applicable to the work of this Division, and are hereby incorporated by reference.

B. 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 the following enclosed controllers rated 600 V and less:

1. Full-voltage manual.
2. Full-voltage magnetic.
3. Reduced-voltage solid state.

1.3 DEFINITIONS

A. CPT: Control power transformer.

B. MCCB: Molded-case circuit breaker.

C. MCP: Motor circuit protector.

D. N.C.: Normally closed.

E. N.O.: Normally open.

F. OCPD: Overcurrent protective device.

G. SCR: Silicon-controlled rectifier.

1.4 SUBMITTALS

A. Product Data: For each type of enclosed controller. Include manufacturer's technical data on features, performance, electrical characteristics, ratings, and enclosure types and finishes.

B. Shop Drawings: For each enclosed controller. Include dimensioned plans, elevations, sections, details, and required clearances and service spaces around controller enclosures.

1. Show tabulations of the following:

a. Each installed unit's type and details.

b. Factory-installed devices.

c. Nameplate legends.

d. Short-circuit current rating of integrated unit.

2. Wiring Diagrams: For power, signal, and control wiring.

C. Qualification Data: For qualified testing agency.

D. Field quality-control reports.

E. Operation and Maintenance Data: For enclosed controllers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 include the following:

1. Routine maintenance requirements for enclosed controllers and installed components.

2. Manufacturer's written instructions for setting field-adjustable overload relays.

3. Manufacturer's written instructions for testing, adjusting, and reprogramming reduced-voltage solid-state controllers.

F. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

G. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor running overload protection suit actual motors to be protected.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store enclosed controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet.

B. Interruption of Existing Electrical Systems: Do not interrupt electrical systems in facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Architect and Owner no fewer than fourteen days in advance of proposed interruption of electrical systems.
2. Indicate method of providing temporary utilities.
3. Do not proceed with interruption of electrical systems without Owner's written permission.
4. Comply with NFPA 70E.

1.8 COORDINATION

A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

1.9 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
2. Indicating Lights: Two of each type and color installed.
3. Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.
4. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

PART 2 - PRODUCTS

2.1 FULL-VOLTAGE CONTROLLERS

A. General Requirements for Full-Voltage Controllers: Comply with NEMA ICS 2, general purpose, Class A.

B. Motor-Starting Switches: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off or on.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
    b. ABB-General Electric; GE Consumer & Industrial - Electrical Distribution.
    c. Rockwell Automation, Inc.; Allen-Bradley brand.
    d. Siemens Energy & Automation, Inc.
    e. Square D; a brand of Schneider Electric.
2. Configuration: Nonreversing.
3. Surface mounting.
4. Red pilot light.

C. Fractional Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
    b. ABB-General Electric; GE Consumer & Industrial - Electrical Distribution.
    c. Rockwell Automation, Inc.; Allen-Bradley brand.
    d. Siemens Energy & Automation, Inc.
    e. Square D; a brand of Schneider Electric.
2. Configuration: Nonreversing.
3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button; bimetallic type.
4. Surface mounting.
5. Red pilot light.

D. Integral Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
    b. ABB-General Electric; GE Consumer & Industrial - Electrical Distribution.
    c. Rockwell Automation, Inc.; Allen-Bradley brand.
    d. Siemens Energy & Automation, Inc.
    e. Square D; a brand of Schneider Electric.
2. Configuration: Nonreversing.

3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters and sensors in each phase, matched to nameplate full-load current of actual protected motor and having appropriate adjustment for duty cycle; external reset push button; bimetallic type.
4. Surface mounting.
5. Red pilot light.
6. N.O. auxiliary contact.

E. Magnetic Controllers: Full voltage, across the line, electrically held.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   b. ABB-General Electric; GE Consumer & Industrial - Electrical Distribution.
   c. Rockwell Automation, Inc.; Allen-Bradley brand.
   d. Siemens Energy & Automation, Inc.
   e. Square D; a brand of Schneider Electric.
2. Configuration: Nonreversing.
3. Contactor Coils: Pressure-encapsulated type with coil transient suppressors.
   a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.
4. Power Contacts: Totally enclosed, double-break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
5. Control Circuits: 120-V ac; obtained from integral CPT, with primary and secondary fuses, with CPT of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.
   a. CPT Spare Capacity: 50 VA.
6. Bimetallic Overload Relays:
   a. Inverse-time-current characteristic.
   b. Class 10 tripping characteristic.
   c. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
   d. Automatic resetting.
7. N.O., isolated overload alarm contact.
8. External overload reset push button.

2.2 REDUCED-VOLTAGE SOLID-STATE CONTROLLERS

A. General Requirements for Reduced-Voltage Solid-State Controllers: Comply with UL 508.

B. Reduced-Voltage Solid-State Controllers: An integrated unit with power SCRs, heat sink, microprocessor logic board, door-mounted digital display and keypad, bypass contactor, and overload relay; suitable for use with NEMA MG 1, Design B, polyphase, medium induction motors.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

   b. ABB-General Electric; GE Consumer & Industrial - Electrical Distribution.

   c. Rockwell Automation, Inc.; Allen-Bradley brand.

   d. Siemens Energy & Automation, Inc.

   e. Square D; a brand of Schneider Electric.

2. Configuration: Standard duty; nonreversible.

3. Starting Mode: Voltage ramping.

4. Stopping Mode: Coast to stop.

5. Logic Board: Identical for all ampere ratings and voltage classes, with environmental protective coating.

6. Control Circuits: 120-V ac; obtained from integral CPT, with primary and secondary fuses, with CPT of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.

   a. CPT Spare Capacity: 100 VA.

7. Adjustable acceleration-rate control using voltage or current ramp, and adjustable starting torque control with up to 400 percent current limitation for 20 seconds.

8. SCR bridge shall consist of at least two SCRs per phase, providing stable and smooth acceleration without external feedback from the motor or driven equipment.

9. Keypad, front accessible; for programming the controller parameters, functions, and features; shall be manufacturer's standard and include not less than the following functions:

   a. Adjusting motor full-load amperes, as a percentage of the controller's rating.

   b. Adjusting current limitation on starting, as a percentage of the motor full-load current rating.

   c. Adjusting linear acceleration and deceleration ramps, in seconds.

d. Initial torque, as a percentage of the nominal motor torque.

e. Adjusting torque limit, as a percentage of the nominal motor torque.

f. Adjusting maximum start time, in seconds.

g. Adjusting voltage boost, as a percentage of the nominal supply voltage.

h. Selecting stopping mode, and adjusting parameters.

i. Selecting motor thermal overload protection class between 5 and 30.

j. Activating and de-activating protection modes.

k. Selecting or activating communication modes.

10. Digital display, front accessible; for showing motor, controller, and fault status; shall be manufacturer's standard and include not less than the following:

    a. Controller Condition: Ready, starting, running, stopping.

    b. Motor Condition: Amperes, voltage, power factor, power, and thermal state.

    c. Fault Conditions: Controller thermal fault, motor overload alarm and trip, motor underload, overcurrent, shorted SCRs, line or phase loss, phase reversal, and line frequency over or under normal.

11. Controller Diagnostics and Protection:

    a. Microprocessor-based thermal protection system for monitoring SCR and motor thermal characteristics, and providing controller overtemperature and motor-overload alarm and trip; settings selectable via the keypad.

    b. Protection from line-side reverse phasing; line-side and motor-side phase loss; motor jam, stall, and underload conditions; and line frequency over or under normal.

    c. Input isolation contactor that opens when the controller diagnostics detect a faulted solid-state component or when the motor is stopped.

12. Remote Output Features:

    a. All outputs prewired to terminal blocks.

    b. Form C status contacts that change state when controller is running.

    c. Form C alarm contacts that change state when a fault condition occurs.

13. Optional Features:

    a. Analog output for field-selectable assignment of motor operating characteristics; 0 to 10-V dc.

    b. Additional field-assignable Form C contacts, as indicated, for alarm outputs.

c. Surge suppressors in solid-state power circuits providing three-phase protection against damage from supply voltage surges 10 percent or more above nominal line voltage.

d. Full-voltage bypass contactor operating manually, with NORMAL/BYPASS selector switch. Power contacts shall be totally enclosed, double break, and silver-cadmium oxide; and assembled to allow inspection and replacement without disturbing line or load wiring.

e. Solid-State Overload Relay:

1) Switch or dial selectable for motor running overload protection.

2) Sensors in each phase.

3) Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.

f. N.O., isolated overload alarm contact.

g. External overload reset push button.

2.3 ENCLOSURES

A. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.

1. Dry and Clean Indoor Locations: Type 1.

2. Outdoor Locations: Type 3R.

3. Wash-Down Areas: Type 4X, stainless steel.

4. Other Wet or Damp Indoor Locations: Type 4.

5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.

2.4 ACCESSORIES

A. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.

1. Push Buttons, Pilot Lights, and Selector Switches: Heavy-duty, type.

a. Push Buttons: Covered Lockable types; maintained as indicated.

b. Pilot Lights: LED types; colors as indicated; push to test.

c. Selector Switches: Rotary type.

2. Elapsed Time Meters: Heavy duty with digital readout in hours; resettable.

3. Meters: Panel type, 2-1/2-inch minimum size with 90- or 120-degree scale and plus or minus two percent accuracy. Where indicated, provide selector switches with an off position.

B. Reversible N.C./N.O. auxiliary contact(s).

C. Control Relays: Auxiliary and adjustable solid-state time-delay relays.

D. Breather and drain assemblies, to maintain interior pressure and release condensation in Type 4X enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.

E. Space heaters, with N.C. auxiliary contacts, to mitigate condensation in Type 3R enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.

F. Sun shields installed on fronts, sides, and tops of enclosures installed outdoors and subject to direct and extended sun exposure.

G. Cover gaskets for Type 1 enclosures.

H. Terminals for connecting power factor correction capacitors to the line side of overload relays.

I. Spare control wiring terminal blocks, quantity as indicated; wired.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and surfaces to receive enclosed controllers, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Examine enclosed controllers before installation. Reject enclosed controllers that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Division 26.

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

C. Install fuses in each fusible-switch enclosed controller.

D. Install fuses in control circuits if not factory installed. Comply with requirements in Division 26.

E. Install heaters in thermal overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.

F. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.

G. Comply with NECA 1.

3.3 IDENTIFICATION

A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in Division 26.

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved nameplate.
3. Label each enclosure-mounted control and pilot device.

3.4 CONTROL WIRING INSTALLATION

A. Bundle, train, and support wiring in enclosures.

B. Connect selector switches and other automatic-control selection devices where applicable.

1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.
2. Connect selector switches with enclosed-controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
2. Test insulation resistance for each enclosed-controller element, component, connecting motor supply, feeder, and control circuits.
3. Test continuity of each circuit.
4. Verify that voltages at controller locations are within plus or minus 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Construction Manager before starting the motor(s).
5. Test each motor for proper phase rotation.
6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
8. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Enclosed controllers will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports including a certified report that identifies enclosed controllers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

A. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

B. Adjust overload-relay heaters or settings if power factor correction capacitors are connected to the load side of the overload relays.

C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable instantaneous trip elements. Initially adjust to six times the motor nameplate full-load ampere ratings and attempt to start motors several times, allowing for motor cooldown between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Construction Manager before increasing settings.

D. Set the taps on reduced-voltage autotransformer controllers at 65 percent.

E. Set field-adjustable switches and program microprocessors for required start and stop sequences in reduced-voltage solid-state controllers.

3.7 PROTECTION

A. Replace controllers whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers, and to use and reprogram microprocessor-based, reduced-voltage solid-state controllers.

END OF SECTION

SECTION 265100 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Certain requirements common to all the mechanical and electrical trades (Fire Suppression, Plumbing, HVAC, Electrical, and Tele/Data) are specified in Division 20. To avoid repetition, they are not repeated in each relevant Division and Section. However, these requirements are applicable to the work of this Section and are hereby incorporated by reference.

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

C. Typical spacing criteria summary. Applicable for each project type.

D. Typical mounting height. Applicable for each project type and condition

E. This project is required to achieve minimum LEED v4 ID+C: CI Gold Certification. Refer to Sustainable Design Specification Section 018111, as well as Specification Section 017410 Construction Indoor Air Quality and Specification Section 017419 Construction Nonhazardous Waste Management Plan for requirements to achieve this certification.

1.2 SUMMARY

A. Section Includes:

1. Interior lighting fixtures, lamps, and drivers
2. Materials.
3. Finishes.
4. Luminaire support.
5. Emergency lighting unit
6. Exit signs.

1.3 DEFINITIONS

A. LM: Lumen Maintenance (factor): extrapolated performance projections for the platforms noted in a 25 deg. C ambient, based on 10,000 hours LED testing (tested per IESNA LM-80-08 and projected per IESNA TM-21-11)

B. CU: Coefficient of Utilization.

C. cd: candela:

D. CCT: Correlated color temperature.

E. CRI: Color-rendering index.

F. LER: Luminaire efficacy rating.

G. Lumen: Measured output of lamp and luminaire, or both.

H. Mean lumens: average light output over the lamp's rated life, which reflects the gradual deterioration of performance due to the rigors of continued operation.

I. Luminaire: Complete lighting fixture, including ballast housing if provided.

J. Fixture: See "Luminaire."

K. SSL: solid state lighting

L. LED: lighting emitting diodes

M. IP: International Protection or Ingress Protection Rating.

N. SDCM: Standard deviation Color match

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Arrange in order of luminaire designation.

2. Include data on features, accessories, and finishes.

3. Include physical description and dimensions of luminaires.

4. Include emergency lighting units, including batteries and chargers.

5. Include life, output (lumens, CCT, and CRI), and energy efficiency data.

6. Photometric data and adjustment factors based on laboratory tests, complying with IES Lighting Measurements Testing and Calculation Guides, of each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project, IES LM-79 and IES LM-80.

a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by the manufacturer.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.

2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, and required clearances, method of field assembly, components, and location and size of each field connection.

3. Include diagrams for power, signal, and control wiring.

C. Reference RFP for additional requirements.

D. Samples: For the lighting fixture indicated in the Interior Lighting Fixture Schedule. Each Sample shall include the following:

1. LEDs and drivers or lamps and ballasts, installed.

2. Cords and plugs.

3. Pendant support system.

E. Samples for Initial Selection: For each type of luminaire with custom factory-applied finishes.

1. Include Samples of luminaires and accessories involving color and finish selection.

F. Installation instructions

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) 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. Lighting fixtures.

2. Suspended ceiling components.

3. Structural members to which suspension systems for lighting fixtures will be attached.

4. Other items in finished ceiling including the following:

a. Air outlets and inlets.

b. Sprinklers.

c. Smoke and fire detectors.

d. Occupancy sensors

e. Projectors

B. Qualification Data: For testing laboratory providing photometric data for luminaires.

C. Seismic Qualification Certificates: For luminaires, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

D. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Product Certificates: For each type of luminaire.

F. Product Test Reports: For each luminaire, for tests performed by a qualified testing agency.

G. Sample warranty.

H. Reference RFP for additional requirements.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.

1. Provide a list of all lamp types used on Project (if applicable); use ANSI and manufacturers' codes.

2. Provide a complete final fixture schedule and as-built schedules and associated floorplans.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps: Ten (10) of each type and rating installed. Furnish at least one of each type.

2. Diffusers and Lenses: Two (2) for every 100 of each type and rating installed. Furnish at least one of each type.

3. Globes and Guards: Ten (10) of each type and rating installed. Furnish at least one of each type.

4. Emergency battery pack: One for every 50-emergency lighting unit.

5. Driver: (5) for every 100 of each type and rating installed. Furnish at least one of each type.

1.8 QUALITY ASSURANCE

A. Each Luminaire, different than the one listed in the lighting fixture specification, shall be provided with equal or better performance and provide photometric information for its evaluation.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

C. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.

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. Comply with NFPA 70.

F. FM Global Compliance: Lighting fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

G. LED compliance with ANSI/ANSLG (ANSLG: American National Standard Lighting Group)

1. Specifications for the Chromaticity of Solid-State Lighting Products, intended to be used Indoors)
2. Harmonic Emission Limits – Related Power Quality Requirements for Lighting Summarizes harmonic limits and methods of measurements for lighting equipment including SSL drivers and power supplies

H. Provide luminaires from a single manufacturer for each luminaire type.

I. Mockups: For interior luminaires in room or module mockups, complete with power and control connections.

1. Obtain Architect's approval of luminaires in mockups before starting installations.
2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.10 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.11 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five year(s) for LEDs/driver combination from date of the installation

1.12 EXTRA MATERIALS

A. Furnish extra material described:

1. Lamps (LED retrofit lamps)
2. Plastic diffusers and lenses
3. Battery charger data
4. Drivers
5. Lighting Globes/Shades
6. Fixture Guards.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide product indicated on Drawings.

