



PROJECT MANUAL

VOLUME 2 (of 3)

Divisions 09 thru 23

Architect's Project Number: 02303.000

EB Frink Middle School

405 N. Charles Street
La Grange, NC, 28551
Lenoir County, NC

Lenoir County Public Schools
2017 W. Vernon Avenue
Kinston, North Carolina 28504

February 18, 2025
Construction Documents



Set Number: _____

SECTION 00 01 01

PROJECT TITLE PAGE

Date	February 18, 2025 Construction Documents
Project Identification	EB Frink Middle School 405 N. Charles Street La Grange, NC 28551 Lenoir Count, NC Architect Project No.: 02303.000
Owner	Lenoir County Public Schools 2017 W. Vernon Avenue Kinston, North Carolina 28504 Phone: 252-527-1109
Architect	SfL+a Architects, PA 333 Fayetteville Street, Suite 225 Raleigh, NC 27601 Phone: 919-573-6350
Structural Engineer	Bennett and Pless 5430 Wade Park Blvd, Suite 400 Raleigh, NC 27607 Phone: 919-832-5587
Fire Protection Engineer Plumbing Engineer Mechanical Engineer Electrical Engineer Fire Alarm Engineer	Optima Engineering, PA Truist Building 434 Fayetteville Street, Suite 2450 Raleigh, NC 27601 Phone: 919-926-2200
Civil Engineer	Timmons Group 5410 Trinity Road, Suite 102 Raleigh, North Carolina 27607 Phone: 919-866-4951

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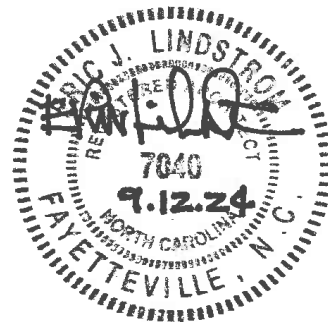
Architect

SfL+a Architects, PA
NC Corporate Registration
NC Registration Number 50676



Architect

SfL+a Architects, PA
Eric J. Lindstrom
NC Registration Number 7040



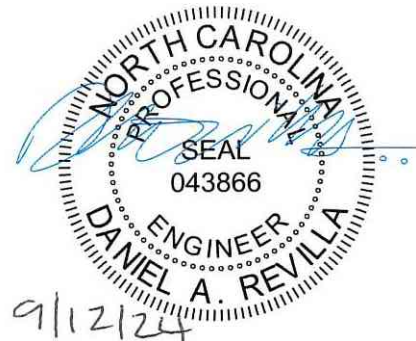
Structural Engineer

Bennett & Pless
Timothy K. Hilton
NC Registration Number 037412



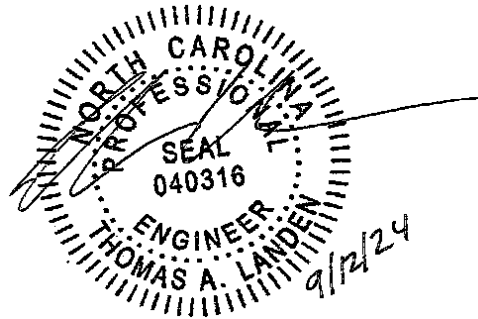
Fire Protection Engineer
Plumbing Engineer

Optima Engineering, PA
Daniel A. Revilla
NC Registration Number 043866



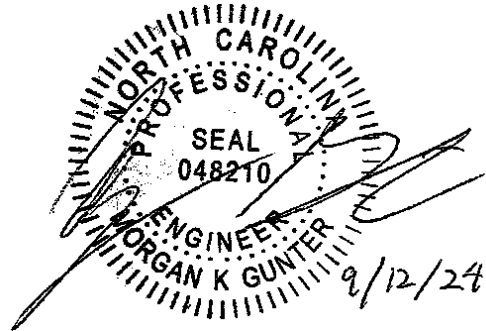
Mechanical Engineer

Optima Engineering, PA
Thomas A. Landen
NC Registration Number 040316



Electrical Engineer
Fire Alarm Engineer

Optima Engineering, PA
Morgan K. Gunter
NC Registration Number 048210



Civil Engineer

Timmons Group
Brandon L. McLamb
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GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Interior Gypsum Board.
 - 2. Exterior Gypsum Board.
 - 3. Framing.
 - 4. Suspension Support.
 - 5. Acoustic Attenuation.
 - 6. Accessories.
- B. Related Requirements:
 - 1. Section 01 33 00 – Submittal Procedures: Delegated-Design Services.
 - 2. Section 01 40 00 - Quality Requirements: Mockup requirements indicated in Schedule of Mockups at end of Section 01 40 00.
 - 3. Section 05 40 00 - Cold-Formed Metal Framing.
 - 4. Section 06 10 53 - Miscellaneous Rough Carpentry: Wood blocking for support of wall cabinets, toilet accessories and other wall mounted Work.
 - 5. Section 07 21 00 - Thermal Insulation: Insulation for gypsum board assemblies requiring thermal insulation.
 - 6. Section 07 90 00 - Joint Protection.
 - 7. Section 09 30 00 - Tiling: For Tile Backer Board that is to be installed on framing that is provided in this Section.

1.2 REFERENCES

- A. ASTM International (ASTM):
 - 1. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
 - 2. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members; 2015.
 - 3. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
 - 4. ASTM C303 - Standard Test Method for Dimensions and Density of Preformed Block and Board-Type Thermal Insulation; 2021.
 - 5. ASTM C473 - Standard Test Methods for Physical Testing of Gypsum Panel Products; 2019.
 - 6. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2017; Reapproval 2022.
 - 7. ASTM C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2022.
 - 8. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2018.
 - 9. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2023.
 - 10. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.
 - 11. ASTM C834 - Standard Specification for Latex Sealants; 2017, Reapproval 2023.

12. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2023.
 13. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications; 2022.
 14. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2022.
 15. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2022.
 16. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base; 2019.
 17. ASTM C1104/C1104M - Standard Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation; 2019.
 18. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2017.
 19. ASTM C1280 - Standard Specification for Application of Exterior Gypsum Panel Products for Use as Sheathing; 2018, Reapproval 2023.
 20. ASTM C1338 - Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings; 2019, Reapproval 2022.
 21. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.
 22. ASTM C1629/C1629M - Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels; 2023.
 23. ASTM C1658/C1658M - Standard Specification for Glass Mat Gypsum Panels; 2019, Editorial Changes 2020.
 24. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.
 25. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
 26. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009, Reapproval 2023.
 27. ASTM E136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 Degrees C; 2024.
 28. ASTM E970 - Standard Test Method for Critical Radiant Flux of Exposed Attic Floor Insulation Using a Radiant Heat Energy Source; 2017, Editorial Changes 2022.
 29. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, Editorial Changes 2021.
- B. California Department of Public Health (CDPH):
1. CDPH Standard Method VOC V1.2 - Standard Method For The Testing And Evaluation Of Volatile Organic Chemical Emissions From Indoor Sources Using Environmental Chambers - Version 1.2; 2017.
- C. Gypsum Association (GA):
1. GA-216 - Application and Finishing of Gypsum Panel Products; 2021.
 2. GA-600 - Fire Resistance and Sound Control Design Manual; 2021.
- D. International Organization for Standardization (ISO):
1. ISO 11600 - Building Construction - Jointing Products - Classification and Requirements For Sealants; 2002, Amendments 2011.
- E. Intertek Testing Services (ITS):
1. ITS (DIR) - Directory of Listed Products; Current Edition.
- F. Underwriters Laboratories Inc. (UL):
1. UL (FRD) - Fire Resistance Directory; Current Edition.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit data on metal framing; gypsum board and sheathing; joint treatment materials; and acoustic accessories.
- C. Shop Drawings: Indicate special details associated with fireproofing and acoustic accessories.
 - 1. Show type, weight, location, and spacing of members. Clearly identify attachments and connections using AWS symbols for welds, standard designations for fasteners. Show bracing, supplemental strapping, clips, and other accessories required.
 - 2. Delegated Engineering Design: Shop drawings shall be sealed by a licensed Professional Structural Engineer registered in the State in which the project is located and shall include structural calculations verifying compliance with the performance data specified and as noted on the Building Code Data Sheet and Structural requirements on the Drawings. Design is to comply with the provisions of the State Building Code, for the State in which the Work is constructed.
 - a. Provide sealed calculations indicating that design of suspension systems provide compliance with seismic structural requirements indicated in the Performance and Design Requirements article in this Section.
 - b. Verify and coordinate stud depth with the partition schedule on the Drawings. Indicate component details, framed openings, bearing, anchorage, loading, welds, seismic design components, type and location of fasteners, accessories, and items required for the Work.
 - c. Show type, weight, location, and spacing of members. Clearly identify attachments and connections using AWS symbols for welds, standard designations for fasteners. Show bracing, supplemental strapping, clips, and other accessories required.
- D. Samples:
 - 1. Submit two sets of each item indicated in ACCESSORIES article in this Section, illustrating manufacturer's full range of options. Submit for selection by Architect.

1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three (3) years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three (3) years documented experience.
- C. Delegated Engineering Design: Design all metal stud and cold rolled steel framing using the engineering services of a Professional Structural Engineer experienced in design of this Work and licensed to perform professional engineering services in the State in which the project is located.

PART 2 PRODUCTS

2.1 PERFORMANCE AND DESIGN REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: Provide completed assemblies complying with applicable code.
- B. Fire Rated Wall Construction: Wall assembly fire rating to be as indicated on Drawings and as required by building code.
- C. Seismic Design is to comply with requirements for the Seismic Design Category as indicated on the Structural Drawings and Section 00 31 00 - Available Project Information.

- D. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

2.2 MANUFACTURERS

- A. Manufacturers:
 - 1. CertainTeed Corporation (CTC).
 - 2. Georgia-Pacific Gypsum Corporation (GPG).
 - 3. National Gypsum Company (NGC).
 - 4. USG Corporation (USG).
 - 5. Substitutions: Section 01 60 00 - Product Requirements.

2.3 INTERIOR GYPSUM BOARD MATERIAL

- A. Standard Gypsum Board: ASTM C1396/C1396M; paper faced; maximum available length in place; tapered edges; suitable for finish and paint.
 - 1. 5/8 inch, Type X fire resistant complying with requirements of ASTM C1396/C1396M.
 - 2. Combustibility: Noncombustible complying with ASTM E136.
 - 3. Surface Burning Characteristics: When tested in accordance with ASTM E84.
 - a. Flame Spread: 15, maximum.
 - b. Smoke Development: Zero.
 - c. Class: Class A.
 - 4. Finish Level: Refer to Finish Levels Schedule at end of this Section.
 - 5. Basis of Design:
 - a. NGC - Gold Bond Fire-Shield X.
 - 6. Locations: All interior gypsum surfaces in the following areas unless indicated otherwise on Drawings.
 - a. All interior gypsum surfaces where no other gypsum board type is indicated.
- B. Mold Resistant Gypsum Board: ASTM C1396/C1396M; paper faced; maximum available length in place; ends square cut; tapered edges; suitable for finish and paint.
 - 1. 5/8 inch, Type X fire resistant complying with requirements of ASTM C1396/C1396M.
 - 2. Combustibility: Noncombustible complying with ASTM E136.
 - 3. Surface Burning Characteristics: When tested in accordance with ASTM E84.
 - a. Flame Spread: 15, maximum.
 - b. Smoke Development: 5, maximum.
 - c. Class: Class A.
 - 4. Water Absorption: 5 percent maximum by weight after two-hour immersion when tested in accordance with ASTM C473.
 - 5. Mold Growth Resistance: Score of 10 minimum, in accordance with ASTM D3273 for mold growth on interior coatings surface.
 - 6. Finish Level: Refer to Finish Levels Schedule at end of this Section.
 - 7. Basis of Design:
 - a. NGC - Gold Bond XP Fire-Shield X.
 - 8. Locations: All interior gypsum surfaces in the following areas unless indicated otherwise on Drawings.
 - a. Toilet Areas WITHOUT contiguous shower stalls.
 - b. Drinking Fountain Areas.
 - c. Walls With Sink(s): Entire wall length and minimum height from finish floor to 8 feet high above finish floor unless otherwise indicated on Drawings.
 - d. Kitchen Food Preparation Areas.
 - e. Kitchen Food Storage Areas.
 - f. Food Serving Areas.
 - g. Dish Washing Area.

- h. Janitor And Custodian Closets.
- C. Abuse and Mold Resistant Gypsum Board: ASTM C1396/C1396M; paper faced; maximum available length in place; ends square cut; tapered edges; suitable for finish and paint.
 - 1. 5/8 inch, Type X fire resistant complying with requirements of ASTM C1396/C1396M.
 - 2. Combustibility: Noncombustible complying with ASTM E136.
 - 3. Surface Burning Characteristics: When tested in accordance with ASTM E84.
 - a. Flame Spread: 15, maximum.
 - b. Smoke Development: 5, maximum.
 - c. Class: Class A.
 - 4. Water Absorption: 5 percent maximum by weight after two-hour immersion when tested per ASTM C473.
 - 5. Mold Resistance: Score of 10 minimum, in accordance with ASTM D3273 for mold growth on interior coatings surface.
 - 6. Finish Level: Refer to Finish Levels Schedule at end of this Section.
 - 7. Basis of Design:
 - a. NGC - Gold Bond XP Hi-Abuse.
 - 1) Surface Abrasion: Level 3 minimum, per ASTM C1629/C1629M.
 - 2) Indentation: Level 1 minimum, per ASTM C1629/C1629M.
 - 3) Soft Body Impact: Level 2 minimum, per ASTM C1629/C1629M.
 - 4) Hard Body Impact: Level 1 minimum, per ASTM C1629/C1629M.
 - 8. Locations: All interior gypsum surfaces in the following areas unless indicated otherwise on Drawings.
 - a. All classrooms and rooms of instruction and teaching; minimum height from finish floor to 8 feet above finish floor unless otherwise indicated on Drawings.
 - b. Media Center and Learning Commons Areas; minimum height from finish floor to 8 feet above finish floor unless otherwise indicated on Drawings.
 - c. All circulation areas, corridors, and passageways; minimum height from finish floor to 8 feet above finish floor unless otherwise indicated on Drawings.

2.4 EXTERIOR GYPSUM BOARD MATERIAL

- A. Exterior Soffit Gypsum Board: ASTM C1396/C1396M; maximum available length in place; tapered edges; suitable for finish and paint.
 - 1. 5/8 inch, Type X fire resistant complying with requirements of ASTM C1396/C1396M.
 - 2. Combustibility: Noncombustible complying with ASTM E136.
 - 3. Surface Burning Characteristics: When tested in accordance with ASTM E84.
 - a. Flame Spread: 20, maximum.
 - b. Smoke Development: Zero.
 - c. Class: Class A.
 - 4. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL (FRD) or ITS (DIR) listed.
 - 5. Comply with ASTM C1396/C1396M for water resistant and exterior gypsum soffit board.
 - 6. Finish Level: Refer to Finish Levels Schedule at end of this Section.
 - 7. Basis of Design:
 - a. USG - Sheetrock Mold Tough Firecode X.
 - 8. Locations: Exterior soffits and ceiling in protected areas unless indicated otherwise on Drawings. Protected areas are surfaces protected from excessive, repetitive or continuous moisture.
- B. Exterior Fiberglass Faced Sheathing Gypsum Board: ASTM C1177/C1177; glass mat faced gypsum substrate; maximum available length in place; tapered edges.
 - 1. 5/8 inch, Type X fire resistant complying with requirements of ASTM C1177/C1177M.