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE 7.

1. The term "withstand" means the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the “seismic event."

2.3 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

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. Incandescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5A.

C. HID Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5B.

D. Standards:

1. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.

2. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

3. UL or ETL Listing: Listed for dry, damp, wet location.

4. Recessed luminaires shall comply with NEMA LE 4.

5. User Replaceable Lamps:

a. Bulb shape complying with ANSI C78.79.

b. Lamp base complying with ANSI C81.61 or IEC 60061-1.

2.4 GENERAL REQUIREMENTS FOR LIGHTING COMPONENTS/MATERIALS

A. Metal Parts: All sheet metal work shall be free of burrs, sharp corners and edges, tool marks and dents, and shall have accurate angles bent as sharp as compatible with the gauges of the required metal. All intersections and joints shall be formed true of adequate strength and structural rigidity to prevent any distortion after assembly.

B. Sheet Metal Components: a minimum of #20 gauge (0.0359 inch) thick cold rolled sheet Steel unless otherwise indicated. Form and support to prevent warping and sagging.

C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit re-lamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during re-lamping and when secured in operating position.

D. All Lamp sockets in lighting fixtures shall be suitable for the indicated lamps and shall be set so that lamps are positioned in optically correct relation to all lighting fixture components. If adjustable socket positions are provided, socket should be preset in factory for the specified lamp. If different socket positions are specified for same fixture, sockets shall be preset for each type, and cartons marked accordingly.

E. All fixtures shall be completely wired at the factory.

F. Mounting Frames and Rings: If ceiling system requires, each recessed and semi-recessed fixture shall be furnished with a mounting frame or ring compatible with the ceiling in which they are to be installed. The frames and rings shall be one piece or constructed with electrically-welded butt joints, and of sufficient size and strength to sustain the weight of the fixture.

G. Light leaks:

1. Between ceilings trims of recessed lighting equipment and the ceilings will not be accepted.

2. Between lighting components within the fixtures (louvers, trims, etc) will not be accepted.

H. Yokes, brackets and supplementary supporting members needed to mount lighting fixtures to carrier channels or other suitable ceiling members shall be furnished and installed by the Contractor.

I. Adjustable Angle Fixtures: Each lighting fixture which has a beam angle adjustment shall have reliable angle locking devices.

J. Continuous linear fixtures: each continues linear fixture mounted inside coves or within a restricted architectural section requires factory shop drawings and field measurement prior placing order.

K. Diffusers and Globes:

1. Acrylic Lighting Diffusers: Plastic for lenses and diffusers shall be formed of colorless 100 percent virgin acrylic as manufactured by Rohm & Haas, Dupont or as acceptable. The quality of the raw material must exceed IES, SPI, and NEMA Specifications by at least 100 percent which, as a minimum standard, shall not exceed a yellowness factor of 3 after 2,000 hours of exposure in the Fade-meter or as tested by an independent test laboratory. Acrylic plastic lenses and diffusers shall be properly cast, molded or extruded as specified, and shall remain free of any dimensional instability, discoloration, embrittlement, or loss of light transmittance for at least 15 years.

a. Lens Thickness: At least 0.125 inchminimum unless otherwise indicated.

b. UV stabilized.

2. Glass: Annealed crystal glass unless otherwise indicated.

L. Housings:

1. Extruded-aluminum housing and heat sink.
2. Painted finish as selected by the Architect.

M. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:
   a. "USE ONLY" and include specific lamp type.
   b. Lamp diameter, shape, size, wattage, and coating.
   c. CCT and CRI for all luminaires.

N. Air-Handling Fluorescent Fixtures: For use with plenum ceiling for air return and heat extraction and for attaching an air-diffuser-boot assembly specified in Division 23.

1. Air-Supply Units: Slots in one or both side trims join with air-diffuser-boot assemblies.
2. Heat-Removal Units: Air path leads through lamp cavity.
3. Combination Heat-Removal and Air-Supply Unit: Heat is removed through lamp cavity at both ends of the fixture door with air supply same as for air-supply units.
4. Dampers: Operable from outside fixture for control of return-air volume.
5. Static Fixture: Air-supply slots are blanked off, and fixture appearance matches active units.

2.5 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.6 LUMINAIRE SUPPORT

A. Comply with requirements in Division 26 for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage

D. Rod Hangers: 3/16-inchminimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

2.7 EXIT SIGNS

A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:

1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.
2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
   a. Battery: Sealed, maintenance-free, nickel-cadmium type.
   b. Charger: Fully automatic, solid-state type with sealed transfer relay.
   c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
   d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
   e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

2.8 LED LIGHTING

A. Color temperature: shall be 3000K.

B. CRI: LED CRI shall be minimum 80 unless otherwise noted. Manufacturer must provide all “R” values or R1 through R15.

C. The LED system shall use 14-bit or greater nonlinear scaling techniques for high-resolution output. Manufacturer of LED systems shall utilize an advanced production LED binning process to maintain color consistency.

D. The LED fixture shall be operated at constant and carefully regulated current levels. LEDs shall not be overdriven beyond their specified nominal voltage and current. Data must be submitted showing and proving the measurement test point of the LED case within the fitting in situ.

E. Thermal management: all LED fixtures shall be thermally protected. They must be passively cooled through conduction unless otherwise noted

F. LED fixture housing shall be designed to transfer heat from the LED board to the outside environment.

G. LED fixture manufacturer must provide fixture wattage information and not LED data.

H. For wet and damp use, LED-based fixture itself shall be sealed, rated, and tested for appropriate environmental conditions, not accomplished by using an additional housing or enclosure.

I. LED fixture shall be UL listed or UL classified, CE certified. And PSA marked. LED fixture and systems shall meet RoHS (Removal of Hazardous Substances) directives. Manufacturer shall be able to provide supporting documentation of the product meeting third party regulatory compliance as well as environmental testing results.

J. Manufacturer shall provide optical performance, polar diagrams, and relevant luminance and illuminance photometric data based on test results from an independent testing lab

K. Rated Life: LED Fixtures shall be rated for 59,000 hour minimum performance on all LED diode components.

L. Warranty: LED Manufacturers shall provide a minimum 5-year warranty on LED components. Along with it, the manufacturer shall provide warranty and comply with the criteria for: color shifting, lumen and color maintenance described below on bullet points 1 and 2.

If extreme color shift or extreme color inconsistency develops within the warranty period, it will be considered a failure, and the Manufacturer shall be responsible for replacing all affected fixtures free of charge.

1. Color Shifting: Color must be maintained within (+/- 150 Kelvin) and +/- .003 Duv in accordance with LM-80 Test Procedure and color maintenance data to be provided with submittal in a graphical format to show exact spatial movement of each test sample.

2. Lumen and Color Maintenance Criteria of white LEDs

   a. Lumen Maintenance: The luminous flux of the Source shall not depreciate more than 20 percent after 50,000 hours of use as extrapolated from LM-80 test data using the TM-21 calculation.

   b. Reliability Data Submission for color and lumen maintenance: TM-21 extrapolation curve must be provided prior to fixture submission.

M. ANSI Standards: LED fixtures shall meet ANSI Standards C78.377-2008, Specifications for the Chromaticity of Solid-State Lighting Products, and C82.37-2011, Harmonic Emission Limits – Related Power Quality Requirements for Lighting.

N. IES LM-79 and LM-80: LED Fixtures shall be LM-79-08, Electrical and Photometric Testing of Solid-State Lighting Devices, and LM-80-08, Measuring Lumen Depreciation of LED Light Sources, tested and approved.

O. NEMA: LED Diodes and Electronic Drivers shall comply with NEMA guideline SSL-3-2010, High-Power White LED Binning for General Illumination, and SSL-1-2010, Electronic Drivers for LED Devices, Arrays, or Systems.

2.9 LED DRIVERS: GENERAL REQUIREMENTS

A. All hardwired connections to LED fixtures shall be reverse polarity protected and provide high voltage protection in the event connections are reversed or shorted during the installation process.

B. Drivers shall operate at 120 volts and 277 volts with +/- 10 percent variation tolerance.

C. LED Driver shall operate LED Line modules.

D. LED Drivers should have Class 2 output.

E. LED Driver shall have wide operating window to accommodate variation in Led count and forward voltage variation over life and operating conditions.

F. LED Driver shall have adjustable output current to optimize lumens and efficacy of luminaires.

G. When using PMS - Pulse with Modulated Signal (applied to the CTRL pin than can change the LED current) to adjust the brightness of white LED, fixture sample shall be tested at the site prior submission of the PO in order to be tested for electromagnetic and radio interference.

H. LED Driver should have functionality to protect LED module by monitoring module temperature.

I. LED Driver shall have connectors suitable for field wiring.

J. LED Driver shall have maximum case temperature of 75 deg. C.

K. The enclosure case of the driver must be connected to earth ground when installed in the end-use application.

L. All LED fixtures and power/data supplies shall be provided by a single manufacturer to ensure compatibility. LED Manufacturer shall have at least eight years of experience designing, selling and supporting intelligent LED systems.

M. Total Harmonic distortion (THD): Less than 20 percent at maximum load under all input voltage.

N. Power Factor shall be greater than 0.9.

O. Driver shall tolerate sustained open circuit and short circuit output conditions without damage.

P. Drivers shall meet all the Regulatory requirements:

1. Driver shall not contain any Polychlorinated Biphenyl (PCB).
2. Driver shall be Underwriters Laboratories (UL) recognized for Dry and Damp location and Canadian Standards Association (CSA) certified where applicable.
3. Driver shall be compliant to UL 1310, First Edition, revised dated November 1, 2011.
4. Driver shall comply with ANSI C62.41 Category A for Transient protection.
5. Driver shall comply with ANSI C82.11 where applicable.
6. Driver shall comply with the requirements of the Federal Communications Commission (FCC) rules and regulations, part 15 (Radio Frequency Devices) and 18 9dor industrial, scientific and medical equipment)
7. Driver shall comply with NEMA 410 for in-rush current limits.
8. Driver shall meet the RoHS Directive 2002/95EC on the restriction of hazardous substances such as lead, cadmium, mercury, hexavalent chromium, PBBs and PBDEs
9. Driver shall be manufactured in a factory certified to ISO 9001 Quality System Standards.

Q. Driver replacement parts must be aproved by the lighting fixture manufacturer prior installation.

R. Title 24 compliance: (applicable for the projects that require compliance)o

1. Provide independent circuits and Indepent control from other electrical loads.
2. Driver shall allow for multi-level control and dimming for areas with LPD larger than 0.5 W/ft.
   a. The LED system shall be scalable, with every LED fixture/address in the system capable of being controlled by a single, centralized controller.
3. All LED Drivers should be dimmable with a 0-10 V dimming circuit, unless otherwise indicated in the lighting fixture schedule
4. 0-10V Dimming shall follow ANSI.
5. LED drivers shall be compatible with demand responsive control if the building is bigger than 10k square feet.
6. LED drivers shall be compatible with system that allows disaggregation of electrical circuits control if the building is bigger than 10k square feet.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

3.3 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and re-lamping.
3. Provide support for luminaire without causing deflection of ceiling or wall.

4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.

E. Flush-Mounted Luminaire Support:

1. Secured to outlet box.
2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
3. Trim ring flush with finished surface.

F. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls, attached using through bolts and backing plates on either side of wall, or securely mounted as wall construction permits.
2. Do not attach luminaires directly to the gypsum board.

G. Ceiling-Mounted Luminaire Support:

1. Ceiling mount with two 5/32-inch diameter aircraft cable supports adjustable to 120 inchesin length.
2. Ceiling mount with pendant mount with 5/32-inch diameter aircraft cable supports adjustable to 120 inchesin length.
3. Ceiling mount with hook mount.

H. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing or rod or wire support for suspension for each unit length of luminaire chassis, including one at each end.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.
5. Continuous Rows longer that 60”, where fixture is one piece or an assembly of multiple sections to complete row lengths as defined in specifications:
   a. Fixtures should be hung straight and true with no waivers or sag initially or over time.
   b. All suspension points for that fixture shall be perfectly aligned to avoid visible bending and misalignment along the continuous row.
   c. Provide alignment splines at housing joints to assure tight hairline joints and perfect alignments between housings

I. Ceiling-Grid-Mounted Luminaires:

1. Secure to any required outlet box.
2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

J. Comply with requirements in Division 26 for wiring connections.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. Comply with requirements for startup specified in Division 26.

3.7 AIMING AND ADJUSTING

A. Occupancy Adjustments: When requested within 3 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
1. All adjustable lighting units shall be aimed, focused, locked, etc., by the Subcontractor under the supervision of the Lighting Consultant. The Lighting Consultant shall indicate the number of crews (foreman and apprentice) required. All aiming and adjusting shall be carried out after the entire installation is complete. All ladders, scaffolds, etc. required shall be furnished by the Contractor at the direction of the Lighting Consultant. As aiming and adjusting is completed, locking set-screws and bolts and nuts shall be tightened securely.
2. Adjust the aim of luminaires in the presence of the Architect and/or end user shall provide written instruction for aiming intent for all the adjustable fixture.

3.8 APENDIX A

A. Lighting fixture cuts

END OF SECTION

SECTION 283105 - FIRE ALARM CABLES AND PATHWAYS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Certain requirements common to all the mechanical and electrical trades (Fire Suppression, Plumbing, HVAC, Electrical, and Tele/Data) are specified in Division 20. To avoid repetition, they are not repeated in each relevant Division of the Specifications. However, these requirements are applicable to the work of this Division, and are hereby incorporated by reference.

B. 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 cables.
2. Fire-resistive data cables.
3. Fiber-optic cables and hardware.
4. Fire alarm terminal cabinets.
5. Fire alarm raceway and boxes.

1.3 DEFINITIONS

A. Dedicated Continuous Metal Raceway: Enclosed metal pathway dedicated to power-limited fire alarm cable; comprised of and limited to: EMT, IMC, RGS, FMC, and / or LFMC as specified.

1.4 ACTION SUBMITTALS

A. Product Data: For each fire alarm cable application, including cable type, wire size, shielding, and electrical characteristics.

1. Include statement endorsed by the manufacturer’s authorized representative that the electrical characteristics of the submitted fire alarm cables are within all operating parameters of the fire alarm system as designed and represented by the detailed fire alarm system Shop Drawings.

B. Product Data: For fire alarm terminal cabinets, including furnished options and accessories.

1.5 INFORMATIONAL SUBMITTALS

A. Record of Inspection and Testing: For field wiring inspection and testing; for each circuit indicate measured values and corresponding acceptance criteria for circuit continuity, resistance, stray voltage, ground-faults, short-circuit-faults, and any other manufacturer recommended conductor field testing parameters.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.7 SYSTEM TRACING PRIOR TO DEMOLITION

A. Contractor shall trace out existing fire alarm system wiring, conduit, pathways, etc prior to demolition and shall report to engineer of record any cabling that will require demolition or relocation. Contractor shall provide pricing allowance for this work.

PART 2 - PRODUCTS

2.1 FIRE ALARM CABLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Belden Inc.
2. Southwire Co.
3. West Penn Wire.
4. Windy City Wire.

B. Fire Alarm Cable: UL 1424, Type FPL, FPLR and FPLP**,** power-limited fire alarm cable; red-jacketed, twisted-pair and parallel-pair insulated solid copper conductors; unshielded and shielded.

C. Fire Alarm Water Resistant Cables: UL 444 & UL 13 and TIA455-82B Water Infiltration Test, power-limited fire alarm cable, twisted-pair insulated stranded copper conductors; unshielded and shielded.

D. Minimum Fire Alarm Cable Conductor Size:

1. Auxiliary (24 Vdc) Power: 14 AWG / 2C.
2. Data Communications Network: 16 AWG / 2C.
3. Digital Voice Riser: 16 AWG / 2C.
4. Notification Appliance Circuits: 14 AWG / 2C.
5. Relay Circuits: 14 AWG / 2C.
6. RS Serial Data Communications: 18 AWG / 2C.

7. Signaling Line Circuits: 16 AWG / 2C.
8. Speaker Circuits: 16 AWG / 2C.
9. Supervision Circuits: 16 AWG / 2C.

E. Data and Voice Circuits:

1. Fire alarm cable for Data Communications Network, Digital Voice Riser, Signaling Line Circuits, Speaker Circuits, RS Serial Data Communications, and other manufacturer-specific data and voice circuits shall be shielded, twisted-pair unless fire alarm manufacturer's installation guidelines recommend or require unshielded twisted-pair cable.
2. Fire alarm cable electrical characteristics for Data Communications Network, Signaling Line Circuits, RS Serial Data Communications, and other manufacturer-specific data circuits shall comply with the fire alarm manufacturer limitations for linear-unit and total-circuit capacitance and resistance.