2. Combustibility: Noncombustible complying with ASTM E136.
3. Surface Burning Characteristics: When tested in accordance with ASTM E84.
 - a. Flame Spread: Zero.
 - b. Smoke Development: Zero.
 - c. Class: Class A.
4. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly. If no tested assembly is indicated, use Type X board, UL (FRD) or ITS (DIR) listed.
5. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
6. Fungal Resistance: No fungal growth when tested in accordance with ASTM G21.
7. Basis of Design:
 - a. NGC - Gold Bond eXP Sheathing Fire-Shield.
8. Locations: Exterior sheathing unless indicated otherwise on Drawings.

2.5 FRAMING MATERIAL

- A. Thicknesses provided here are minimum and subject to increase by Delegated Engineer's design requirements.
 1. Studs: ASTM C645; galvanized sheet steel.
 - a. 0.0312 inch thick, C shape.
 2. Runners and Tracks: ASTM C645; galvanized sheet steel.
 - a. 0.0312 inch thick, C shape.
 3. Furring, Framing, and Accessories: ASTM C645; galvanized sheet steel.
 - a. 0.0312 inch thick, C shape.
 4. Shaft Wall Studs and Accessories: ASTM C645; galvanized sheet steel.
 - a. 0.0312 inch thick, C shape.
- B. Galvanizing: Comply with ASTM A653/A653M zinc-coated hot dipped galvanized steel.
 1. Interior Framing: G40.
 2. Exterior Framing: G60.
- C. Framed Partition Head To Structure Connections: Provide one of the following types and coordinate to provide fire rated constructed assemblies as indicated on Drawings.
 1. Single Long-Leg Runner System: ASTM C645 top runner with 2-inch- deep flanges in thickness not less than indicated for studs, installed with studs friction fitted into top runner and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.
 2. Double-Runner System: ASTM C645 top runners, inside runner with 2-inch-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.
- D. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding strength, and other properties required to fasten steel members to substrates. Use screws with low profile head where board, or other overlay sheathing, is to be applied.
- E. Anchorage to Substrate: Provide tie wire, fasteners, screws, metal supports, and other anchorage devices, of type and size to suit application, and to secure materials to building structural elements.

2.6 SUSPENSION SUPPORT MATERIAL

- A. Suspension Systems: ASTM C635/C635M heavy-duty main beam classification; ASTM A653/A653M zinc-coated hot dipped galvanized steel; ASTM C645 Standard specification for rigid furring channels for screw application of gypsum board.
- B. Accessories: Stabilizer bars, clips, splices, and perimeter moldings required for suspended grid system.
- C. Support Channels and Hangers: Primed steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.

2.7 ACOUSTIC ATTENUATION MATERIAL

- A. Acoustic Attenuation Insulation: Install at interior walls and ceilings as indicated on Drawings.
 - 1. Mineral Wool Batt Insulation: Flexible or semi-rigid preformed batt or blanket, complying with ASTM C665; friction fit.
 - a. Unfaced Type: ASTM C665 Type-I (unfaced).
 - b. Combustibility: Noncombustible complying with ASTM E136.
 - c. Surface Burning Characteristics: When tested in accordance with ASTM E84.
 - 1) Flame Spread: 25, maximum.
 - 2) Smoke Development: 50, maximum.
 - d. Fungi Resistance: Passes when tested in accordance with ASTM C1338.
 - e. Nominal Density: Minimum 2.5 pcf when tested in accordance with ASTM C303.
 - f. Corrosivity to Steel: Passes when tested in accordance with ASTM C665.
 - g. Blanket Width: Sized to fully friction fit space between framing members.
 - h. Blanket Thickness: Sized to fully friction fit cavity, but not less than 3-1/2 inches.
 - i. Manufacturers:
 - 1) Johns Manville.
 - 2) Knauf Insulation.
 - 3) Owens Corning.
 - 4) Rockwool.
- B. Acoustic Sealant: For exposed and concealed joints and annular spaces around through-penetrations. Type to be non-sag, paintable, non-staining latex sealant complying with ASTM C834, ASTM C919 and as follows:
 - 1. Sealant to reduce airborne sound transmission through head-of-wall and bottom-of-wall joints and openings to accommodate through-penetrations in building construction as demonstrated by testing representative assemblies in accordance with ASTM E90.
 - 2. Sound Transmission Class: Sealant to maintain STC ratings at sound rated partitions as indicated on the drawings.
 - 3. Surface Burning Characteristics: When tested in accordance with ASTM E84.
 - a. Flame Spread: 10, maximum.
 - b. Smoke Development: 10, maximum.
 - 4. Mold and Mildew Resistance: Rating of zero (0), "no growth", in accordance with ASTM G21.
 - 5. Movement Capability: 10 percent minimum, in accordance with ISO 11600.
 - 6. Sealant materials and methods shall conform to applicable governing codes and authorities having jurisdiction.
 - 7. Maximum volatile organic compound content to be in accordance with CDPH Standard Method VOC V1.2.
 - 8. Basis of Design: As indicated on Drawings.
- C. Acoustic Sprays: For exposed and concealed locations; sprayable latex material complying with ASTM C919 and the following:

1. Spray to reduce airborne sound transmission through head-of-wall joints in building construction as demonstrated by testing representative assemblies in accordance with ASTM E90.
2. Sound Transmission Class: Spray to maintain STC ratings at sound rated partitions as indicated on the drawings.
3. Surface Burning Characteristics: When tested in accordance with ASTM E84.
 - a. Flame Spread: 10, maximum.
 - b. Smoke Development: 10, maximum.
4. Mold and Mildew Resistance: Rating of zero (0), "no growth", in accordance with ASTM G21.
5. Movement Capability: 10 percent minimum, in accordance with ISO 11600.
6. Spray materials and methods shall conform to applicable governing codes and authorities having jurisdiction.
7. Maximum volatile organic compound content to be in accordance with CDPH Standard Method VOC V1.2.
8. Basis of Design: As indicated on Drawings.

2.8 ACCESSORIES

- A. Finishing Trim: To be metal conforming to ASTM A653/A653M, ASTM A1003/A1003M, ASTM C1047, unless otherwise indicated. Includes trims such as corner beads, edge trim, control joints and expansion joints.
 1. Types: As detailed or required for finished appearance.
 - a. Continuous finishing bead profile required for termination and protection of gypsum board finish compound edge.
 - b. J-trim, without bead, is not permitted at gypsum board termination edge unless indicated on Drawings.
 2. Special Shapes: In addition to conventional corner bead and control joints, provide U-bead at exposed panel edges.
- B. Expansion Joints:
 1. Type: Accordion profile with factory-installed protective tape.
- C. Control Joints:
 1. Type: V-shaped metal with factory-installed protective tape.
- D. Joint Materials: ASTM C475/C475M; reinforcing tape, joint compound, and water.
 1. Joint Tape:
 - a. Fiberglass Tape: 2 inch (50 mm) wide, open-weave coated glass fiber tape for joints and corners, except as otherwise indicated.
 - b. Paper Tape: 2 inch (50 mm) wide, creased paper tape for joints and corners, except as otherwise indicated.
 2. Joint Compound:
 - a. Drying-Type: Vinyl-based, ready-mixed.
 - b. Setting-Type: Chemical hardening, field-mixed.
- E. Screws for Fastening Board Materials to Steel Framing Members:
 1. Gypsum Board: Use S-Type screws complying with the following.
 - a. Metal thickness from 0.033 to 0.112 inch: ASTM C954; steel drill screws, corrosion resistant.
 - b. Metal thickness less than 0.033 inch: ASTM C1002; self-piercing tapping screws, corrosion resistant.
- F. Exterior Soffit Vents: One piece, perforated, ASTM B221 6063 T5 alloy aluminum, with edge suitable for direct application to gypsum board and manufactured especially for soffit application. Provide continuous vent unless otherwise indicated on Drawings.

1. Finish and color to be selected by Architect for manufacturer's full range.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 73 00 - Execution: Verification of existing conditions before starting work.
- B. Verify site conditions are ready to receive work and opening dimensions are as indicated on shop drawings.

3.2 PREPARATION

- A. Section 01 73 00 - Execution: Prepare field conditions and existing construction for installation of work of this Section.
- B. Prepare materials to be installed and equipment to be used during installation.

3.3 INSTALLATION - GENERAL

- A. Section 01 73 00 - Execution: Related to installation of Work.
- B. Installation requirements in this Section are minimum requirements and are subject to more stringent requirements as may be indicated in the design by the Delegated Engineering Design.
- C. SUPPORT AND ANCHOR FRAMING SYSTEMS TO FLOOR SYSTEM BELOW AND BUILDING STRUCTURAL MEMBERS ABOVE. DO NOT SUSPEND, SUPPORT, OR ANCHOR FRAMING SYSTEMS TO NON-STRUCTURAL BUILDING ELEMENTS ABOVE SUCH AS ROOF DECKING AND FLOOR DECKING. DO NOT ALLOW ANCHORS OR SUPPORTS TO TOUCH OR DAMAGE EMBEDDED, CONCEALED OR VISIBLE WORK SUCH AS HVAC, ELECTRICAL, AND PLUMBING COMPONENTS.
- D. Environmental Limitations: Install gypsum board, joint treatment materials, finish materials, and adhesives in accordance with ASTM C840 requirements and gypsum board manufacturer's written recommendations.
- E. Do not install panels that are wet, moisture damaged, or mold damaged.
 1. Indications that panels are wet, or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or blotchy surface contamination and discoloration.

3.4 METAL FRAMING INSTALLATION

- A. Install metal framing in accordance with GA-216, GA-600, ASTM C754, and manufacturer's recommendations.
- B. Wall Framing:
 1. Metal stud spacing to be 16 inches on center, minimum.
 2. Refer to Drawings for indication of partitions extending stud framing through ceiling to structure above. Maintain clearance under structural building members to avoid deflection transfer to studs. Provide extended leg ceiling runners.
 3. Door Opening Framing: Reinforce openings as required to withstand the forces imposed by the weight and operation of specified doors or operable panels, using not less than double studs at jambs and increased reinforcing as needed.

4. Blocking: Screw wood blocking to studs. Install blocking as required for support of wall mounted construction, devices, and equipment similar to, but not limited to, the following:
 - a. Toilet partitions and accessories; cabinet units; visual display surfaces; televisions and monitors; handrails; fixtures.
- C. Wall Furring:
 1. Erect wall furring for direct attachment to concrete masonry walls.
 2. Erect furring channels vertically; space maximum 24 inches o.c., not more than 4 inches from abutting walls. Secure in place on alternate channel flanges at maximum 24 inches on center.
 3. Erect metal stud framing spaced 1/2 inches from concrete masonry walls, attached by adjustable furring brackets.
 4. Wall Furring for Fire Ratings: Install furring as required for fire resistance ratings indicated and to GA-600 requirements.
- D. Ceiling Framing:
 1. Coordinate location of hangers with other work.
 2. Install ceiling framing independent of walls, columns, and above ceiling work.
 3. Reinforce openings in ceiling suspension system which interrupt main carrying channels or furring channels, with lateral channel bracing. Extend bracing minimum 24 inches past each end of openings.
 4. Laterally brace entire suspension system.

3.5 ACOUSTIC ACCESSORIES INSTALLATION

- A. Install acoustic accessories in accordance with GA-600 as related to sound control.
- B. Acoustic Attenuation Insulation: Friction fit insulation within framing cavity in partitions tight within spaces, around cut openings, behind and around electrical and mechanical items within or behind partitions, and tight to items passing through partitions. Thickness to be as required to fill cavity.
- C. Acoustic Sealant and Spray:
 1. General: Comply with Drawings and acoustic sealant and spray manufacturer's written installation instructions for products and applications indicated.
 2. Standards: Comply with recommendations of ASTM C919 for use of joint sealants in acoustical applications as applicable to materials, applications and conditions indicated.
 3. Install acoustic sealant backings of type indicated to support sealant and spray during application in accordance with manufacturer's written installation instructions.
 4. Install acoustic sealant and spray free of air pockets, embedded foreign matter, sags and ridges.
 5. Tooling of Non-sag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - a. Remove excess acoustic sealant from surfaces adjacent to joint.
 - b. Remove excess acoustic spray from surfaces adjacent to joint as indicated on the drawings.
 - c. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - d. Provide concave joint configuration unless otherwise indicated.

3.6 GYPSUM BOARD INSTALLATION

- A. Install gypsum board in accordance with ASTM C840, and GA-216.

B. Gypsum Board:

1. Use screws when fastening gypsum board to metal furring or framing.
2. Erect single layer gypsum board in most economical direction, with ends and edges occurring over firm bearing. Exception as follows:
 - a. Erect single layer fire rated gypsum board vertically, with edges and ends occurring over firm bearing.
3. Erect exterior gypsum sheathing in accordance with ASTM C1280, horizontally, with edges butted and ends occurring over firm bearing.
4. Double Layer Applications: Secure second layer to first with fasteners. Place second layer parallel to first layer. Offset joints of second layer from joints of first layer.
5. Treat cut edges and holes in moisture resistant gypsum board and exterior gypsum soffit board with sealant.
6. Control Joints: Construct control joint in accordance with the drawings, GA-216, and as follows:
 - a. Place control joints consistent with lines of building space and features. When not indicated in the drawings, install control joints per GA-216 and as follows:
 - 1) Not more than 30 feet apart on walls over 50 feet long.
 - 2) At ceilings, not more than 30 feet apart in both directions.
 - 3) At interior and exterior gypsum and stucco soffits and bulkheads, at all inside corners of vertical surfaces not more than 30 feet apart on vertical and horizontal surfaces. Control joints installed on vertical surfaces shall continue, in alignment/direction and through corner finish, onto contiguous horizontal surface of like material (like treatment from horizontal surfaces to contiguous vertical surfaces).
 - 4) At interior and exterior soffits and bulkheads, not more than 30 feet apart on vertical and horizontal surfaces. Control joints installed on vertical surfaces shall continue, in alignment/direction and through corner finish, onto contiguous horizontal surface of like material (like treatment from horizontal surfaces to contiguous vertical surfaces).
7. Place corner beads at external corners. Use longest practical length.
8. Edge Trim: Install LC Bead edge trim at locations where gypsum board abuts dissimilar materials. Allow appropriate space for application of appropriate sealant to seal and bridge between the gypsum finished edge trim and the dissimilar material.
9. Exterior Soffit Vents: Install according to manufacturer's written instructions and in locations shown on the drawings. Provide vent area indicated.

3.7 JOINT TREATMENT AND FINISH

- A. Finish gypsum board materials in accordance with ASTM C840 and to Finish Level as indicated in Schedule at end of this Section.
- B. Fiberglass Joint Tape: Embed and finish with setting-type joint compound in the following locations and as otherwise recommended by board manufacturer for application conditions.
 1. Exterior Locations: All exterior locations.
 2. Interior Locations: Tile backer board locations.
 3. All Glass Mat Faced Board Locations: Interior and exterior.
- C. Paper Joint Tape: Embed with drying-type joint compound and finish with drying-type joint compound in the following locations.
 1. Exterior Locations: No paper joint tape to be used.
 2. Interior Locations: To be used at locations where fiberglass joint tape is not indicated.
- D. Tape, fill and sand joints, edges and corners, ready to receive finishes.
- E. Glass Mat Faced Gypsum Board Surfaces:
 1. Use fiberglass joint tape, embed and finish with setting type joint compound.

2. Provide full surface skim coat finishing as required to conceal and prevent telegraphing of glass mat texture, resulting in a smooth surface finish.

3.8 SHAFT WALL INSTALLATION

- A. Install in accordance with manufacturer's installation instructions, GA-216, GA-600, and ASTM C754.
- B. Fasten runners to structure with short leg to finished side, using appropriate power-driven fasteners at not more than 24 inches on center.
- C. Install studs at spacing required to meet performance requirements.
- D. Shaft Wall Liner: Cut panels to accurate dimension and install sequentially between special friction studs.
 1. On walls over sixteen feet high, screw-attach studs to runners top and bottom.
 2. Seal perimeter of shaft wall and penetrations with acoustical sealant.