2.2 FIBER OPTIC CABLES FOR FIRE ALARM

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Belden Inc.
2. CommScope, Inc.
3. Corning Cable Systems.
4. General Cable Technologies Corporation.
5. Optical Cable Corporation.
6. 3M Communication Markets Division.
7. Tyco Electronics Corporation; AMP Products.

B. Description: Single-mode, 9/125-micometer, 6-strand minimum, tight buffer, fiber optic cable; with performance characteristics to satisfy fire alarm system manufacturer requirements for digital network and voice applications.

1. Multi-mode fiber permitted where required by fire alarm system manufacturer.
2. Comply with ICEA S-83-596 for mechanical properties.
3. Comply with TIA/EIA-568-B.3 for performance specifications.
4. Comply with TIA-492-CAAA for detailed specifications.
5. Maximum Attenuation (Premises): 1.0 dB/km at 1310 nm; 1.0 dB/km at 1550 nm.
6. Maximum Attenuation (Outside Plant): 0.5 dB/km at 1310 nm; 0.5 dB/km at 1550 nm.

C. Jacket:

1. Jacket Color: Yellow for 9/125-micrometer cable.
2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-C.

3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.

2.3 OPTICAL FIBER CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Belden Inc.
2. Corning Cable Systems.
3. Optical Cable Corporation.
4. 3M Communication Markets Division
5. Tyco Electronics Corporation; AMP Products.

B. Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.

1. Number of Connectors per Field: One for each cable of fibers assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.

C. Patch Cords: Factory-made, dual-fiber cables in 36-inch lengths.

D. Cable Connecting Hardware:

1. Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA-604-2-B, TIA-604-3-B, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.
2. Quick-connect, simplex and duplex, Type SC or Type LC connectors. Insertion loss not more than 0.75 dB.
3. Type SFF connectors may be used in termination racks, patch panels, and equipment enclosures.

2.4 FIRE ALARM TERMINAL CABINETS

A. Enclosure: 16-gauge steel; factory applied red enamel finish; removable hinged door with keyed locking latch; with embedded 1/2 inch, 3/4 inch, 1 inch, 1-1/2 inch and 2 inch knockout clusters.

B. Terminals: Each terminal pole with quick-connect wire termination points and integral test port; sized to accept 20 - 12 AWG and rated for 20 amp at 250V (Class B/UL) 300V (CSA).

C. Identification: Marked “FIRE ALARM TERMINAL CABINET” in 2-inch white factory applied indelible screened lettering; field identification labels on the inside cover corresponding to the terminal strip’s labeling inside the back box.

D. Basis-of-Design Product: Subject to compliance with requirements, provide IF-Series fire alarm terminal cabinets, manufactured by Space Age Electronics Inc.

2.5 FIRE ALARM RACEWAY AND BOXES

A. Comply with Division 26.

1. Finish: Factory applied red finish for cover plates and connectors.

PART 3 - EXECUTION

3.1 GENERAL

A. Comply with NFPA 70 and NFPA 72.

B. Unless more restrictive requirements are noted in Division 28, comply with applicable Division 26 sections for the installation of low voltage electrical systems.

C. Comply with Division for NFPA 72 pathway Class and Survivability Level requirements.

D. Install fire alarm system pathways and cables in accordance with the reviewed fire alarm system Shop Drawings. Where field modifications of layout are necessary, obtain prior approval from the fire alarm system vendor's qualified fire alarm system designer.

3.2 FIRE ALARM PATHWAY INSTALLATION

A. Pathways for Fire Alarm: The pathway system for fire alarm shall be dedicated continuous metal raceway throughout.

1. Comply with Division 26 for application and installation of EMT, IMC, RGS, FMC, and LFMC with respect to environmental conditions and resistance to physical damage.

B. Pathways beneath Slab, Within Slab, and Buried: Comply with Division 26 for applicable RNC installation requirements.

C. Class A and X Pathways: Unless greater distances are indicated on the Drawings or Specifications, install Class A and X pathways in compliance with NFPA 72 recommendations for minimum horizontal and vertical separation between supply and return pathways.

3.3 FIRE ALARM CABLE INSTALLATION

A. Install fire alarm cables within dedicated continuous metal raceway throughout. Wiring shall be continuous between equipment, device, and appliance terminals without splices.

B. T-tapping: Not permitted for any fire alarm circuit.

C. Do not install fire alarm system wiring within conduits, junction boxes, or outlet boxes containing conductors of lighting or power systems.

D. Separate power-limited and non-power-limited conductors within enclosures as recommended by the manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess.

E. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams.

F. Not more than two conductors shall be installed under any device screw terminal. The wires under the screw terminal shall be straight when placed under the terminal then clamped in place under the screw terminal. The wires shall be broken and not twisted around the terminal.

3.4 FIBER OPTIC CABLE FOR FIRE ALARM INSTALLATION

A. Comply with TIA/EIA-568-B.3.

B. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

3.5 GROUNDING

A. Comply with Division 26.

3.6 FIELD QUALITY CONTROL

A. Field inspections and testing shall be performed by fire alarm system manufacturer's factory-authorized service technicians.

B. End-to-end cabling shall be considered defective if it does not pass tests and inspections.

C. Perform visual wiring inspections in accordance with fire alarm system manufacturer recommendations. Correct deficiencies.

D. Test wiring in accordance with fire alarm system manufacturer requirements and NFPA 72 for Initial Acceptance Testing of conductors. Correct deficiencies.

E. Document inspections and tests via formal inspection test and report(s).

END OF SECTION

SECTION 283111 - DIGITAL, ADDRESSABLE FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, including 01 26 42 Amendments (Section E0 for single / soul source approval, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Notification appliances.

1.3 DEFINITIONS

A. ADS: Acoustically Distinguishable Space.

B. AHJ. Authority Having Jurisdiction.

C. BMS: Building Management System.

D. EVACS: Emergency Voice Alarm Communication System.

E. FACU: Fire Alarm Control Unit.

F. FATC: Fire Alarm Terminal Cabinet.

G. IDC: Initiating Device Circuit.

H. NAC: Notification Appliance Circuit.

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

J. PSTN: Publically Switched Telephone Network.

K. SLC: Signaling Line Circuit.

1.4 SUBMITTALS

A. Comply with Division 20 for common mechanical/electrical requirements.

B. Comply with Division 28 specifications and drawings; state/local regulations; and NFPA 72 - Chapter “Documentation”. For purposes of applying NFPA 72, all identified documentation requirements are a mandatory part of the Work, including those that “apply only where required by other governing laws, codes, or standards, by other parts of the Code; or by project specifications or drawings”.

C. Submit Action Submittals prior to applying for authority having jurisdiction installation permits (where required) and system installation.

D. Submit Informational Submittals after successful initial system testing and prior to scheduling authority having jurisdiction final approval demonstration testing.

E. Submit Closeout Submittals as part of project closeout procedure.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product, including furnished options and accessories.

1. Include approvals and listings, construction details, material descriptions, dimensions, profiles, and finishes.

2. Include rated capacities, operating characteristics, and electrical characteristics.

3. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements of this Specification and of NFPA 72.

B. Shop Drawings: For fire alarm system and fire safety control interfaces.

1. Floor Plans. Include floor plans to indicate final equipment, cabinet, device and appliance locations. Indicate address of each addressable device. Show all interface modules. Show candela setting for each strobe appliance. Show complete point-to-point routing of all circuits and pathways; indicate Class and Survivability Level. Show size and type of all conduits, cable, wire, and conductors. Indicate panel circuit designation for each normal power supply branch circuit.

2. Riser Diagram. Include complete device/appliance accurate riser diagram. Indicate address of each addressable device. Show all interface modules. Show candela setting of each strobe appliance. Show each circuit and pathway; indicate Class and Survivability Level. Show size and type of all conduits, cable, wire, and conductors. Indicate panel circuit designation for each normal power supply branch circuit.

3. Equipment Wiring Diagrams. Include wiring diagrams for each system component/node including control unit cabinets, remote power supply cabinets, terminal cabinets, remote annunciators, supervising station transmitters, and PC workstations.

4. Component Wiring Diagrams. Include typical wiring diagrams for fire detector bases, pull stations, conventional devices, interface modules including wiring connections to supervised/controlled equipment, notification appliances, and component modules and cards.

5. Ductwork Smoke Detector Plans. Include installation details for typical ductwork detector condition. Show plan and section view for each condition. Show requirements for ductwork attachments, penetrations, and access panels.

6. Calculations - Voltage Drop. Include voltage drop calculations inclusive of safety/spare capacity factor(s) for notification-appliance circuits. Calculations shall assume alarm operation using the minimum standby power available at the conclusion of quiescent and alarm phases of operation.

7. Calculations - Power Supply and Battery Capacity. Include power capacity calculations inclusive of safety/spare capacity factor(s) for each system power supply and connected battery set.

8. Calculations - Conduit Fill. Include conduit fill calculations prepared in accordance with the National Electric Code.

9. Sequence of Operation. Include complete and detailed input/output sequence of operation matrix. Supplement matrix with narrative descriptions for complex specialty sequences.

10. Emergency Voice/Alarm Communication Systems; additionally:

    a. Floor Plans. Indicate amplifier equipment cabinets, primary and remote paging locations, and associated circuits and pathways. Show wattage tap and corresponding ADS for each speaker. Indicate circuit pathway Class and Survivability Level.

    b. Equipment Wiring Diagrams and Component Wiring Diagrams. For amplifier racks, remote microphone stations, and speaker appliances.

    c. Amplifier Loading. For each speaker circuit, identify quantity of speakers at each wattage tap setting and total connected wattage per circuit and per amplifier. Demonstrate calculated loading inclusive of safety/spare capacity factor(s) is accommodated by amplifier nominal power (watts) capacity.

    d. Audio dB Loss Calculations. For each speaker circuit.

    e. Power Supply Battery Capacity Calculations. For each amplifier array power supply and connected battery set, inclusive of safety/spare capacity factor(s).

C. Existing Conditions Pathway Report

1. Drawings and narrative indicating the existing fire alarm pathways that are required to be relocated to accommodate the architectural and mechanical scope of work.

2. Report shall be submitted prior to start of construction to architect and engineer of record.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer and Certified Engineering Technician.

B. Record of Inspection and Testing. Detailed documentation of completed 100 percent fire alarm and signaling system initial acceptance testing. Use NFPA 72 “System Record of Inspection and Testing” forms.

C. Statement of Completion: Written statement that system has been installed in accordance with approved plans and tested in accordance with the manufacturer’s published instructions and appropriate NFPA 72 requirements.

D. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Record of Completion. Provide detailed description of installed, tested, and approved fire alarm and signaling system; including description of protected premises, fire alarm system and component sub-systems, fire safety function interfaces, monitoring service,

and all other information required by NFPA 72. Use NFPA 72 “System Record of Completion” forms.

B. Record Drawings. Provide complete Shop Drawing re-submittal updated to reflect actual final system installation and sequence of operation of all components.

C. Device address list. Provide complete device address list organized by SLC loop and system node.

D. System type detectors shall be tested for their sensitivity compensation head room range (% dirty). Detectors shall not be greater than 20% dirty for their compensation range. Detectors over 20% shall be clean or replaced per the manufacturer’s requirements.

E. Operation and Maintenance Data: For fire alarm systems and components to include in emergency, operation, and maintenance manuals.

1. Provide manufacturer's Owner’s Operation and Maintenance Manuals with required related system warranty requirements.

2. Provide NFPA 72 “Inspection, Testing, and Maintenance” tables indicating required component inspection and testing activities and frequencies.

3. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:

F. Software and Firmware Operational Documentation:

1. Provide software operating and upgrade manuals.

2. Site-specific Software Backup: Provide on compact solid state USB storage device or compact disk; complete with data files.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Personnel licensed by the governing licensing authority for the installation of fire alarm systems. Successfully installed, tested, obtained approvals for, and put into service no less than three (3) fire alarm systems similar in type, size, and complexity to that of the Work of this Section.

B. Certified Engineering Technician Qualifications: Personnel trained and certified by the fire alarm system manufacturer as an approved technician.

1. Shop Drawings and Calculations prepared by personnel certified by NICET as fire alarm Level III or IV technician, or licensed as a Professional Fire Protection Engineer by the governing licensing authority.

C. Source Limitations for Fire Alarm System and Components: Single vendor source to provide fire alarm system components and connected non-system components as a single listed addressable fire alarm and signaling system.

1. Modifications to Existing Systems: Components compatible with, and operate as an extension of, existing system.

D. Product Standards: Listed in the "Fire Protection Equipment Directory" published by UL or the "Approval Guide" published by FM Global.

1. Subject to compliance with requirements, indication of a UL product requirement within Part 2 shall be construed to be inclusive of a corresponding FM Global approved product, with or without UL listing.

E. 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. Explosion-Proof: Listed and labeled for use in “Hazardous (Classified) Locations”; Class and Division listing appropriate to intended location and application.

1.9 COORDINATION

A. Definition, “Coordinate”: Where Sections of the Work interact, the Contractor responsible for this Section of the Work initiates verbal and/ or written communication with one or more different Contractors responsible for other interacting Sections of the Work for the purposes of establishing a coordinated approach of product selections and installation sequencing that satisfies the individual requirements of the interacting Sections of the Work as well as the requirements of the Work as a whole.

B. Coordinate construction operations with those of other Sections of the Work and other entities to ensure efficient and orderly installation of each part of the Work.

C. Coordinate operations and product selections of this Section with operations and product selections included in different Sections that depend on each other for proper installation, connection, and operation.

D. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.

E. Coordinate installation of different components with other Sections of the Work to ensure maximum performance and accessibility for required maintenance, service, and repair.

F. Make adequate provisions to accommodate items scheduled for later installation.

G. Coordination Drawings: Contribute to preparation of Coordination Drawings in the sequence established under Division 1 and Division 20; indicate water-based fire suppression system Work coordinated with other Sections of the Work.

1.10 MAINTENANCE 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. Smoke Detectors and Heat Detectors: Five (5) of each type installed.
2. Detector Bases: Five (5) of each type installed.
3. Audible and Visual Notification Appliances: Five (5) of each type installed.
4. Keys and Tools: One extra set for access to locked or tamper-proof components.

5. Fuses: Two (2) of each type installed in the system. Provide in a box or cabinet with compartments marked with fuse types and sizes.

1.11 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace fire alarm system equipment and components that fail in materials or workmanship within specified warranty period.

1. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.

2. Warranty Period: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products listed as a component of a single addressable fire alarm and signaling system technology platform by the following:

1. Edwards Fire Safety, (EST3)

B. Where additional manufacturer listings or basis of design products are indicated, provide products listed and duty-rated as compatible with the selected fire alarm and signaling technology platform.

2.2 SYSTEM DESCRIPTION

A. UL 864; non-coded, microprocessor-based addressable protected premises fire alarm and signaling system, with multiplexed signal transmission and audible/visual evacuation signaling. All components provided listed for use and compatible with fire alarm system head-end FACU.

B. Protected premises backbone architecture comprised of multiple fire alarm control units and system components networked via peer-to-peer communications node network.

C. Control units, system components, and power supplies inclusive of boards, drivers, and expansion modules necessary to support the specified system performance criteria, minimum quantity of circuits, and NFPA 72 circuit pathway class designations.

D. System circuiting and component power loading to provide minimum specified spare capacities, safety factors, and redundancies.

E. Special Alarm Signal Processing – RESERVED.

F. NFPA 72 Pathway Class (Performance During Fault) and Survivability Level (Fire Resistance):

1. Addressable signaling loops.

a. Circuit Type: SLC.

b. Pathway Class: A.

c. Class A Short-circuit Fault Isolation Modules or Bases Located as Follows:

1) At each SLC exit/entry point of from/to a control unit or terminal cabinet.

2) No more than twenty (20) addressable devices between isolation modules at any point on SLC.

3)

d. Pathway Survivability Level: **0**.

2. Audible and intelligible public mode signaling (occupant evacuation).

a. Circuit Type: NAC.

b. Pathway Class: B.

c. Pathway Survivability Level: 0.

3. Visible public mode signaling (occupant evacuation).

a. Circuit Type: NAC.

b. Pathway Class: B.

c. Pathway Survivability Level: 0.