3.9 ERECTION TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Maximum Variation of Finished Gypsum Board Surface from Flat Surface: 1/8 inch in 10 feet in any direction.

3.10 SCHEDULES

- A. Finish Levels Schedule: Gypsum finish levels to be in accordance with ASTM C840:
 1. Level 1: Surfaces above finished ceilings and concealed from view.
 2. Level 5: All surfaces exposed to view (includes GWB that is painted or covered with adhered wall covering sheet materials).

END OF SECTION

SECTION 09 30 00

TILING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Floor Tile and setting applications.
 - 2. Wall Tile and setting applications.
 - 3. Trim and accessories.
 - 4. Accessories.
- B. Related Requirements:
 - 1. Section 03 30 00 - Cast-In-Place Concrete: Substrate for floor tile.
 - 2. Section 04 20 00 - Unit Masonry: Substrate for wall tile.
 - 3. Section 09 21 16 - Gypsum Board Assemblies: Framing and support construction for installation of tiling backer board specified in this Section.

1.2 REFERENCE STANDARDS

- A. American National Standards Institute (ANSI):
 - 1. ANSI A108/A118/A136 - Installation of Ceramic Tile; 2021:
 - a. Includes ANSI A108.01, .02, .1A, .1B, .1C, .4, .5, .6, .8, .9, .10, .11, .12, .13, .14, .15, .16, .17, .18, and 21 - defines the installation of ceramic tile.
 - 1) ANSI A108.1A - Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar.
 - 2) ANSI A108.1B - Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar.
 - 3) ANSI A108.11 - Interior Installation of Cementitious Backer Units.
 - 4) ANSI A108.13 - Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone.
 - 5) ANSI A108.17 - Installation of Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone.
 - b. Includes ANSI A118.1, .3, .4, .5, .6, .7, .8, .9, .10, .11, .12, .13, .15, .16, and ANSI A136 - defines the test methods and physical properties for ceramic tile installation materials.
 - 1) ANSI A118.1 - Dry-Set Cement Mortar.
 - 2) ANSI A118.3 - Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy and Water Cleanable Tile-Setting Epoxy Adhesive.
 - 3) ANSI A118.4 - Modified Dry-Set Cement Mortar
 - 4) ANSI A118.5 - Chemical Resistant Furan Mortars and Grouts for Tile Installation.
 - 5) ANSI A118.6 - Standard Cement Grouts for Tile Installation.
 - 6) ANSI A118.7 - High Performance Cement Grouts for Tile Installation.
 - 7) ANSI A118.8 - Modified Epoxy Emulsion Mortar/ Grout.
 - 8) ANSI A118.9 - Test Methods and Specifications for Cementitious Backer Units.
 - 9) ANSI A118.10 - Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation.
 - 10) ANSI A118.11 - EGP (Exterior Glue Plywood) Modified Dry-Set Mortar.

- 11) ANSI A118.12 - Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation.
 - 12) ANSI A118.15 - Improved Modified Dry-Set Cement Mortar.
 - 13) ANSI A136.1 - Organic Adhesives for installation of Ceramic Tile.
2. ANSI A137.1 - Standard Specification for Ceramic Tile; 2022.
3. ANSI A137.2 - Standard Specifications for Glass Tile; 2022.
- B. ASTM International (ASTM):
 1. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2022.
 2. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete; 2020.
 3. ASTM C373 - Standard Test Methods for Determination of Water Absorption and Associated Properties by Vacuum Method for Pressed Ceramic Tiles and Glass Tiles and Boil Method for Extruded Ceramic Tiles and Non-tile Fired Ceramic Whiteware Products; 2018, Reapproval 2023.
 4. ASTM C650 - Standard Test Method for Resistance of Ceramic Tile to Chemical Substances; 2020.
 5. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2022.
 6. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2022.
 7. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel; 2018.
 8. ASTM C1278/C1278M - Standard Specification for Fiber-Reinforced Gypsum Panel; 2017.
 9. ASTM C1325 - Standard Specification for Fiber-Mat Reinforced Cementitious Backer Units; 2022.
 10. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.
 11. ASTM D2394 - Standard Test Methods for Simulated Service Testing of Wood and Wood-Based Finish Flooring; 2017, Reapproval 2022.
 12. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.
 13. ASTM D4397 - Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications; 2016.
 14. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023a.
 15. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2022, Editorial Changes 2023.
 16. ASTM E136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C; 2022.
 17. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, Editorial Changes 2021.
- C. Tile Council of North America (TCNA):
 1. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2023.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this Section; require attendance by all affected installers.

1.4 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide manufacturer's data sheets on tile, mortar, grout, and accessories. Include manufacturer's recommendations for using installation of system components including, but not limited to, tile, setting materials, accessories, trim, grouts, and adhesives.
- C. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, trim shapes and locations, junctions with dissimilar materials, control and expansion joints, termination edge conditions, accessories, areas receiving waterproofing membrane, and setting details.
- D. Samples for Initial Selections: Two manufacturer's complete set of color samples illustrating the full range of finishes, textures, and colors available for each product; submit for Architect's initial selections.
- E. Samples for Verification: From the Architect's initial selections, prepare and submit two samples for each selected finish, texture, and color; samples to be same product material type indicated for final Work; each sample 12 x 12 inches. Where finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.
- F. Samples for Verification of Products Indicated On Drawings: Prepare and submit two samples for each selected finish, texture and color; samples to be same product material type indicated for final Work; each sample to be actual size required for work. Where finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.
- G. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 78 23 - Operation and Maintenance Data.
- B. Operation and Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods. Include recommended polishes, waxes and other restorative/protective products and methods.

1.6 QUALITY ASSURANCE

- A. Perform work in accordance with ANSI A108/A118/A136 and TCNA (HB).
- B. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this Section, with minimum ten (10) years of documented experience.
- C. Installer Qualifications: Company specializing in performing tile installation, with minimum of five (5) years of documented experience.
- D. Prior to grouting, prepare and protect the finish surfaces of tile work as needed to prevent staining of tile work during the grouting process and cleanup. Tile work that is stained by grout or other material is not acceptable tile work.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Protect adhesives and other temperature sensitive materials from freezing or overheating in accordance with manufacturer's instructions.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Do not install solvent-based products in an unventilated environment.
- B. Maintain ambient and substrate temperature of 50 degrees F (10 degrees C) during installation of mortar materials.

1.9 SPARE PARTS AND MAINTENANCE PRODUCTS

- A. Section 01 60 00 - Product Requirements: Extra materials, spare parts, and maintenance products.
 - 1. Five percent (5%) full size units of each product type, size, color, shape, profile, and surface finish combination installed, but no less than the following:
 - a. Twenty (20) square feet of field tiles.
 - b. Five (5) units of each trim and accessory.
 - c. Sixteen (16) linear feet of each type and color non-ceramic trim.
 - d. Sixteen (16) linear feet of threshold.

PART 2 PRODUCTS

2.1 TILE

- A. Manufacturers: All products of each type by the same manufacturer.
 - 1. Crossville Tile Company: www.crossvilleinc.com.
 - 2. Daltile Corporation: www.daltile.com.
 - 3. Atlas Concorde: www.atlasconcorde.com/en
 - 4. Other manufacturers as may be indicated on Drawings.
 - 5. Substitutions: Section 01 60 00 - Product Requirements.
- B. Porcelain Floor Tile: ANSI A137.1, Standard Grade.
 - 1. Moisture Absorption: 0.5 to 3.0 percent, tested in accordance with ASTM C373.
 - 2. Basis of Design:
 - a. As indicated on Drawings.
 - 3. Colors:
 - a. As indicated on Drawings.
 - 4. Grout Joints Size:
 - a. As recommended by manufacturer.
 - 5. Sizes:
 - a. As indicated on Drawings.
 - b.
 - 6. Thickness: As indicated on Drawings, but not less than 3/8 inch.
 - 7. Shapes:
 - a. As indicated on Drawings.
 - 8. Edges:
 - a. As indicated on Drawings.
 - 9. Surface Finishes:
 - a. As indicated on Drawings.
 - 10. Patterns:
 - a. As indicated on Drawings.
 - 11. Tile Trim: Refer to TRIM AND ACCESSORIES article in this Section.
- C. Porcelain Wall Tile: ANSI A137.1, Standard Grade.
 - 1. Moisture Absorption: 0.5 to 3.0 percent, tested in accordance with ASTM C373.
 - 2. Basis of Design:
 - a. As indicated on Drawings.
 - 3. Colors:
 - a. As indicated on Drawings.

4. Grout Joints Size:
 - a. As recommended by manufacturer.
 5. Sizes:
 - a. As indicated on Drawings.
 6. Thickness: As indicated on Drawings, but not less than 3/8 inch.
 7. Shapes:
 - a. As indicated on Drawings.
 8. Edges:
 - a. Cushioned, unless indicated otherwise on Drawings.
 - b. As indicated on Drawings.
 9. Surface Finishes:
 - a. As indicated on Drawings.
 10. Patterns:
 - a. As indicated on Drawings.
 11. Tile Trim: Refer to TRIM AND ACCESSORIES article in this Section.
- D. Ceramic Wall Tile: ANSI A137.1, Standard Grade.
1. Moisture Absorption: 7.0 to 20.0 percent, tested in accordance with ASTM C373.
 2. Basis of Design:
 - a. As indicated on Drawings.
 3. Colors:
 - a. As indicated on Drawings.
 4. Grout Joints Size:
 - a. As recommended by manufacturer.
 5. Sizes:
 - a. As indicated on Drawings.
 6. Thickness: As indicated on Drawings, but not less than 1/4 inch.
 7. Edges:
 - a. Cushioned, unless indicated otherwise on Drawings.
 8. Surface Finishes:
 - a. As indicated on Drawings.
 9. Patterns:
 - a. As indicated on Drawings.
 10. Tile Trim: Refer to TRIM AND ACCESSORIES article in this Section.

2.2 TRIM AND ACCESSORIES

- A. Wall Tile Trim Units:
1. Top Open Edges: Schluter – Schiene
 2. Inside Corners:
 - a. Miter.
 3. Outside Open Corners: Schluter –Schiene
- B. Base Tile Trim Units - With wall tile above:
1. Wall tile is to continue down to terminate at floor.
 - a. Bottom: Cove and edge to match floor tile edge type for flush transition.
 - 1) If wall tile is not available with bottom cove, wall tile is to terminate at floor tile with straight joint to floor.

2.3 SETTING MATERIALS

- A. Bond Coat Materials: As recommended by tile manufacturer and TCNA for substrate types and installation conditions.
1. Latex/Polymer Modified Portland Cement Mortar:

- a. Complying with ANSI A118.4.
2. Modified Dry-Set Mortar for Large and Heavy Tile (LHT) Mortar:
 - a. Application: Bond coat for large tiles with at least one side measuring 15 inches or greater.
 - b. Complying with ANSI A118.4H.
 - c. Approved by manufacturer for application thickness 3/32 inch to 1/2 inch.
 - d. Manufacturers:
 - 1) Laticrete International, Inc. - LHT Plus.
 - 2) Mapei Corporation - Ultraflex LHT.
 - 3) H.B. Fuller Corporation, Inc. - TEC PermaFlex 300 LHT Mortar.

2.4 GROUT AND JOINT MATERIALS

- A. Manufacturers:
 1. Ardex Engineered Cements: www.ardexamericas.com/#sle.
 2. Custom Building Products: www.custombuildingproducts.com/#sle.
 3. Laticrete International, Inc.: www.laticrete.com/#sle.
 4. MAPEI Corporation: www.mapei.com.
 5. Merkrete, by Parex USA, Inc.: www.merkrete.com/#sle.
- B. High Performance Cement Grout: ANSI A118.7, polymer modified cement grout.
 1. Applications:
 - a. Use this type of grout where indicated and where no other type of grout is indicated.
 2. Use sanded grout for joints 1/8 inch wide and larger; if joint design is indicated to be less than 1/8 inch wide, use unsanded grout.
 3. Color(s): To be selected by Architect from full range of colors
 4. Basis of Design: Laticrete PermaColor Grout.
- C. Tile Joint Sealant: Gunable, silicone, siliconized acrylic, or urethane sealant; moisture and mildew resistant type.
 1. Applications: Control joints; tile surface change of plane; tile abutment joints to dissimilar materials such as, but not limited to, door frames, drains, gypsum wall board, concrete masonry units, and plumbing pipe penetrations.
 2. Color: Match grout color.
 3. Use sanded type for joints designed to be 1/8 inch or wider.
 4. Use unsanded type for joints designed to be less than 1/8 inch.
 5. Products: Same manufacturer as grout material or as per written recommendation from grout manufacturer.
- D. Grout Joint Sealer: Liquid-applied, moisture and stain protection for existing or new Portland cement grout.
 1. Composition: Water-based colorless silicone.
 2. Products: Same manufacturer as grout material or as per written recommendation from grout manufacturer.

2.5 ACCESSORY MATERIALS

- A. Waterproofing Membrane: Provide membrane system designed for bonding to cementitious substrate under thick mortar bed or thin-set tile; complying with ANSI A118.10 (waterproofing).
 1. Fluid or Trowel Applied Type:
 - a. Membrane Material: Synthetic rubber.
 - b. Thickness:
 - 1) 40 mils (1.00 mm), minimum, dry film thickness.
 - c. Products:

- 1) Custom Building Products: RedGard Crack Prevention and Waterproofing Membrane: www.custombuildingproducts.com
- 2) Laticrete International, Inc.: Laticrete Hydro Ban: www.laticrete.com
- 3) Merkrete, by Parex USA, Inc.: Merkrete Hydro Guard 2000: www.merkrete.com
- 4) TEC, an H.B. Fuller Construction Products Brand; TEC HydraFlex Waterproofing Crack Isolation Membrane: www.tecspecialty.com
2. Crack Isolation Reinforcing Fabric: Fabric type as recommended by waterproofing membrane manufacturer.
3. When both a Crack Isolation Membrane and a Waterproofing Membrane are indicated, both membranes are to be manufactured by same manufacturer and designed to be compatible with each other, the substrate, and the subsequent applied materials.
- B. Crack Isolation Membrane: Provide membrane system designed for bonding to cementitious substrate under thick mortar bed or thin-set tile; complying with ANSI A118.12 (crack isolation).
 1. Fluid or Trowel Applied Type:
 - a. Membrane Material: Synthetic rubber.
 - b. Thickness:
 - 1) 40 mils (1.00 mm), minimum, dry film thickness.
 - c. Products:
 - 1) Custom Building Products: RedGard Crack Prevention and Waterproofing Membrane: www.custombuildingproducts.com
 - 2) Laticrete International, Inc.: Laticrete Hydro Ban: www.laticrete.com
 - 3) Merkrete, by Parex USA, Inc.: Merkrete Hydro Guard 2000: www.merkrete.com
 - 4) TEC, an H.B. Fuller Construction Products Brand; TEC HydraFlex Waterproofing Crack Isolation Membrane: www.tecspecialty.com
 2. Crack Isolation Reinforcing Fabric: Fabric type as recommended by crack isolation membrane manufacturer.
 3. When both a Crack Isolation Membrane and a Waterproofing Membrane are indicated, both membranes are to be manufactured by same manufacturer and designed to be compatible with each other, the substrate, and the subsequent applied materials.
- C. Cleavage Membrane: ANSI A108.02.
 1. Polyethylene Sheeting: 4 mil (0.1 mm) thickness; complying with ASTM C171 or ASTM D4397.
 - a. Application: Under mortar bed of thick mortar bed tile installation method.
- D. Reinforcing Metal Fabric: ANSI A108.02.
 1. Welded Wire Fabric: 2 x 2 inches (51 by 51 mm) size weave of 16/16 wire size; welded fabric; galvanized steel; complying with ASTM A1064/A1064M.
 - a. Application: Suspended in mortar bed of thick mortar bed tile installation method.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 73 00 - Execution: Verification of existing conditions before starting work.
- B. Verify that substrates to be tiled are sound, smooth, and flat within the tolerances specified for that type of work and are ready to receive tiling.

- C. Verify that cracks in substrates to be tiled can be repaired, to include compatible crack isolation membrane, as required to prevent defects from occurring in the tiling work and finish. Remove and replace defective substrate materials.
- D. Verify that sufficient solid anchorage materials are installed for anchoring other work elements that are to be secured through tile.
- E. Verify that substrates to be tiled are dust-free and free of substances that could impair bonding of membrane and setting materials to substrate surfaces.
- F. Verify that substrate slopes to drains where floor drains are indicated in contract documents.
- G. For mortar bed method of tile installation, verify that sub-floor is recessed deep enough to accommodate mortar bed thickness variations to achieve slope to floor drains.
- H. Verify the locations of areas that are to receive specified waterproofing membrane prior to proceeding with thin-set method and mortar bed method of tile installations.
- I. Verify that concrete and CMU substrates are ready for tile installation by testing for moisture emission rate and alkalinity; obtain instructions if test results are not within limits recommended by manufacturers of tile system components.
- J. Verify that required floor-and wall mounted utilities and devices are at correct location, alignment, and elevation.
- K. Verify that floor drains are aligned as indicated on Drawings. If alignment is not indicated on Drawings, aligned parallel with tile pattern joint lines.

3.2 PREPARATION

- A. Section 01 73 00 - Execution: Prepare field conditions and existing construction for installation of work of this Section.
- B. Prepare materials to be installed and equipment to be used during installation.
- C. Protect surrounding work from damage.
- D. Vacuum clean surfaces and damp clean.
- E. Seal substrate surface cracks with filler compatible with tiling system components. Level existing substrate surfaces to acceptable flatness tolerances.
- F. Prepare substrate surfaces for installation of waterproofing and crack isolation membrane in accordance with membrane manufacturer's instructions.
- G. Prepare substrate surfaces for adhesive installation in accordance with adhesive manufacturer's instructions.

3.3 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
- B. Add materials, water, and additives in accurate proportions.
- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

3.4 INSTALLATION - GENERAL

- A. Install tile, transition and termination trim, accessories, setting materials, grout, joint sealants, and all tile work components in accordance with applicable requirements of ANSI

- A108/A118/A136, product manufacturer's instructions, TCNA (HB) recommendations, and the Drawings.
- B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.
 - C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor, base, and wall joints.
 - D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size.
 - E. Wall Corners: Form internal angles square and external angles bullnosed.
 - F. Install non-ceramic trim in accordance with manufacturer's instructions.
 - G. Install thresholds where indicated on Drawings and at floor tile open edges.
 - H. Sound test tiles after setting. Replace hollow sounding tiles that are not fully bonded to substrate.
 - I. Construct expansion, movement, control, contraction, perimeter, and soft joints in compliance with the applicable TCNA (HB) Methods prescribed for joint construction type indicated.
 - 1. Keep such joints free of mortar, grout, adhesive and debris that can interfere with application of final joint construction components.
 - J. Prior to grouting, allow installation to completely cure; minimum of 48 hours.
 - K. Prior to grouting, prepare and protect the finish surfaces of tile work as needed to prevent staining of tile work during the grouting process and cleanup. Tile work that is stained by grout or other material is not acceptable tile work.
 - L. Grout tile joints unless otherwise indicated. Grout joints to be without voids, cracks, excess mortar or excess grout, or too little grout.
 - M. Tile Sealant Application: Use tile joint sealant instead of grout at the following locations.
 - 1. Tile changes in plane and tile-to-tile control joints. Use either bond breaker tape or backer rod as appropriate to prevent sealant from bonding to tiled substrate.
 - 2. Tile abutment joints to dissimilar materials such as door frames, drains, GWB, CMU, and penetrations such as plumbing piping and countertop support brackets.
 - N. Apply grout sealer in accordance with grout and tile manufacturers' instructions.

3.5 INSTALLATION - CRACK ISOLATION MEMBRANE

- A. Install components to comply with ANSI A108.17 (crack isolation), and manufacturer's written instructions.
- B. Existing Cracks: Comply with TCNA Method F125-Partial; bridging existing cracks and include use of crack isolation reinforcing fabric.
- C. Full Substrate Coverage: Comply with TCNA Method F125-Full; full substrate coverage.
 - 1. Include bridging existing cracks; TCNA Method F125-Partial.
 - 2. Membrane to be uniform thickness and bonded securely to substrate.
 - 3. Allow membrane to cure before installing tile or setting materials.

3.6 INSTALLATION - WATERPROOFING MEMBRANE

- A. Install components to comply with ANSI A108.13 (waterproofing), and manufacturer's written instructions.
- B. Existing Cracks: Comply with TCNA Method F125-Partial for bridging existing cracks and include use of crack isolation reinforcing fabric.

- C. Full Substrate Coverage:
 - 1. Include bridging existing cracks; TCNA Method F125-Partial.
 - 2. Membrane to be waterproof, uniform thickness and bonded securely to substrate.
 - 3. Allow membrane to cure and verify waterproof condition by testing before installing tile or setting materials.
- D. Transition of waterproofing membrane from floor tile to wall:
 - 1. Extend continuous floor membrane up behind wall base tile.
 - 2. Extend continuous floor membrane up behind wall tile.
 - a. Where Drawings indicate wall tile to be "without" waterproofing membrane, extend membrane up behind wall tile 4 inches from floor.
- E. Transition of waterproofing membrane from shower area to floor tile beyond where floor tile beyond is indicated to be "without" waterproofing membrane:
 - 1. Extend continuous floor membrane beyond shower curtain line minimum 36 inches in front of shower and 24 inches left and right of shower opening, and up behind wall base tile contiguous to the extended membrane areas. Feather membrane edges at perimeters of extended membrane areas.

3.7 INSTALLATION - INTERIOR FLOORS: THIN-SET METHOD

- A. To be used at locations where concrete substrate IS NOT DEPRESSED.
- B. TCNA Method F122: On-ground concrete.
 - 1. Locations: Wet areas and as indicated here; otherwise use TCNA Method F113.
 - a. Showers (all tiling surfaces).
 - b. Wash Basins (all tiling surfaces).
 - c. Group Toilet Rooms (floor tiling and wall base tiling only).
 - d. Single Occupancy Toilet Rooms (floor tiling and wall base tiling only).
 - e. Locker and Dressing Rooms (floor tiling and wall base tiling only).
 - f. Dishwashing Areas (floor tiling and wall base tiling only).
 - g. Food Preparation Areas (floor tiling and wall base tiling only).
 - h. Mechanical Rooms (floor tiling and wall base tiling only).
 - i. Areas with similar surfaces subject to periods of running or standing water.
 - j. Other areas indicated on Drawings to receive waterproofing membrane.
 - 2. Waterproofing Membrane; ANSI A118.10.
 - 3. Crack Isolation Membrane; ANSI A118.12.
 - a. TCNA Method F125-Partial with crack isolation reinforcing fabric.
 - 4. Bonding Coat:
 - a. Latex/Polymer Modified Portland Cement Mortar; ANSI A118.4.
 - b. Modified Dry-Set Mortar for Large and Heavy Tile (LHT) Mortar; ANSI A118.4H.
 - 5. Grout:
 - a. High Performance Cement Grout; ANSI A118.7.
- C. TCNA Method F122A: Above-ground concrete.
 - 1. Locations: Wet areas and as indicated here; otherwise use TCNA Method F113A.
 - a. Showers (all tiling surfaces).
 - b. Wash Basins (all tiling surfaces).
 - c. Group Toilet Rooms (floor tiling and wall base tiling only).
 - d. Single Occupancy Toilet Rooms (floor tiling and wall base tiling only).
 - e. Locker and Dressing Rooms (floor tiling and wall base tiling only).
 - f. Dishwashing Areas (floor tiling and wall base tiling only).
 - g. Food Preparation Areas (floor tiling and wall base tiling only).
 - h. Mechanical Rooms (floor tiling and wall base tiling only).
 - i. Areas with similar surfaces subject to periods of running or standing water.

- j. Other areas indicated on Drawings to receive waterproofing membrane.
 - 2. Waterproofing Membrane; ANSI A118.10.
 - 3. Crack Isolation Membrane; ANSI A118.12.
 - a. TCNA Method F125-Partial with crack isolation reinforcing fabric.
 - 4. Bonding Coat:
 - a. Latex/Polymer Modified Portland Cement Mortar; ANSI A118.4.
 - b. Modified Dry-Set Mortar for Large and Heavy Tile (LHT) Mortar; ANSI A118.4H.
 - 5. Grout:
 - a. High Performance Cement Grout; ANSI A118.7.
- D. TCNA Method F113: On-ground concrete.
 - 1. Locations:
 - a. Locations that ARE NOT indicated to receive waterproofing membrane in this Section or on Drawings.
 - b. Locations that ARE NOT indicated to be installed with other TCNA Method.
 - 2. Crack Isolation Membrane; ANSI A118.12.
 - a. TCNA Method F125-Partial: At all existing cracks.
 - 3. Bonding Coat:
 - a. Latex/Polymer Modified Portland Cement Mortar; ANSI A118.4.
 - b. Modified Dry-Set Mortar for Large and Heavy Tile (LHT) Mortar; ANSI A118.4H.
 - 4. Grout:
 - a. High Performance Cement Grout; ANSI A118.7.

3.8 INSTALLATION - WALLS: THIN-SET METHODS

- A. TCNA Method W202E.
 - 1. Locations:
 - a. Exterior and interior locations on masonry and concrete substrates.
 - b. Waterproofing membrane required in wet areas, and for exterior applications, or if otherwise indicated on Drawings.
 - 2. Waterproofing Membrane; ANSI A118.10 (waterproofing), specified in this Section.
 - 3. Bonding Coat:
 - a. Latex/Polymer Modified Portland Cement Mortar:
 - 1) Complying with ANSI A118.4.
 - b. Modified Dry-Set Mortar for Large and Heavy Tile (LHT) Mortar; ANSI A118.4H.
 - 4. Grout:
 - a. High Performance Cement Grout: ANSI A118.7.

3.9 ADJUSTING

- A. Section 01 73 00 - Execution: Starting, testing, adjusting, and balancing.
- B. Remove and replace unacceptable tiles. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement. Unacceptable tiles include, but are not limited to, the following:
 - 1. Tile that is damaged.
 - 2. Tile that does not match adjoining tile or is not compliant with the color/pattern indicated.
 - 3. Tile that is not fully bonded to substrate.

3.10 CLEANING

- A. Section 01 73 00 - Execution and Section 01 77 00 - Closeout Procedures: Related to cleaning.
- B. Clean all ceramic tile surfaces so they are free of foreign matter.
- C. Remove grout residue and stains from tile as soon as possible.
- D. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions and use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3.11 PROTECTION

- A. Section 01 73 00 - Execution: Protecting installed construction.
- B. Protect installed tile work with kraft paper or other heavy covering during construction period.
- C. Prohibit foot and wheel traffic from tiled floors for at least seven (7) days after grouting is completed.
- D. Remove protective coverings and clean for substantial completion inspection and for final inspection. Between inspections, reinstall protective coverings and maintain protection of work.

END OF SECTION

SECTION 09 51 13
ACOUSTICAL PANEL CEILINGS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Acoustic Ceiling Panels.
 - 2. Suspension Grid Systems.
- B. Related Requirements:
 - 1. Section 04 20 00 - Unit Masonry.
 - 2. Section 07 95 13 - Expansion Joint Cover Assemblies.
 - 3. Section 09 21 16 - Gypsum Board Assemblies.
 - 4. Division 21 - Fire Suppression: Coordinate with devices in areas of work.
 - 5. Division 23 - HVAC: Coordinate with devices in areas of work.
 - 6. Division 26 - Electrical: Coordinate with devices in areas of work.
 - 7. Division 27 - Communications: Coordinate with devices in areas of work.
 - 8. Division 28 - Electronic Safety and Security: Coordinate with devices in areas of work.

1.2 REFERENCES

- A. American Society of Civil Engineers (ASCE):
 - 1. ASCE 7 - Minimum Design Loads And Associated Criteria For Buildings And Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- B. ASTM International (ASTM):
 - 1. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy- Coated (Galvannealed) by the Hot-Dip Process; 2023.
 - 2. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
 - 3. ASTM C635/C635M - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2022.
 - 4. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2019.
 - 5. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
 - 6. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2022.
 - 7. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2023.

1.3 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate other construction that is concealed by or interfaces with the work of this Section. This includes, but is not limited to, wall devices, light fixtures, HVAC equipment, and fire suppression system components.

1.4 SEQUENCING

- A. Section 01 30 00 - Administrative Requirements: Scheduling and sequencing.
- B. Sequence work as to not install work until building is enclosed, sufficient air temperature and humidity level is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
- C. Install ceiling panels after interior wet work is dry.

1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit data on suspension grid system components, acoustic panels, and accessories.
- C. Shop Drawings: Show suspension grid layout and dimensioning, panel layouts, lighting fixtures, air diffusers, grilles, and all other items exposed in acoustical ceilings, locations of seismic braces and hangers, and suspension, seismic and bracing details. Show details of junctions with other work or ceiling finishes, and special conditions.
- D. Provide seismic design of suspended ceiling systems under direct supervision and sealed by Professional Structural Engineer.
 - 1. Provide sealed calculations indicating that design of suspension systems provide compliance with seismic structural requirements indicated in the Performance and Design Requirements article in this Section.
- E. Samples:
 - 1. Submit two samples 12 x 12 inches in size illustrating material, fabrication, and finish of acoustic panels.
 - 2. Submit two samples each, 6 inches long, of suspension system main runner, cross runner, perimeter wall molding and trim, and seismic components.
- F. Designer's Qualification Statement.
- G. Manufacturer's Qualification Statement.
- H. Installer's Qualification Statement.
- I. Manufacturer's Installation Instructions: Submit special procedures, and perimeter conditions requiring special attention.

1.6 QUALIFICATIONS

- A. Designer Qualifications for Seismic Design: Perform under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed at the State in which the Project is located.
- B. Acoustical Panels and Suspension System Manufacturer Qualifications: Company specializing in manufacturing products indicated with minimum five (5) years documented experience.
- C. Installer: Company specializing in performing indicated work with minimum five (5) years documented experience.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements.

- B. Maintain the following minimum environmental requirements in installation areas prior to, during, and after acoustic panel installation. If manufacturer's requirements are more stringent, comply with manufacture's requirements.
 - 1. Enclosed and weatherproof; wet work in place is completed and nominally dry; free of construction dust and debris.
 - 2. Ambient air conditions of temperature and humidity are continuously maintained at values intended for final occupancy and operations.

1.8 SPARE PARTS AND MAINTENANCE PRODUCTS

- A. Section 01 60 00 - Product Requirements: Extra materials, spare parts, and maintenance products.
- B. Furnish the following extra materials to the Owner:
 - 1. Three (3) manufacturer's cartons of each tile panel type installed.
 - 2. Twenty (20) linear feet of each of the following components of each type and color of suspended grid system installed: Main grid runners, cross grid members, perimeter wall trim, and face trim.

PART 2 PRODUCTS

2.1 PERFORMANCE AND DESIGN REQUIREMENTS:

- A. Seismic Loads: Design and size components to withstand seismic loads and sway displacement as calculated according to ASCE 7 and applicable codes.
 - 1. Design is to include compliance with ASTM E580/E580M.
 - 2. Seismic Design is to comply with requirements for the Seismic Design Category as indicated on the Structural Drawings and Section 00 31 00 - Available Project Information.
- B. Surface Burning Characteristics: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.
- C. Suspension System: Secure acoustic ceiling system including integral mechanical and electrical components with maximum deflection of 1/360.