4. Audible and visible private mode signaling.

a. Circuit Type: NAC.

b. Pathway Class: AB.

c. Pathway Survivability Level: 0.

5. Supervision of conventional devices.

a. Circuit Type: IDC.

b. Pathway Class: B.

c. Pathway Survivability Level:0.

6. Fail-safe operation, magnetic door holders and similar.

a. Circuit Type: Fail safe.

b. Pathway Class: D.

c. Pathway Survivability Level: 0.

7. Communication between fire alarm network nodes and digital audio risers.

a. Circuit Type: Comm and DVC.

b. Pathway Class: X.

c. Pathway Survivability Level: 3.

G. All addressable circuits designed and installed without T-taps.

H. Maximum 100 addressable alarm-initiating devices on each SLC.

I. No fewer than two (2) visible and two (2) audible NAC's serving each protected premises fire area or evacuation zone. Unless noted otherwise, notification appliances circuited such that no two adjacent appliances are connected to the same NAC.

J. Component Primary Power: 24-V dc obtained from premises AC power supply.

1. Capacity: Alarm current draw of components connected to each power-supply module no greater than 80 percent of the power-supply module rating.

K. Component Standby Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.

1. Base Capacity: System operation for twenty-four (24) hours under quiescent load plus fifteen (15) minutes operating all alarm notification appliances.

2. Spare Capacity: 20 percent.

L. Remote power supplies used as distributed power sources only and not as in-line circuit power "boosters".

M. Fire alarm system listed for protected premises in-building Emergency Voice Alarm Communications System (EVACS) service utilizing digital multi-channel technology:

1. Fire Emergency Voice Alarm Communications Systems (EVACS); comply with UL 864, 1480, and 1711.

2. Mass Notification System (MNS); comply with UL 2572.

3. Amplifier loading no greater than 80 percent of rated power capacity (Watts).

4. Complete functional integration (common audio circuits and speakers) of protected premises fire alarm in-building EVACS and premises Public Address System (PAS).

N. Fire alarm system interfaces with other premises building systems including Fire Suppression, HVAC, Vertical Transportation, Audio/Visual, Public Address, Access Control, Fire Protection Opening Protectives, Emergency Power, and similar for all code-required and project-specified fire safety supervision and functional control.

O. Wide-area Campus/Site Integration.

1. Complete functional integration of protected premises in-building fire alarm network nodes with wide-area campus/site fire alarm node network to form a global peer-to-peer fire alarm network.

2. Complete functional integration of protected premises in-building fire alarm network nodes with wide-area campus/site fire alarm node network via contact-id signal transmission to proprietary supervising station alarm receiver.

3. Complete functional integration of protected premises in-building EVACS and campus/site Wide Area Mass Notification System (WAMNS).

2.3 PERFORMANCE REQUIREMENTS

A. Operational Performance: Fire alarm system shall process alarm, supervisory, and trouble status signals and perform associated output functions in compliance with NFPA 72, Division 28 and Drawings "Input/Output Matrix".

B. Circuit Integrity and Fault Performance: Fire alarm system circuit integrity and functional performance capability under fault conditions shall comply with the NFPA 72 circuit Class designations as indicated within the “System Description” Article and as indicated on the Drawings.

C. Survivability Performance: Fire alarm system fire resistive performance capability shall comply with the NFPA 72 circuit Level designations as indicated within the “System Description” Article and as indicated on the Drawings.

D. Design and Installation Standard(s):

1. Fire Alarm Systems: Comply with NFPA 72.

2.4 EMERGENCY VOICE ALARM COMMUNICATION SYSTEMS

A. General: NFPA 72 compliant, digital, multi-channel, one-way emergency voice alarm communication system for automatic and manual voice broadcast of fire or other emergency instructions and signals; distributed system architecture with central master audio controller and distributed amplifier arrays connected via digital voice audio riser.

B. Master Audio Controller: Solid-state digital multi-channel audio controller with digitized alarm tones and digitally recorded voice messages stored in on-board memory.

C. Tones and Messages: Selectable evacuation tones (Temporal-3, Slow/Fast Whoop, GSA), standard digitally pre-recorded voice messages and digitally recorded custom voice messages. Module on-board memory capacity sufficient for minimum of 32 minutes total message duration at standard resolution.

D. Amplifiers: UL 1711, digital, multi-channel, power-limited 25 or 70 VRMS, with on-board test switches and indicators.

1. Self-Backup Mode: Automatically re-route NAC’s connected to a disabled amplifier channel to remaining active amplifier channel(s).

2. Degrade Mode: On-board temporal pattern horn tone for default backup signaling over connected NAC’s.

E. Amplifier Supervision: Digital communication between amplifiers and controller for supervision and indication of amplifier status and operating power and voltage values.

F. Microphone Module: Push-to-talk integral corded microphone for manual voice messaging; with local speaker, volume controls, and LED status indicators.

G. Controls and Status Indicators:

1. Indicators: LED indicators for indication of system status and operation of user selected functions.

2. Function-keys: Membrane switch buttons with corresponding LED indicators for selective user initiation of voice messaging and evacuation functions on a premises-wide or per- zone basis.

H. Auxiliary Audio Inputs: Audio controller capable of accepting line-level auxiliary audio source input for re-broadcast over emergency voice speaker circuits.

I. Auxiliary Audio Outputs: Audio controller capable of transmitting line-level auxiliary audio source output for re-broadcast over another system's emergency or non-emergency voice speaker circuits.

J. Cabinet Enclosures: Comply with Article "Fire Alarm Control Units" for cabinet enclosures. Modules and amplifiers mounted within cabinet enclosures common to FACU and within dedicated solid-door remote amplifier array cabinet enclosures.

2.5 NOTIFICATION APPLIANCES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Same manufacturer as the selected manufacturer of the fire alarm and signaling system technology platform.
2. Edwards Signaling.

B. General Performance Requirements for Notification Appliances: Signaling appliances connected to notification appliance circuits for NFPA 72 public operating mode signaling to building occupants protected by the fire alarm system; and private operating signaling to those persons directly concerned with implementation and direction of emergency action and procedures. Appliance assemblies include audible/intelligible**,** visible, and combination type as indicated on Drawings.

C. Mounting: Wall or ceiling mount as indicated on Drawings.

D. Housing: Thermoplastic, impact resistant, and flame retardant.

E. Finish: Red housing with White contrasting engraved lettering.

F. Identification: Engraved lettering on housing indicating "FIRE".

G. Weather proof applications: Listed for indoor and outdoor installation.

2.6 AUDIBLE/INTELLIGIBLE NOTIFICATION APPLIANCES

A. Comply with "Notification Appliances" Article.

B. Speakers: UL 1480, 25 or 70 nominal VRMS speaker within dedicated housing, listed sound pressure level of 90 dBA measured at 10 feet.

1. Frequency Range: 400 to 4000 Hz.
2. Wattage Taps: Field selectable 0.25 W, 0.50 W, 1.0 W, 2.0W.

C. High-Range Audible and Intelligible Notification Appliances (Re-entrant Speakers):

1. UL 1480, 25 or 70 nominal VRMS, listed sound pressure level of 102 dBA measured at 10 feet.
2. Frequency Range: 400 to 14000 Hz.
3. Wattage Taps: Field selectable 0.9, 1.8 W, 3.8 W, 7.5 W, 15.0 W.
4. Finish: Red.

D. High-fidelity Speakers – Provide high fidelity speakers in Animal Holding Rooms.

1. Frequency: 520 Hz.
2. Wattage Taps: Field selectable 0.25 W, 0.50 W.

2.7 VISIBLE NOTIFICATION APPLIANCES

A. Comply with “Notification Appliances” Article.

B. Strobes: UL 1971, LED with clear polycarbonate lens mounted on an aluminum faceplate and field selectable candela output setting within dedicated housing, 24-V dc; with candela setting indicator visible through viewing window.

1. Strobe flashing in temporal pattern, synchronized throughout each evacuation zone and synchronized between evacuation zones where strobes from multiple evacuation zones can be observed by a single viewer.
2. Comply with Drawings for appliance candela output.
3. Where existing circuiting have Xenon type, xenon type strobes are acceptable.

C. Flashing Beacons: UL 1638; 6-inch diameter, red lens beacon, 24-V dc; listed for indoor and outdoor applications.

2.8 COMBINATION AUDIBLE/INTELLIGIBLE AND VISIBLE NOTIFICATION APPLIANCES

A. Combination audible/intelligible and visible notification appliance with audible and visible signaling elements assembled within a common housing.