2.2 ACOUSTIC PANEL CEILING SYSTEMS

- A. Manufacturers:
 - 1. Armstrong World Industries.
 - 2. CertainTeed.
 - 3. USG Interiors.
 - 4. Substitutions: Section 01 60 00 - Product Requirements.

2.3 ACOUSTIC PANELS

- A. Acoustic Panels - **Type APC1:**
 - 1. Basis of Design: Armstrong - Ultima (1910).
 - 2. Classification: ASTM E1264, Type IV - Mineral fiber with acoustically transparent membrane and factory-applied latex paint.
 - a. Form: 2 - water felted.
 - b. Pattern:
 - 1) E - lightly textured.
 - c. Fire Class A, ASTM E 84.
 - d. Sag Resistant.
 - e. Mold and Mildew Resistant.

3. Size: 24 x 24 inches.
 4. Thickness:
 - a. 3/4 inch.
 5. Light Reflectance: 88 percent.
 6. NRC: 0.75.
 7. CAC: 35.
 8. Edge: Formed to suit grid profile.
 - a. Tegal
 9. Surface Color: White.
 10. Suspension Grid Type as indicated in this Section:
 - a. Suspension Grid Type SG-1.
- B. Acoustic Panels - **Type VACT:**
1. Basis of Design: Armstrong - Ultima Health Zone (1935).
 2. Classification: ASTM E1264, Type IV - Mineral fiber with acoustically transparent water-repellent membrane and factory-applied latex paint.
 - a. Form: 2 - water felted.
 - b. Pattern:
 - 1) E - lightly textured.
 - c. Sag Resistant.
 - d. Mold and Mildew Resistant.
 - e. Anti-Bacterial Resistant.
 3. Size: 24 x 24 inches.
 4. Thickness:
 - a. 3/4 inch.
 5. Light Reflectance: 86 percent.
 6. NRC: 0.70.
 7. CAC: 35.
 8. Edge: Formed to suit grid profile.
 - a. Square.
 9. Surface Color: White.
 10. Suspension Grid Type as indicated in this Section:
 - a. Suspension Grid Type SG-1.
- C. Acoustic Panels - **Type APC2:**
1. Basis of Design: Armstrong - Create, Ultima.
 2. Classification: ASTM E1264, Type III - Mineral fiber with latex painted finish.
 - a. Form: 2 - water felted.
 - b. Pattern:
 - 1) E - lightly textured.
 - c. Fire Class A, ASTM E84.
 - d. Sag Resistant.
 - e. Mold and Mildew Resistant.
 3. Size: 24 x 24 inches.
 4. Thickness:
 - a. 3/4 inch.
 5. NRC: 0.75.
 6. CAC: 35.
 7. Edge: Formed to suit grid profile.
 - a. Tegal.
 8. Surface Color: Black.
 9. Suspension Grid Type as indicated in this Section:
 - a. Suspension Grid Type SG-1.
 - b. Color: Black.

2.4 SUSPENSION GRID SYSTEMS

- A. General:
 - 1. Support Channels and Hangers: Primed steel; size and type to suit application, seismic requirements, load support requirements, and ceiling system flatness requirements.
 - 2. Provide stabilizer bars, clips, splices, and perimeter wall moldings and trim required for suspension grid system, and as indicated on Drawings and in this Section.
- B. Suspension Grid - **Type SG-1**: Exposed to view.
 - 1. Basis of Design: Manufacturer to be same as manufacturer of ceiling panels.
 - 2. Non-fire Rated Grid: ASTM C635/C635M, exposed T; components die cut and interlocking.
 - a. Structural Classification:
 - 1) Intermediate-duty.
 - 3. Grid Materials: Hot-dipped galvanized steel sheet complying with ASTM A653/A653M.
 - 4. Exposed Grid Surface Width:
 - a. 15/16 inch.
 - 5. Grid Finish Color:
 - a. Match color of Acoustic Panel. If no match is available, submit full range of colors available for selection by Architect.
 - 6. Perimeter Wall Moldings and Trim: As indicated in ACCESSORIES article.

2.5 ACCESSORIES

- A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.
- B. Perimeter Wall Moldings: Perimeter wall moldings for termination and support of suspension grid system at abutment to vertical construction and other grid system interruptions:
 - 1. Material, Finish Type and Color: Match suspension grid system.
 - 2. For Exposed Suspension Grid System:
 - a. L-shaped molding; 7/8 inch exposed face; mounted flush with grid face.
 - 3. Manufactured Corners: Provide single piece seamless corners conforming to corner angle or radius.
 - 4. Manufactured Radius: Provide seamless radius trim at maximum lengths practical but not less than 8 feet.
 - 5. Manufactured Column Rings: For conditions where curved columns penetrate or abut ceiling, provide column trim ring at radius to match column size and radius.
- C. Exposed fastener heads to be shop finished to match grid system finish type and color.
- D. Touch-up Paint: Type and color to match acoustic panels and grid components.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 73 00 - Execution: Examination, coordination, and project conditions.
- B. Verify layout of hangers will not interfere with other work.

3.2 PREPARATION

- A. Section 01 73 00 - Execution: Prepare field conditions and existing construction for installation of work of this Section.
- B. Prepare materials to be installed and equipment to be used during installation.

3.3 INSTALLATION

- A. Section 01 73 00 - Execution: Related to installation of Work.
- B. Suspension Grid System:
 - 1. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions and as supplemented in this Section.
 - 2. Suspended ceilings are subject to special inspection.
 - 3. Locate system on room axis according to reflected ceiling plan in Drawings.
 - 4. Install after major above ceiling work is complete. Coordinate location of hangers with other work. Coordinate with sprinkler head penetrations for oversized trim if not braced. Ceilings without rigid bracing must have 2 inch oversized trim rings for sprinklers and other penetrations.
 - 5. Install suspension system in accordance with manufacturer's seismic requirements and installation guide, and in compliance with the Seismic Design Category design requirements.
 - 6. Ceiling areas over 1,000 SF must have horizontal restraint wire or rigid bracing.
 - 7. Ceiling areas over 2,500 SF must have seismic separation joints or full height partitions.
 - 8. Install system capable of supporting imposed loads to deflection of 1/360 maximum.
 - 9. Ends of cross tees to be locked into main beams to prevent their spreading.
 - 10. Hang suspension system from building structural members and independent of walls, columns, ducts, pipes, cable trays, and conduit. Do not hang suspension system from non-structural building elements. Do not hang suspension system from roof deck. Do not allow suspension system components to touch ducts, pipes, conduit, or other ceiling installations.
 - 11. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
 - 12. Changes in ceiling plane must have positive bracing.
 - 13. Where ducts or other equipment prevent regular spacing of hangers, reinforce nearest affected hangers, and related carrying channels to span extra distance.
 - 14. Do not support components on main runners or cross runners when weight causes total dead load to exceed deflection capability. Support fixture loads by supplementary hangers located within 6 inches of each corner; or support components independently.
 - 15. Do not eccentrically load system or produce rotation of runners.
 - 16. Perimeter Wall Moldings:
 - a. Install perimeter wall molding at ceiling abutment to vertical construction.
 - b. Use longest practical lengths.
 - c. Install manufactured seamless corners.
 - d. Install manufactured seamless radius trim at curved walls and round columns.
 - 17. Form expansion joints as detailed. Form to accommodate plus or minus 1 inch movement. Maintain visual closure.
- C. Acoustic Panels:
 - 1. Fit acoustic panels in place, free from damaged edges or other defects detrimental to appearance and function.
 - 2. Lay directional patterned panels as shown on the Drawings. Fit border trim neatly against abutting surfaces.

3. Install panels after above ceiling work is complete.
4. Install acoustic panels level, in uniform plane, and free from twist, warp, and dents.
5. Cutting Acoustic Panels:
 - a. Cut to fit irregular grid and perimeter edge trim.
 - b. Make field cut edges of same profile as factory edges.
 - c. Double cut and field finish exposed edges to match panel finish.
6. Where round obstructions and bullnose concrete block corners occur, provide preformed closures to match perimeter wall molding or trim.
7. Install hold-down clips on each panel to retain panels tight to grid system; comply with fire rating requirements.
8. Install hold-down clips to retain panels tight to suspension grid system within 10 feet of exterior door.

3.4 ERECTION TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.
- C. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

3.5 CLEANING

- A. Section 01 73 00 - Execution and Section 01 77 00 - Closeout Procedures: Clean installed work and comply with manufacturer's recommendations.
- B. Clean installed work in accordance with manufacturer's recommended materials and procedures.

3.6 PROTECTION OF INSTALLED CONSTRUCTION

- A. Section 01 73 00 - Execution: Protecting installed construction.
- B. Protect against modifications to completed suspension and hanger systems by unauthorized persons.
- C. Protect installed work from damage and marring of finishes. Remove and replace components that become damaged.

3.7 SCHEDULES

- A. Refer to Reflected Ceiling Plans, Finish Schedules, Details, and Notes on Drawings for locations and configurations of systems indicated in this Section.

END OF SECTION

SECTION 09 64 66
WOOD ATHLETIC FLOORING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Wood flooring for athletic and sports areas.
- B. Related Requirements:
 - 1. Section 03 30 00 - Cast-In-Place Concrete: Substrate for flooring system.

1.2 REFERENCES

- A. APA - The Engineered Wood Association (APA).
- B. ASTM International (ASTM):
 - 1. ASTM D2240 - Standard Test Method for Rubber Property-Durometer Hardness; 2015, Reapproval 2021.
 - 2. ASTM D3676 - Standard Specification for Rubber Cellular Cushion Used for Carpet or Rug Underlay; 2018.
 - 3. ASTM D4397 - Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Application; 2016.
 - 4. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2019a, Editorial Changes 2020.
 - 5. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2022.
 - 6. ASTM F1861 - Standard Specification for Resilient Wall Base; 2021.
 - 7. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2022.
 - 8. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.
- C. American Wood Protection Association (AWPA).
 - 1. AWPA U1 - Use Category System: User Specification for Treated Wood; 2023.
- D. California Department of Public Health (CDPH):
 - 1. CDPH Standard Method VOC v1.2 - Standard Method For The Testing And Evaluation Of Volatile Organic Chemical Emissions From Indoor Sources Using Environmental Chambers - Version 1.2; 2017.
- E. Maple Flooring Manufacturers Association, Inc. (MFMA):
 - 1. MFMA Standards:
 - a. Guide Specifications for Maple Flooring Systems; Current Edition Online, www.maplefloor.org/ForArchitects/Specifying-a-Floor.aspx.
 - b. PUR - Performance and Uniformity Rating Sport Specific Standards; Current Edition Online, www.maplefloor.org/Standards/PUR-Standards.aspx.
 - c. Athletic Flooring Sealer and Finish Specifications and Conformance List; Current Edition Online, www.maplefloor.org/TechnicalInfo/Finishes-Sealers.aspx.
- F. National Federation of State High School Associations (NFHS):
 - 1. NFHS - Court and Field Diagram Guide; Current Edition Online, www.nfhs.com.

1.3 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate the installation of the concrete substrate with the requirements of the Work of this Section.
 - 1. The finish elevation of the depressed concrete is to be equal to the assembled and finished flooring system as required to achieve flush flooring transitions. The concrete finish is to be steel troweled to a true level and finished smooth and straight to a tolerance of 1/4 inch in a 10 foot radius. High spots are to be ground level and low spots filled in with approved leveling compounds to achieve the required elevation and level flatness.
- C. Floor Boxes, Access Covers, Trim and Other Floor Devices: Coordinate work of this Section with work requirements by others that interface with the work of this Section.

1.4 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this Section. Review the work requirements, application procedures, quality control, testing and inspection and production schedule.
- C. Using a small mockup assembly (about 12 inches square) of the flooring systems, demonstrate that the assembled flooring systems will finish level and flush with adjacent floor finishes at doorways, openings, and points of egress.

1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Provide data for materials and accessories; include standard construction details, material descriptions, dimensions of individual components, profiles, assemblies, and finishes.
- C. Shop Drawings: Indicate floor joint pattern and termination details.
 - 1. Indicate materials, layout, dimensions, installation details, moisture protection, methods of attachment in construction, relationships, and transitions to surrounding and adjacent construction, base and trim details, direction of wood strips and floor boxes and devices.
 - 2. Indicate provisions for expansion and contraction, base, base corner details.
 - 3. Indicate equipment inserts, floor boxes, sockets, and other devices within the flooring area.
 - 4. Indicate location, size, design, and color of game line markings and graphics.
- D. Samples - Wood Flooring Samples:
 - 1. Samples for Initial Selection: Submit two paper chip samples; 2 x 3 inches in size; illustrating range of stained and non-stained colors and sheens available for each wood species indicated; submit for Architect's initial selections.
 - 2. Samples for Verification: From the Architect's initial selections, prepare and submit two samples for each selected color and sheen; minimum 8 x 8 inches assembled of actual wood strips of each wood species required in construction. Where finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.
- E. Manufacturer's Certifications:
 - 1. Certify products meet or exceed specified requirements.
 - 2. Certify compatibility of complete finishing systems.

- 3. Certify approval of Installer.
- F. Installation Instructions: Indicate standard and special installation procedures. Include instructions for applying finishing system.
- G. Maintenance Data: Include maintenance procedures and recommended maintenance materials.

1.6 CLOSEOUT SUBMITTALS

- A. Section 01 77 00 - Closeout Procedures.
- B. Operation and Maintenance Data: Submit manufacturer's instructions for maintaining and refinishing of each flooring type installed.

1.7 QUALITY ASSURANCE

- A. Perform work of this Section in accordance with MFMA Standards.
- B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this Section with minimum six (6) years documented experience.
 - 1. Certification: Provide flooring that carries MFMA mark on each bundle or piece.
 - 2. Member mill of the Maple Flooring Manufacturers Association, Inc (MFMA).
- C. Installer Qualifications: Company specializing in performing work of the type specified and with at least six (6) years of documented experience.
 - 1. Single Source Responsibility: Engage a single qualified Installer to provide the work of this Section.
 - 2. Approved by flooring manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Do not deliver wood components and other materials until after concrete, masonry, ceramic tile, terrazzo, and similar wet work is complete, cured, and dry.
- C. Moisture Content: At time of delivery to Project, maintain 6 to 9 percent average moisture content.
- D. Accept materials on site in manufacturer's original packaging. Inspect for damage.
- E. Store wood components and other materials in a dry, warm, well-ventilated, weathertight location, in a horizontal position, and protected from exposure to moisture.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements: Requirements before, during and after Work.
- B. Do not install wood flooring until wet construction work is complete and permanent heat and air conditioning is installed and operating.
- C. Maintain room temperature between 65 degrees F and 75 degrees F and relative humidity between 35 to 40 percent for a period of seven (7) days prior to delivery of materials to installation area, during installation, and after installation.
- D. Acclimate flooring materials by storing materials in conditioned installation area prior to installation as follows:
 - 1. 7 days, minimum.

1.10 WARRANTY

- A. Section 01 77 00 - Closeout Procedures: Product warranties.
- B. Manufacturer's Warranty: Furnish two (2) year warranty against defects in materials and workmanship.
- C. Installer's Warranty: Furnish three (3) year warranty for materials, installation, and finish.

1.11 SPARE PARTS AND MAINTENANCE PRODUCTS

- A. Section 01 60 00 - Product Requirements: Extra materials, spare parts, and maintenance products.
 - 1. Extra Flooring Material: Provide ten (10) square yards of each flooring type installed; unfinished; full size units; unassembled.

PART 2 PRODUCTS

2.1 WOOD ATHLETIC FLOORING

- A. Description: Floating system; tongue and groove wood strips; over plywood subfloor; over wood sleepers with resilient pads; over vapor retarder; on concrete slab-on-grade.
 - 1. Finishing: Refer to WOOD FLOOR FINISH MATERIALS articles in this Section.
- B. Manufacturers:
 - 1. Aacer Flooring, LLC.
 - 2. Action Floor Systems.
 - 3. Connor.
 - 4. Horner Flooring Company.
 - 5. Robbins, Inc.
 - 6. Substitutions: Section 01 60 00 - Product Requirements.
- C. Basis of Design:
 - 1. Connor - DuraCushion III.
- D. Components:
 - 1. Wood Strip Flooring: Comply with MFMA Standards.
 - a. Species: Northern Hard Maple.
 - b. Grade:
 - 1) Second and better grade.
 - c. Cut: Edge grain.
 - d. Moisture Content: 6 to 9 percent.
 - e. Actual Thickness: 25/32 inch.
 - f. Actual Width: 2-1/4 inches.
 - g. Edge: Tongue and groove cut.
 - h. End: End matched.
 - i. Back Channeling: Back channel each piece according to manufacturer's standards, unless specifically recommended by manufacturer and installer to be plain or flat backed for application indicated.
 - j. Length: Random, 8 feet, minimum of 9 inches.
 - k. Seasoning: Kiln dry flooring before milling. Air dried flooring will not be acceptable.
 - 2. Wood Subflooring: Plywood; APA Rated Sheathing, span rating of 40/20; C-D Exposure 1; square edges; preservative-treated.
 - a. Edges: Square cut.

- b. Thickness: Number of layers and thickness to be as indicated on Drawings, but initial layer on sleepers to be not less than 5/8 inch thick.
- 3. Sleepers and Shims: Standard grade, nominal 2 by 3 inches by 4 feet long, kiln dried Eastern hemlock, fir, pine, or spruce, waterborne pressure preservative-treated according to AWWPA U1, Use Category UC2.
- 4. Resilient Cushion Pads: Resilient pads, rubber material, unsealed air slots for resiliency; 2-1/4 x 3 inches size and 3/8 inch thick; factory applied to bottom of sleepers at 12 inches o.c. and each end.
- 5. Vapor Retarder: ASTM D4397, black polyethylene sheet, 8 mil thick; 2 inch wide tape as recommended by vapor retarder manufacturer for continuous joint sealing.

2.2 ACCESSORIES

- A. Flooring System Fasteners: Non-corrosive type as recommended by flooring system manufacturer.
- B. Subflooring Fasteners: Screws of non-corrosive type; length as required to secure each subflooring layer into sleepers below.
- C. Perimeter Springs: Flat spring steel, leaf shaped, with attachment clips, 0.093 x 1 x 9 inches size.
- D. Transition Covers: Extruded aluminum, ADA compliant, top grooved parallel to length, factory countersunk anchor holes, and mill finished.
- E. Vented Wall Base: Molded rubber complying with ASTM F1861, Type TS, Group 1 (solid) Standard Specification for Resilient Wall Base.
 - 1. Pre-molded outside corners with minimum 3 inch returns. Pre-molded end caps.
 - 2. Size: 4 inches (10.16 cm) high by 5/16 inch (7.94 mm) thick coved profile with a 3 inch (7.62 cm) long by 3/8 inch (9.53 mm) thick toe.
 - 3. Venting: Back of vertical surface grooved with vertical semi-circular vents. 15 vents per 4 ft. length.
 - 4. Length: Minimum 4 foot lengths.
 - 5. Hardness: ASTM D2240 - Not less than 85 Shore A.
 - 6. Fire Resistance: Meets ASTM E648 - Class I.
 - 7. Comply with ASTM F1861 requirements for resistance to heat/light aging, chemicals, and dimensional stability.
 - 8. Color: To be as selected by Architect from manufacturer's full range.

2.3 GAME LINES AND GRAPHICS

- A. Apply painted lines and graphics after wood sealer coating and before wood finish coating.
- B. Game Lines: Layout to be as indicated on Drawings and in compliance with the current NFHS - Court and Field Diagram Guide.
- C. Graphics:
 - 1. Provide twelve (12) graphic letters at each end of main gym basketball court; 20 inches high; uppercase; one color and font to be selected by Architect from full range.
 - 2. Provide 14 ft diameter custom graphic logo at center of main gym basketball court. Graphic design to be provided by Architect. Three (3) colors to be selected by Architect from full range.

2.4 WOOD FLOOR FINISH MATERIALS

- A. Provide certification that wood floor finish materials are compatible with each other and the wood flooring material.

- B. Wood Fillers and Penetrating Stain: Fillers to be tented and stained to match final color of wood. Stain color as selected by Architect from manufacturer's full range.
- C. Game Lines and Graphics Paint: High gloss acrylic paint to be provided by or recommended by wood sealer and finish system manufacturer.
 - 1. Apply after wood sealer coating and prior to wood finish coating.
- D. Wood Sealer and Finish System: Comply with MFMA Standards and the current MFMA Conformance List.
 - 1. Manufacturer:
 - a. BonaKemi USA, Inc.
 - b. Hillyard Industries, Inc.
 - c. Poloplaz by Canlak Coatings Company.
 - 2. Oil-Based System:
 - a. Oil-Based Sealer: Two coats; MFMA Approved - Group 1.
 - 1) Basis of Design:
 - a) Hillyard - Gold Medalist Wood Seal (2 coats).
 - b. Oil-Based Finish: Two coats; MFMA Approved - Group 3.
 - 1) Basis of Design:
 - a) Hillyard - Gold Medalist Gym Finish (1 coat), and 450 Gym Finish (1 coat).

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 73 00 - Execution: Verification of existing conditions before starting work.
- B. Verify compliance with the requirements in the PART 1, ENVIRONMENTAL REQUIREMENTS article.
- C. Verify that existing conditions are as required before starting work of the Section.
- D. Verify that the finish elevation of the depressed concrete is equal to the assembled and finished flooring system as required to achieve flush flooring transitions.
- E. Verify that the assembled and finished floor system of this Section will finish flush with floor boxes, inserts, devices, and adjacent finished floors. This flush transition requirement cannot be over emphasized. The transition joints must be tight and flush to eliminate trip hazards.
- F. Verify that floor boxes, inserts, utilities, and other floor devices are installed in correct locations.
- G. Verify that all adjacent work (including flooring by others) is completed and that overhead work trades have finished their work in the flooring areas.
- H. Verify that the building is dry, all openings are closed in, adequate ventilation is provided, and permanent heating and air conditioning is installed operating and providing the required conditioning of the air in the work area.
- I. Verify that surfaces are free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- J. Verify that the concrete finish has been steel troweled to a true level and finished smooth and straight to a tolerance of 1/4 inch in a 10 foot radius. High spots are to be ground level

and low spots filled in with approved leveling compounds to achieve the required elevation and level flatness.

- K. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive wall base material.
- L. Verify that the concrete substrate is dry in accordance with industry standard testing procedures, free of foreign materials, and broom cleaned.
- M. Cementitious Substrate Surfaces Testing: Verify that substrates are ready for flooring installation by testing for moisture and alkalinity (pH).
 - 1. Alkalinity (pH) Testing: ASTM F710. Measurement for pH range is to be not less than 7 pH and not more than 9 pH, unless written recommendations of flooring manufacturer or adhesive manufacturer are more stringent.
 - 2. Internal Relative Humidity Testing: ASTM F2170. Perform test using in situ probes. Humidity level of substrates is to measure no more than 75 percent relative humidity level, unless written recommendations of flooring manufacturer or adhesive manufacturer are more stringent.
 - 3. Moisture Vapor Emission Testing: ASTM F1869. Perform anhydrous calcium chloride test. Moisture vapor emission rate (MVER) from the slab is to be less than or equal to 3 lbs of water per 1,000 sf in 24 hours, unless written recommendations of flooring manufacturer or adhesive manufacturer are more stringent.
 - 4. Conduct tests by an independent testing agency acceptable to Owner.
- N. Do not proceed with installation work until noncompliant conditions have been corrected.

3.2 PREPARATION

- A. Section 01 73 00 - Execution: Prepare field conditions and existing construction for installation of work of this Section.
- B. Prepare materials to be installed and equipment to be used during installation.
- C. Comply with product manufacturer's site and material condition requirements for installation.
- D. Clean substrate.

3.3 INSTALLATION

- A. Section 01 73 00 - Execution: Related to installation of Work.
- B. Comply with MFMA Standards and the requirements in this Section.
- C. Floor Boxes, Access Covers, and Other Floor Devices: Coordinate work of this Section with other contractors/installers of such devices and trim components.
- D. Install floor sockets and inserts to a depth sufficient to ensure flush top surface with floor surface.
- E. Cushioned Sleepers:
 - 1. Place vapor retarder over concrete subfloor surface, lapping edges and ends minimum 6 inches and tape for continuous seal; spot glue in place.
 - 2. Place cushioned sleepers over vapor retarder; end to end at right angles to the direction of the finish wood flooring strips. Stagger end joints 24 inches minimum. Space sleepers 12 inches on center. Do not secure to concrete subfloor. Maintain an expansion void at walls and all vertical obstructions; void size as recommended by manufacturer, but no less than 1-1/2 inches.

- a. Coordinate with requirements of fixed or telescoping bleachers to provide additional sleepers or blocking as support of bleachers bearing on or tracking across wood strip flooring system.
 3. Install shims as required for equal bearing on concrete substrate and to achieve level line of plus or minus 1/8 inch in a 10 feet radius.
- F. Wood Subflooring: Place plywood subflooring over sleepers.
 1. Lay plywood with the long edge perpendicular to the sleepers, with end joints over sleepers, and secure to sleepers with fasteners at 12 inches on center or closer if recommended by manufacturer.
 2. If two layers of subflooring are indicated, continue as follows:
 - a. Place sheathing paper between subflooring layers, lapping edges and ends 2 inches, staple in place.
 - b. Lay the second layer in the same direction as first layer, with edge joints offset from first layer by 24 inches and end joints offset from first layer by one sleeper. Secure to sleepers with fasteners at 12 inches on center.
- G. Prepare wood subfloor to receive wood flooring in accordance with manufacturer's recommendations and MFMA Standards.
- H. Broom clean wood subfloor.
- I. Sheathing Paper: Place between top of wood subfloor and bottom of finish wood flooring; lap edges and ends 2 inches, staple in place.
- J. Wood Strip Flooring:
 1. Install in accordance with manufacturer's recommendations and MFMA Standards; predrill and blind nail to sleepers.
 2. Wood Strip Direction - Unless indicated otherwise on Drawings, lay wood flooring strips parallel to the main playing court. Verify alignment as work progresses.
 3. Arrange flooring with end matched grain set flush and tight.
 4. Terminate flooring at adjacent flooring, allowing expansion void, and install aluminum saddle type threshold of such width and thickness as to bridge the expansion void.
 5. Where divider strips and transition strips are required, provide such strips in accordance with flooring manufacturer's recommendations and as indicated.
 6. Install edge strips at unprotected or exposed edges, and where flooring terminates.
 7. Secure edge strips before installation of flooring with stainless steel screws.
 8. Install flooring tight to floor access covers, unless indicated otherwise by manufacturer's installation recommendations.
 9. Install flooring under movable partitions without interrupting floor pattern.
 10. Provide expansion requirements in field and space at fixed walls and other interruptions as needed for expansion and contraction.
 11. At cushioned sleepers, install springs in perimeter expansion space at 24 inches.
- K. Finishing Wood Strip Flooring:
 1. Allow installed flooring to acclimate to ambient conditions for a minimum period of 7 days before sanding.
 2. Mask off and protect adjacent surfaces before beginning sanding.
 3. Sand flooring to smooth even finish with no evidence of sander marks. Take precautions to contain dust.
 - a. Machine sand with coarse, medium, and fine grades of sandpaper. After sanding, buff entire floor using 120 grit screen or equal grit sandpaper, with a heavy-duty buffing machine.

- b. Clean with power vacuum, tack, and check to confirm that entire surface of each piece has been sanded, and that floor is level and smooth, without ridges or cups. Proceed immediately with finish process.
- 4. Apply finish system in accordance with floor finish manufacturer's recommendations and MFMA Standards.
 - a. Where penetrating stain is indicated, apply prior to first coat of sealer.
 - b. Where painted game lines or other graphics are indicated, apply after second coat of sealer.
 - 1) Lay out lines, fields and other graphics as indicated for colored enamel application. Mask flooring to provide sharp edges.
 - 2) Apply game lines and graphics with crisp and distinct edges.
 - 3) Apply game lines straight and true.
 - 4) Main basketball court lines are continuous. Main volleyball court lines are secondary and will break at main basketball court lines.
 - 5) Apply paint to minimum 1.0 mil thickness, in colors as indicated, or as selected by Architect.
- 5. Allow each coat to cure. Buff lightly to remove irregularities. Vacuum clean and wipe with damp cloth and allow to dry before applying succeeding coat.
- 6. Apply last coat of finish. After the last coat of finish has cured, if there are any areas of the finish that appear to have a dull or inconsistent sheen, apply additional finish coats as required to achieve a consistent and uniform sheen.
- L. Install wall base at floor perimeter to cover expansion space in accordance with manufacturer's instructions. Miter inside corners and install premolded outside corners.

3.4 CLEANING

- A. Section 01 73 00 - Execution and Section 01 77 00 - Closeout Procedures: Clean installed work and comply with manufacturer's recommendations.
- B. Clean and polish floor surfaces in accordance with flooring and finishing manufacturers' recommended material, procedures, and instructions.

3.5 PROTECTION

- A. Section 01 73 00 - Execution: Protecting installed construction.
- B. Prohibit traffic on floor finish for 48 hours after installation.
- C. Place protective coverings over finished floors; do not remove coverings until Substantial Completion inspection by Architect. Resume protection until final completion.

END OF SECTION

SECTION 09 65 00
RESILIENT FLOORING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Resilient tile flooring.
 - 2. Resilient wall base - non-vented type.
- B. Related Requirements:
 - 1. Section 03 30 00 - Cast-In-Place Concrete: Finishing of floor slab for resilient floor application.
 - 2. Sections indicating Plumbing, Electrical and Mechanical as related to floor installed devices such as drains, utility boxes, devices, and trim.

1.2 REFERENCES

- A. ASTM International (ASTM):
 - 1. ASTM D2240 - Standard Test Method for Rubber Property-Durometer Hardness; 2015, Reapproval 2021.
 - 2. ASTM D3389 - Standard Test Method for Coated Fabrics Abrasion Resistance (Rotary Platform Abrader); 2021.
 - 3. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
 - 4. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2023.
 - 5. ASTM E662 - Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials; 2021a, Editorial Revisions.
 - 6. ASTM F150 - Standard Test Method for Electrical Resistance of Conductive and Static Dissipative Resilient Flooring; 2006, Reapproval 2018.
 - 7. ASTM F386 - Standard Test Method for Thickness of Resilient Flooring Materials Having Flat Surfaces; 2017, Reapproval 2022.
 - 8. ASTM F410 - Standard Test Method for Wear Layer Thickness of Resilient Floor Coverings by Optical Measurement; 2008, Reapproval 2022.
 - 9. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2022.
 - 10. ASTM F1066 - Standard Specification for Vinyl Composition Floor Tile; 2023.
 - 11. ASTM F1344 - Standard Specification for Rubber Floor Tile; 2021a.
 - 12. ASTM F1700 - Standard Specification for Solid Vinyl Floor Tile; 2020.
 - 13. ASTM F1861 - Standard Specification for Resilient Wall Base; 2021.
 - 14. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2023.
 - 15. ASTM F1914 - Standard Test Methods for Short-Term Indentation and Residual Indentation of Resilient Floor Covering; 2018, Reapproval 2023.
 - 16. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.
 - 17. ASTM F2195 - Standard Specification for Linoleum Floor Tile; 2018, Reapproval 2023.
 - 18. ASTM F2421 - Standard Test Method for Measurement of Resilient Floor Plank by Dial Gauge; 2019a.
- B. National Fire Protection Association (NFPA):

1. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; 2023.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit data describing physical and performance characteristics; include manufacturer's full range of sizes, patterns, colors, and finishes available; include moldings, transition and edge trim as indicated on Drawings and otherwise recommended by manufacturer of Resilient Floor products; include installation instructions.
- C. Shop Drawings: Submit shop drawings indicating each product, locations, layouts, dimensions, patterns, trim details, and interface with adjacent work by others.
- D. Samples for Initial Selection: Two manufacturer's complete set of color samples illustrating the full range of sizes, patterns, colors, and finishes available; submit for Architect's initial selections.
- E. Samples for Verification: From the Architect's initial selections, prepare and submit two samples for each selection; samples to be same product material type indicated for final Work; each sample 4 x 4 inches. Where finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 78 23 - Operation and Maintenance Data.
- B. Operation and Maintenance Data: Submit maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.6 MOCK-UPS

- A. Section 01 40 00 - Quality Requirements: Mock-up requirements.
- B. At project site, install mock-up using acceptable products and manufacturer approved installation methods, including concrete substrate testing. Obtain Architect's approval of mock-up.
 1. Mock-up Size and Locations: One typical room; location as indicated by Architect.
 2. Mock-up may be incorporated into the final construction upon Architect's approval for mock-up to remain.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.
- C. Store all materials off the floor in an acclimatized, weather-tight space.
- D. Maintain temperature in storage area between 55 degrees F and 90 degrees F.
- E. Protect roll materials from damage by storing on end.