1. Audible/intelligible speakers - comply with “Audible/Intelligible Notification Appliances” Article.
2. Visible strobe - comply with “Visible Notification Appliances” Article.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare and submit “Action Submittals” prior to equipment procurement.

3.2 TECHNICIAN DESIGN AND LAYOUT

A. Roles and responsibilities shall be as set forth in NSPE Position Statement No. 1749 “SFPE/NSPE/NICET Joint Position of the Engineer and the Engineering Technician Designing the Fire Protection System”, available at nspe.org. As applied to the Work, the Contract Documents have been prepared by the “Engineer” and Shop Drawings required by this Section of the Work are prepared by the “Certified Engineering Technician”.

B. As the Certified Engineering Technician, prepare Shop Drawings including drawings, calculations, certifications, and statements indicating system layout, circuiting, and capacities in accordance with the requirements of the Contract Documents.

C. Design and Installation Standard(s): NFPA 70 and NFPA 72.

D. Comply with the performance requirements indicated by the Contract Documents where such requirements are more stringent than those of the Design and Installation Standard(s); otherwise, comply with the performance requirements of the Design and Installation Standard(s).

3.3 EXAMINATION

A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.

1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.

B. Confirm fire resistance rating of building construction required to perform as fire alarm system Survivability protection before installation.

C. Examine depth of stud walls to verify clearance for flush-mount equipment before installation.

D. Examine roughing-in for electrical connections to verify actual locations of connections before installation.

E. Examine proposed mounting locations of equipment cabinets with user displays and/or controls with the local fire official to verify satisfactory access and ease of identification before installation.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.4 EQUIPMENT INSTALLATION

A. Comply with the most restrictive requirements of this Section and applicable Division 26 sections for the installation of low voltage electrical systems.

B. Comply with NFPA 72, and requirements of authorities having jurisdiction for installation and testing of fire alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."

C. Install fire alarm system in accordance with the reviewed fire alarm system Shop Drawings. Where field modifications of layout are necessary, obtain prior approval from the fire alarm system vendor’s qualified fire alarm system designer.

D. Arrange equipment cabinets, wire-ways, and conduits with adequate clearances to facilitate access for inspection, maintenance, and component replacement.

E. Flush-mount equipment cabinets/back-boxes not located in designated equipment rooms.

F. Flush-mount wall- and ceiling-mounted initiating devices, modules, indicators, and notification appliances unless otherwise indicated.

G. Surface-mount equipment cabinets/back-boxes located in designated equipment rooms.

H. Surface-mount initiating devices, modules, indicators, and notification appliances installed on concrete or masonry unit walls.

I. Surface-mount initiating devices installed to the underside of building structure.

J. Surface-mount or pendant-mount notification appliances installed to the underside of structure.

K. Install ceiling mounted devices, modules, indicators and notification appliances in alignment with adjacent ceiling fixtures and centered within ceiling tiles.

L. Install wall mounted devices, modules, indicators and notification appliances in alignment with adjacent switches and wall fixtures.

M. Do not install addressable devices in areas subject to temperature extremes. Use conventional initiating devices supervised by addressable monitor modules remotely located within an adjacent conditioned space.

3.5 CABLE AND PATHWAY INSTALLATION

A. Comply with Division 28.

3.6 NOTIFICATION APPLIANCE INSTALLATION

A. Comply with Drawings and NFPA 72 “Notification Appliances”.

B. Wall-mounted Audible Notification Appliances: Install with top of appliance not less than 6 inches below the finished ceiling and not less than 90 inches below the finished floor.

C. Wall-mounted Visible and -Combination Audible/Visible Notification Appliances: Install with top of appliance not less than 6 inches below the finished ceiling and the entire appliance strobe lens not less than 80 inches and not more than 96 inches above the finished floor.

D. Install all wall-mounted notification appliances with top of appliance at a common elevation with respect to finished floor.

3.7 CONNECTIONS AND INTERFACES

A. Make connections to premises building systems and components via addressable interface modules. Include necessary interface modules, relays, wiring, resistors, and components as required to achieve the input/output sequence of operations performance criteria indicated by the Drawings.

B. Coordinate voltage and current ratings of connected components such that connections and interfaces operate within listed limitations. Use interposing relays where connected loads exceed rating of addressable interface modules.

C. Arrange connections and interfaces such that circuits are monitored for integrity as required by NFPA 72.

D. Interface to premises systems and components requiring fire alarm supervision of status with addressable interface monitor modules.

E. Interface to premises systems and components requiring Emergency Control Function Interface with addressable interface relay modules installed within 36 inches of the interface wiring termination point.

F. Each addressable interface relay module used for Emergency Control Function Interface shall include one (1) set of spare contacts for monitoring connection to the premises Building Management System, Security System, or similar secondary premises system.

G. For each HVAC air distribution unit, coordinate with Division 23 for exact interface requirements, quantity of fan drives, and detailed sequencing for proper shutdown of the associated air distribution equipment.

3.8 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with Division 26.

B. Label addressable initiating devices and bases and notification appliances. Comply with Drawings.

C. Install framed instructions adjacent to the fire alarm control unit. Installed instructions shall be typewritten computer printout instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

3.9 GROUNDING

A. Comply with Division 26.

B. Comply with fire alarm system manufacturer installation guidelines for grounding.

C. Ground fire alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire alarm control unit

3.10 FIELD QUALITY CONTROL

A. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.

B. Devices placed in service before all other trades have completed cleanup shall be replaced.

C. Field inspections and testing shall be performed by fire alarm system manufacturer’s factory-authorized service technicians.

D. Smoke Control Systems: In addition to Div. 28 fire alarm system inspection and testing requirements, perform additional inspections and integrated functional testing as required to support smoke control system Special Inspections commissioning.

E. Prepare a typewritten computer-output Test Plan that clearly establishes the scope of fire alarm and signaling system testing. Include at a minimum testing methods, personnel, duration, planned impairments, and required coordination for integrated testing of emergency control function interfaces.

F. Functional field tests shall be witnessed by the Construction Manager (CM) and their designees; provide notifications a minimum of two (2) weeks in advance.

G. Acceptance field testing shall be witnessed by the CM, their designees, and authorities having jurisdiction (AHJ); provide notifications a minimum of two (2) weeks in advance.

H. Perform visual inspections in accordance with fire alarm system manufacturer recommendations and NFPA 72 for Initial Acceptance Inspections. Correct deficiencies.

I. Document inspections by completing applicable sections of the NFPA 72 “System Record of Inspection and Testing” report.

J. Provide written notifications for functional field tests; include Test Plan.

K. Perform functional testing in accordance with accordance with fire alarm system manufacturer recommendations and NFPA 72 for “Initial Acceptance Testing”. Correct deficiencies. Repeat functional testing including retesting of unaffected components in accordance with NFPA 72 for “Reacceptance Testing”.

L. System type detectors shall be tested for their sensitivity compensation head room range (% dirty). Detectors shall not be greater than 20% dirty for their compensation range. Detectors over 20% shall be clean or replaced per the manufacturer’s requirements.

M. Document 100 percent satisfactory functional tests by completing remaining sections of the NFPA 72 “System Record of Inspection and Testing” report.

N. Submit NFPA 72 “Statement of Completion” and completed NFPA 72 “System Record of Inspection and Testing” report.

O. Provide written notifications for acceptance field tests; include Test Plan, NFPA 72 “Statement of Completion”, NFPA 72 “System Record of Inspection and Testing” report, and NFPA 72 “System Record of Completion”.

P. Perform acceptance field testing. Demonstrate system operation to the satisfaction of the AHJ. Correct AHJ noted deficiencies. Repeat functional testing including retesting of unaffected components in accordance with NFPA 72 for “Reacceptance Testing”. Amend NFPA 72 “System Record of Inspection and Testing” report, and NFPA 72 “System Record of Completion”.

Q. Place system into normal operating service without system faults or outstanding work.

3.11 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include **twelve (12)** months' full maintenance by skilled employees of manufacturer's designated service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

1. Perform visual inspections at intervals required by NFPA 72 Chapter “Inspection, Testing, and Maintenance”.

2. Perform tests at intervals required by NFPA 72 Chapter “Inspection, Testing, and Maintenance”.

3.12 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning with Substantial Completion, provide software support for two years.

B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.

1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

3.13 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire alarm system.

END OF SECTION