- F. Do not double stack pallets.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements: Requirements before, during and after Work.
- B. Store materials for not less than 48 hours prior to installation in area of installation at temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

1.9 WARRANTY

- A. Section 01 77 00 - Closeout Procedures: Product warranties.
- B. Vinyl Composition Tile: Provide five (5) year manufacturer's warranty.

1.10 SPARE PARTS AND MAINTENANCE PRODUCTS

- A. Section 01 60 00 - Product Requirements: Extra materials, spare parts, and maintenance products.
- B. Resilient Flooring: Furnish to Owner the following for each type and color installed.
 - 1. Fifty (50) square feet of flooring.
- C. Resilient Wall Base: Furnish to Owner the following for each type and color installed.
 - 1. One hundred (100) linear feet of wall base.
 - 2. Ten (10) each of pre-molded corners matching color and profile of each wall base.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire Performance Characteristics: Unless otherwise indicated, provide resilient flooring products with the following fire performance characteristics in accordance with the standards. Testing to be by a certified testing laboratory or other testing agency acceptable to authorities having jurisdiction:
 - 1. Surface Burning Characteristics: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.
 - 2. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter (Class 1) in accordance with ASTM E648 or NFPA 253.
 - 3. Smoke Density: 450 or less in accordance with ASTM E662.

2.2 RESILIENT TILE FLOORING

- A. Luxury Vinyl Tile (LVT):
 - 1. LVT1
 - a. Basis of Design: Patcraft – Polychrome, ECRU 00120 – 9”x48” x 2.5mm
 - b. Alternate 1 – Mannington – Color Anchor, Cottontail – 6”x36”x 2.5mm
 - c. Alternate 2 – J & J Flooring – Step by Step, Oatmeal – 18”x36”x2.5mm
 - 2. LVT2
 - a. Basis of Design: Patcraft – Polychrome, Balsam 00320 – 9”x48” x 2.5mm
 - b. Alternate 1 – Mannington – Color Anchor, Greentea – 6”x36”x 2.5mm
 - c. Alternate 2 – J&J Flooring – Step by Step, Limeade – 18”x36”x 2.5mm
 - 3. LVT3
 - a. Basis of Design: Patcraft – Polychrome, Viridian 00380 – 9”x48” x 2.5mm
 - b. Alternate 1 – Mannington – Color Anchor, Monstera – 6”x36”x 2.5mm
 - c. Alternate 2 – J&J Flooring – Step by Step, Forest – 18”x36”x 2.5mm

4. LVT4
 - a. Basis of Design: Patcraft – Polychrome, Cerulean 00220 V2 – 9”x48” x 2.5mm
 - b. Alternate 1 - Mannington – Color Anchor, Stonewash – 6”x36”x 2.5mm
 - c. Alternate 2 – J&J Flooring – Step by Step, Sky – 18”x36”x 2.5mm
5. LVT5
 - a. Basis of Design: Patcraft – Equal Mix of LVT2, LVT3,LVT4.
 - b. Alternate 1 – Mannington – Equal Mix of Alternate 1 - LVT2, LVT3,LVT4.
 - c. Alternate 2 – J&J Flooring– Equal Mix of Alternate 2 - LVT2, LVT3,LVT4.

2.3 RESILIENT WALL BASE - NON-VENTED TYPE

- A. Manufacturers:
 1. Mannington Commercial.
 2. Johnsonite, a Tarkett Company.
 3. Roppe Corporation.
 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Basis of Design:
 1. Johnsonite, a Tarkett Company.
- C. Resilient Non-vented Wall Base:
 1. Comply with ASTM F1861.
 - a. Type:
 - 1) Type TS - Rubber, vulcanized thermoset.
 - b. Group:
 - 1) Group 1 - Solid.
 - c. Style:
 - 1) Style B - Top set, Cove.
 2. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter (Class 1), when tested in accordance with ASTM E648 or NFPA 253.
 3. Smoke Density: 450 or less in accordance with ASTM E662.
 4. Height:
 - a. 4 inches.
 5. Thickness: 0.125 inch thick.
 6. Finish: Satin.
 7. Length: Roll.
 8. Accessories: Premolded external corners and end stops.
 9. Colors: Solid.
 - a. To be selected by Architect from manufacturer's full range.

2.4 RESILIENT WALL BASE - VENTED TYPE

- A. Manufacturers:
 1. Johnsonite, a Tarkett Company (Basis of Design).
 2. Mannington Commercial.
 3. Roppe Corp.
 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Basis of Design:
 1. Johnsonite, a Tarkett Company.
- C. Resilient Vented Cove Wall Base:
 1. Comply with ASTM F1861.
 - a. Type:

- 1) Type TS - Rubber, vulcanized thermoset.
- b. Group:
 - 1) Group 1 - Solid.
- c. Style - Coved with semi-circular vents on back of vertical leg.
- 2. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter (Class 1), when tested in accordance with ASTM E648 or NFPA 253.
- 3. Smoke Density: 450 or less in accordance with ASTM E662.
- 4. Height:
 - a. 4 inches.
- 5. Thickness: 5/16 inch thick coved profile with a 3/8 inch thick toe.
- 6. Finish: Satin.
- 7. Length: 8 feet.
- 8. Accessories: Premolded external corners and end stops.
- 9. Colors: Solid.
 - a. As indicated on Drawings.

2.5 ACCESSORIES

- A. Subfloor Filler: Factory mixed latex type recommended by manufacturers of flooring and adhesive materials and compatible with substrate materials and conditions.
- B. Primers and Adhesives: Waterproof type recommended by manufacturer of flooring material and compatible with substrate materials and conditions.
- C. Moldings, Transition and Edge Strips: As indicated on Drawings or as otherwise selected by Architect from Product Data submittals.
- D. Feature Strips: Of same material as tile. Width as indicated on Drawings.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 73 00 - Execution: Verification of existing conditions before starting work.
- B. Verify compliance with the requirements in the PART 1, ENVIRONMENTAL REQUIREMENTS article.
- C. Verify that existing conditions are as required before starting work of the Section.
- D. Verify that the assembled and finished floor system of this Section will finish flush with floor boxes, inserts, devices, and adjacent finished floors. This flush transition requirement cannot be over emphasized. The transition joints must be tight and flush to eliminate trip hazards.
- E. Verify that floor boxes, inserts, utilities, and other floor devices are installed in correct locations.
- F. Verify that overhead work trades have finished their work in the flooring areas.
- G. Verify that the building is dry, all openings are closed in, adequate ventilation is provided, and permanent heating and air conditioning is installed operating and providing the required conditioning of the air in the work area.
- H. Verify that surfaces are free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.

- I. Verify that the concrete finish has been steel troweled to a true level and finished smooth and straight to a tolerance of 1/4 inch in a 10 foot radius. High spots are to be ground level and low spots filled in with approved leveling compounds to achieve the required elevation and level flatness.
 - 1. Sloped Concrete: Levelness is relative to slopes indicated such as slopes to drains.
- J. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive wall base material.
- K. Verify that the concrete substrate is dry in accordance with industry standard testing procedures, free of foreign materials, and broom cleaned.
- L. Cementitious Substrate Surfaces Testing: Verify that substrates are ready for flooring installation by testing for moisture and alkalinity (pH).
 - 1. Alkalinity (pH) Testing: ASTM F710. Measurement for pH range is to be not less than 7 pH and not more than 9 pH, unless written recommendations of flooring manufacturer or adhesive manufacturer are more stringent.
 - 2. Internal Relative Humidity Testing: ASTM F2170. Perform test using in situ probes. Humidity level of substrates is to measure no more than 75 percent relative humidity level, unless written recommendations of flooring manufacturer or adhesive manufacturer are more stringent.
 - 3. Moisture Vapor Emission Testing: ASTM F1869. Perform anhydrous calcium chloride test. Moisture Vapor Emission Rate (MVER) from the slab is to be less than or equal to 3 lbs of water per 1,000 sf in 24 hours, unless written recommendations of flooring manufacturer or adhesive manufacturer are more stringent.
 - 4. Conduct tests by an independent testing agency acceptable to Owner.
- M. Do not proceed with installation work until noncompliant conditions have been corrected.

3.2 PREPARATION

- A. Section 01 73 00 - Execution: Prepare field conditions and existing construction for installation of work of this Section.
- B. Prepare materials to be installed and equipment to be used during installation.
- C. Prepare substrates to receive work as recommended by work product manufacturers.
- D. Remove sub-floor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with sub-floor filler to achieve smooth, flat, hard surface.
- E. Prohibit traffic until filler is cured.
- F. Clean substrate.
- G. Apply primer as recommended by resilient flooring product manufacturer and where required to prevent "bleed-through" or interference with adhesion.

3.3 INSTALLATION

- A. Section 01 73 00 - Execution: Related to installation of Work.
- B. General:
 - 1. Starting installation constitutes acceptance of sub-floor conditions.
 - 2. Install in accordance with manufacturer's written instructions and recommendations to ensure warranty requirements.
 - 3. Spread only enough adhesive to permit installation of materials before initial set.
 - 4. Fit joints and butt seams tightly.

5. Set flooring in place, press with heavy roller to attain full adhesion. Sound top surface of installed flooring material to ensure there are no hollow sounds (hollow sound may indicate flooring that is not fully adhered/bonded to substrate).
 6. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door (door in closed position).
 7. Install edge transition strips at unprotected or exposed edges, where flooring terminates, where flooring transitions to dissimilar flooring finishes and as indicated on Drawings.
 8. Resilient Strips: Attach to substrate using adhesive.
 9. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.
 10. Install flooring in recessed floor access covers, maintaining floor pattern.
 11. At movable partitions, install flooring under partitions without interrupting floor pattern.
 12. If feature strips/designs are indicated on Drawings, install feature strips/designs.
 13. Non-Factory Finished Flooring: Provide flooring finishes as indicated and in accordance with flooring manufacturer's recommendations.
- C. Resilient Tile Flooring:
1. Mix tile from containers to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.
 2. Unless flooring layout design is indicated otherwise on Drawings, lay flooring with joints and seams parallel to building lines to produce symmetrical tile pattern.
 3. Install tile to pattern indicated on Drawings. Allow minimum 1/2 full size tile width at room or area perimeter.
- D. Resilient Wall Base:
1. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.
 2. Miter internal corners. At external corners, use premolded units. At exposed ends, use premolded units.
 3. Install wall base on solid backing. Bond tightly to wall and floor surfaces. Bottom edge of wall base should be consistently in contact with finished flooring.
 4. Scribe and fit to door frames and other interruptions.

3.4 CLEANING

- A. Section 01 73 00 - Execution and Section 01 77 00 - Closeout Procedures: Related to cleaning.
- B. Remove excess adhesive from installed work and adjacent surfaces without damage to surfaces.
- C. Clean and maintain the work.

3.5 PROTECTION OF INSTALLED CONSTRUCTION

- A. Section 01 73 00 - Execution: Protecting installed construction.
- B. Prohibit traffic on flooring for duration recommended by manufacturer and not less than the following:
 1. Light Foot Traffic: 24 hours after installation.
 2. Rolling Load Traffic: 72 hours after installation.
- C. Protect the work from stains and damage.

END OF SECTION

SECTION 09 66 23

RESINOUS MATRIX TERRAZZO FLOORING (ALTERNATE 1)

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes resinous matrix terrazzo work and includes the following:
 - 1. Floors.
 - 2. Wall base.
- B. Related Requirements:
 - 1. Section 03 30 00 - Cast-In-Place Concrete: Concrete subfloor with broom finish.
 - 2. Section 07 90 00 - Joint Protection: Joint between terrazzo base and wall surface.
 - 3. Section 07 95 00 - Expansion Control: Building expansion joint covers.

1.2 ALTERNATES

- A. This Section is an Alternate as described in Section 01 23 00 - Alternates. This Section is applicable if the Alternate is accepted by Owner as part of the Contract Work.

1.3 REFERENCES

- A. National Terrazzo and Mosaic Association (NTMA):
 - 1. NTMA - Terrazzo Specifications; Current Edition.

1.4 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate placement of terrazzo divider strips with locations of mechanical and electrical access covers, substrate control joints and expansion joints, and other items built into terrazzo.
- C. Coordinate concrete substrate placement, finishing, and curing to be compatible with and as required for application of the work of this Section. Terrazzo flooring system bond to concrete substrate is required and essential.

1.5 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.6 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit data for divider strips, control joint strips, and sealer.
- C. Shop Drawings: Indicate divider strip and control joint layout, flooring material transitions, color patterns, and details of adjacent components.
- D. Samples for Initial Selection: Two manufacturer's complete set of color samples illustrating the full range of available finishes, colors, chip size and variations, chip gradation, matrix color, and divider and control joint strips; submit for Architect's initial selections.
- E. Samples for Verification: From the Architect's initial selections, prepare and submit two samples for each selected finish and color; samples to be same product material type

indicated for final Work; each sample 8 x 8 inches. Where finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.

- F. Warranty: Submit sample warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Section 01 78 23 - Operation and Maintenance Data.
- B. Operation and Maintenance Data:
 - 1. Submit installation testing and inspection reports.
 - 2. Submit procedures for stain removal, stripping, and sealing.
- C. Record Documentation of Substrate Cracks and Remedies:
 - 1. Submit scaled drawings and photographs that record locations of all substrate cracks and remedial construction applied to eliminate detrimental effect of such cracks on terrazzo flooring system.
 - 2. Include drawings of all floor areas receiving terrazzo. For drawings sheets of areas without substrate cracks, indicate so on the respective sheet.
 - 3. Survey for Record Documentation to be conducted prior to installation of terrazzo.
 - 4. Record Documentation to be titled, "Record Documentation of Substrate Cracks and Remedies." Documentation to include dates and times of survey and remediation.
 - 5. Contractor's project manager to certify Record Documentation with signature and certification date.
 - 6. Include certified documentation in closeout submittals for 01 78 39 - Project Record Documents.

1.8 QUALITY ASSURANCE

- A. Perform work in accordance with NTMA current recommendations.

1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five (5) years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum five (5) years documented experience.

1.10 MOCKUP

- A. Section 01 40 00 - Quality Requirements: Requirements for mockup.
- B. Mockup - To Be Removed From Site At Completion:
 - 1. Construct mockup, 10 x 10 feet, illustrating finish work. Mockup to include concrete substrate, terrazzo flooring of each color divided by divider strips, divider strips illustrating installation at all substrate and terrazzo joint types.
 - 2. Locate mockup as to not interfere with project work and as approved by Architect and Owner.
 - 3. Mockup is not to remain as part of final construction. Remove mockup entirely from project site with consent of Architect and Owner. Restore project area effected by mockup and removal to completed conditions indicated in the contract documents.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Store resin materials in dry, secure area.
- C. Maintain minimum temperature of 55 degrees F.

- D. Keep products away from fire or open flame.

1.12 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements.
- B. Do not install terrazzo when temperature is below 50 degrees F or above 90 degrees F.
- C. Maintain temperature within specified range 24 hours before, during, and 72 hours after installation of flooring.
- D. Provide ambient lighting level of 50 ft candles measured at floor surface.

1.13 WARRANTY

- A. Section 01 77 00 - Closeout Procedures: Product warranties.
- B. Special Warranty: Manufacturer and installer, jointly, agree to provide labor and material to repair and, if necessary, to replace components of terrazzo flooring system that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, loss of bond to substrate, cracks, and damage due to normal wear and tear.
 - 2. Failures do not include the following:
 - a. Damage due to bubbling or loss of adhesion due to moisture penetration through the substrate.
 - b. Acts of God or other elements beyond scope of protection of this system.
 - 3. Warranty Period: Fifteen (15) years from date of Substantial Completion.
 - 4. Limitations:
 - a. In case of warranty claim, Owner will provide written notice to terrazzo manufacturer and installer within 60 days of problem's discovery.
 - b. Remedies provided by epoxy terrazzo flooring manufacturer and installer are limited to removal and replacement of failed terrazzo flooring areas.

PART 2 PRODUCTS

2.1 RESINOUS MATRIX TERRAZZO

- A. Manufacturers:
 - 1. Crossfield Products Corp.
 - 2. Doyle Dickerson Terrazzo, Inc.
 - 3. Fritz Industries Inc.
 - 4. Key Resin Company.
 - 5. Master Terrazzo Technologies.
 - 6. Sherwin-Williams High Performance Flooring.
 - 7. Terrazzo & Marble Supply Companies.
 - 8. Substitutions: Section 01 60 00 - Product Requirements.

2.2 COMPONENTS

- A. Floors: Epoxy matrix.
 - 1. Finished Matrix Thickness:
 - a. 1/4 inch thick.
 - 2. Matrix Color: To be selected by Architect from manufacturer's full range.
 - 3. Aggregate Color: To be selected by Architect from full range of domestic and imported chips.
 - 4. Aggregate Size: No. 0-1.
 - 5. Colors:

- a. As selected by Architect from manufacturer's full range.
 - b. TZ1: Custom Tope Color to match LVT1.
 - c. TZ2: Custom Light Green Color to match LVT2.
 - d. TZ3: Custom Dark Green Color to match LVT3.
 - e. TZ4: Custom Blue Color to Match LVT4.
- B. Wall Base Type:
- 1. Resilient Wall Base Type: As indicated in Section 09 65 00 - Resilient Flooring.
 - a. Colors: As selected by Architect from manufacturer's full range.
- C. Materials:
- 1. Epoxy Matrix: Two component resin and epoxy hardener with mineral filler and color pigment, non-volatile, thermo-setting.
 - 2. Aggregate: Crushed marble, size of standard gradation and uniform coloration.
- D. Mix Proportions: As required to achieve bond, performance, and appearance requirements.
- E. Grit Finish: 1800 grit finish.

2.3 ACCESSORIES

- A. All materials used are to be compatible with the terrazzo system indicated and is be approved by the terrazzo system manufacturer, supplier, and contractor. This requirement includes materials and methods used to correct non-conforming concrete substrate conditions that are detrimental to terrazzo system bonding to substrate and finished flatness requirements.
- B. Divider Strips: Configurations as indicated on Drawings.
- 1. Terrazzo Over Substrate-**With**-Joint: Substrate Control Joint types include expansion joints, contraction joints, and isolation joints.
 - a. Divider Strip:
 - 1) 1/8 inch exposed top.
 - b. Two divider strips required at each joint (one on each side of joint).
 - c. Where filler is required or indicated to fill void between joint divider strips, use neoprene type filler as recommended by terrazzo matrix manufacturer.
 - 1) Color to be as selected by Architect from manufacturer's full range.
 - 2. Terrazzo Over Substrate-**Without**-Joint:
 - a. Divider Strip at Change in Terrazzo Color:
 - 1) 1/8 inch exposed top.
 - b. Divider Strip at No Change in Terrazzo Color:
 - 1) 1/6 inch exposed top.
 - 3. Vertical Height: To suit thickness of terrazzo topping, with allowance for grinding.
 - 4. Material: Aluminum.
 - 5. Divider Strip Attachment: Epoxy adhesive material as recommended by terrazzo flooring manufacturer and installer for substrate type and condition; continuously adhered.
- C. Anti-Crack Membrane: Liquid applied with fiberglass applied reinforcing mesh. Type recommended by terrazzo flooring manufacturer and installer.
- D. Cleaner: Liquid type, pH of 7; as recommended and approved by terrazzo flooring manufacturer and installer.
- E. Subfloor Filler: Type and use as recommended and approved by terrazzo flooring manufacturer and installer.
- F. Terrazzo Sealer: Sealer to be slip-resistant and as recommended by terrazzo flooring manufacturer and installer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 73 00 - Execution: Verification of existing conditions before starting work.
- B. Verify substrate surfaces are ready to receive work.
- C. Verify that substrate flatness and levelness is as required to complete the terrazzo installation within the tolerances indicated in ERECTION TOLERANCES article in this Section.
- D. Do not begin terrazzo work until the following is achieved:
 - 1. Concrete substrate has cured 28 days, minimum, and has dried to a moisture content as recommended by the terrazzo system manufacturer, but in no case greater than 12 percent moisture content.
 - 2. All corrective substrate work has been completed.

3.2 PREPARATION

- A. Section 01 73 00 - Execution: Prepare field conditions and existing construction for installation of work of this section.
- B. Prepare materials to be installed and equipment used during installation.
- C. Clean substrate of foreign matter.
- D. Substrate Preparation:
 - 1. Prepare substrate in accordance with manufacturer's written recommendations.
- E. Collect and record data required, as specified in the CLOSEOUT SUBMITTALS article of this Section, for producing the "Record Documentation of Substrate Cracks and Remedies".
- F. Anti-Crack Membrane:
 - 1. At locations of existing cracks in floor substrate, apply anti-crack membrane with reinforcing mesh for full length of each crack.

3.3 INSTALLATION

- A. Install divider and control joint strips true to alignment and level at locations indicated on Drawings.
- B. Provide control joints in concrete substrate and terrazzo flooring per NTMA recommendations and as follows:
 - 1. Provide terrazzo divider strips at all contraction, expansion, and isolation joints in concrete slab.
 - 2. Provide terrazzo control joint strips at all corner locations.
 - 3. Provide divider and control joint strips in accordance with NTMA standards.
- C. Place terrazzo mix over prepared substrate to thickness indicated.
- D. Close area to allow undisturbed curing.
- E. Finishing:
 - 1. Finish terrazzo to NTMA requirements and as indicated in this Section.
 - 2. Produce terrazzo finish surface to match approved mock-up sample, with 70 percent chip exposed.
 - 3. Grind terrazzo surfaces with power disc machine; sequence with coarse to fine grit abrasive, using wet or dry method.
 - 4. Apply patch mix to match matrix over ground surface to fill honeycomb exposed during grinding.
 - 5. Remove patch coat by grinding, using fine grit abrasive.

6. Finish to specified grit finish.

F. Install wall base.

3.4 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Monitor quality of installation, inspection, and testing.

B. Test installed terrazzo flooring for secure bond to substrate. Remove and replace terrazzo found not to be bonded to include flooring with a hollow sound beneath.

3.5 MANUFACTURER'S FIELD SERVICES

A. Section 01 40 00 - Quality Requirements: Manufacturers' field services.

B. Manufacturer to inspect work once during placement of flooring mixture onto prepared substrate and once at complete of installation. Manufacturer's inspector to provide inspection report that included observed deficiencies and required remedies. If flooring delamination remedial work is required after completion of installation inspection, manufacturer's inspector to reinspect remedial work and provide inspection report. Submit all inspection reports to Architect and Owner and include copies in Closeout Submittals.

3.6 ERECTION TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Maximum Variation from Flat Surface: 1/4 inch in 10 feet.

C. Maximum Variation from Level (except slopes to drains): 1/8 inch.

3.7 CLEANING

A. Section 01 73 00 - Execution and Section 01 77 00 - Closeout Procedures: Related to cleaning.

B. Scrub and clean terrazzo surfaces with cleaner and as recommended jointly by manufacturer and installer. Let dry.

C. Immediately after terrazzo has dried, apply sealer in accordance with manufacturer's instructions.

D. Polish surfaces in accordance with manufacturer's instructions.

3.8 PROTECTION OF INSTALLED CONSTRUCTION

A. Section 01 73 00 - Execution: Protecting installed construction.

B. Do not permit traffic over finished terrazzo surfaces.

END OF SECTION

SECTION 09 67 23
RESINOUS FLOORING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Seamless resinous flooring systems with integral cove base.
- B. Related Requirements:
 - 1. Section 03 30 00 - Cast-In-Place Concrete: Concrete subfloor.

1.2 REFERENCES

- A. ASTM International (ASTM):
 - 1. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2022.
 - 2. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2023.
 - 3. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.
- B. International Concrete Repair Institute (ICRI):
 - 1. ICRI 310.2R - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair; 2013.

1.3 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate finishing of the concrete substrate with the requirements for the flooring system to be installed.
- C. Coordinate curing materials to be used during concrete substrate installation with requirements for flooring system materials. The intent is to prevent installation of curing materials that may inhibit the flooring system's bond/adhesion to concrete substrate.
- D. Coordinate slopes to floor drains during concrete substrate installation.

1.4 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing Work of this Section.

1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit data on specified products describing physical and performance characteristics, and color, pattern, and texture options available.
- C. Shop Drawings: Submit scaled drawings indicating the following:
 - 1. Floor areas to receive the Work. Include the colors and patterns for each area.
 - 2. Indicate walls, floor drains, floor boxes, penetrations, and other surface interruptions.
 - 3. Indicate floor areas to be sloped and direction of slope.
 - 4. Indicate locations to receive waterproofing membrane.

5. Indicate locations of substrate expansion, isolation and control joints requiring joint treatment at interface with flooring system; indicate materials to be used at each such joint type.
 6. Section detail drawings indicating termination and transition edges at interface with other construction work, key cuts, cove base details, treatments at substrate various joint types and cracks (moving and non-moving), interface with floor drains and other obstructions.
- D. Samples for Initial Selection: Two manufacturer's complete sets of color samples illustrating the full range of available finishes, colors, chip and aggregate sizes/colors/blends, resin colors, trim, and accessories; submit for Architect's initial selections. Include sealant colors.
 - E. Samples for Verification: From the Architect's initial selections, prepare and submit two samples for each selected finish and color; samples to be same product material type indicated for final Work; each sample 8 x 8 inches. Where finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.
 - F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
 - G. Manufacturer's Qualification Statement.
 - H. Installer's Qualification Statement.
 - I. Manufacturer's Installation Instructions: Include procedures for installing each flooring system component, special procedures and perimeter conditions requiring special attention.

1.6 CLOSEOUT SUBMITTALS

- A. Section 01 77 00 - Closeout Procedures.
- B. Operation and Maintenance Data: Include maintenance procedures, recommended maintenance materials, procedures for stain removal, repairing surface, and suggested schedule for cleaning.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this Section with minimum five (5) years documented experience.
- B. Installer Qualifications: Company specializing in performing the Work of this Section with minimum five (5) years of documented experience and approved by product manufacturer.
 1. Supervisor Qualifications: Trained by product manufacturer.
- C. Source Limitations: Obtain primary flooring system materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer. Obtain secondary flooring system materials, including patching and fill material, joint sealant, and repair materials, of type and from manufacturer recommended in writing by manufacturer of primary materials.
- D. Flooring systems are to comply with applicable requirements of United States Department of Agriculture (USDA), Food and Drug Administration (FDA), and local Health Department.

1.8 MOCKUP

- A. Section 01 40 00 - Quality Requirements: Requirements for mockup.
- B. Locate where directed by Architect.
- C. Construct mockup, 10 x 10 feet, including flooring, base, and accessories to illustrate appearance of finished Work.

- D. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
- E. Subject to compliance with requirements, approved mockups may become part of the completed Work if undamaged at time of Final Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Store materials in accordance with manufacturer's recommendations but not less stringent than the following:
 - 1. Maintain minimum temperature in storage area of 55 degrees F (13 degrees C).
 - 2. Store materials in area of installation for minimum period of 24 hours prior to installation.
 - 3. Maintain ambient temperature required by manufacturer 72 hours prior to, during, and 24 hours after installation of materials.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements.
- B. Maintain ambient temperature required by manufacturer 72 hours prior to installation, during installation, and 24 hours after floor system has cured.
- C. Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.
- D. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.
- E. Close spaces to traffic during resinous flooring application and for 24 hours after application unless manufacturer recommends a longer period.

1.11 SPARE PARTS AND MAINTENANCE PRODUCTS

- A. Section 01 60 00 - Product Requirements: Extra materials, spare parts, and maintenance products.
- B. Furnish the following to Owner for each flooring system type, color, and finish installed. Materials are to be packaged and sealed by manufacturer in quantities required to produce floor systems matching those installed.
 - 1. Quantities of flooring system materials to fully install 30 square feet of floor area.
 - 2. Quantities of flooring system materials to fully install 10 linear feet of wall base.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers:
 - 1. Dex-O-Tex.
 - 2. Dur-A-Flex, Inc.
 - 3. Sherwin-Williams.
 - 4. Sika.
 - 5. Stonhard, Inc.
 - 6. Substitutions: Section 01 60 00 - Product Requirements.

2.2 RESINOUS FLOORING SYSTEMS

- A. Resinous Flooring **Type RSF1**: Application locations as indicated on Drawings.
1. Basis of Design: Dur-A-Flex, Inc. - Hybri-Flex EC System.
 2. System Thickness: 3/16 inch thick.
 3. Components:
 - a. Primer: Polyurethane based. (Poly-Crete TF Plus)
 - b. Base Coat: Cementitious urethane based, with fine aggregate. (Poly-Crete SL)
 - 1) Broadcast:
 - a) Vinyl flakes.
 - (1) Micro size
 - c. Broadcast Coat: Epoxy based. (Dur-A-Glaze #4)
 - 1) Broadcast:
 - a) Vinyl flakes.
 - (1) Micro Size
 - d. Grout Coat: Epoxy based. (Dur-A-Glaze #4)
 - 1) Slip Resistant Grit: 36 grit aluminum oxide, white. (Dur-A-Grit #36)
 - 2) Slip resistant grit to be applied only in the following area types:
 - a) Shower Areas.
 - b) Athletic Locker Rooms.
 - c) Restrooms and Toilets.
 - d) Other areas where indicated on Drawings.
 - e. Topcoat: Aliphatic urethane based. (Armor Top)
 4. Finish Appearance:
 - a. Color:
 - b. As indicated on Drawings Sheen:
 - 1) To be selected by Architect from manufacturer's full range.
 - 2) Gloss.
 - c. Texture:
 - 1) To be selected by Architect from manufacturer's full range.
 - 2) Slip resistant.
 5. Resinous Base: Match resinous flooring; seamless with radius cove integral to resinous flooring material. No slip resistant grit required.
 - a. Base Height:
 - 1) 4 inches unless indicated otherwise on Drawings.
 - b. Base Top:
 - 1) Zinc metal angle trim sized for thickness of resinous base for termination and protection of top edge of resinous base. To be installed as integral part of resinous base.
- B. Resinous Flooring **Type RSF2**: Application locations as indicated on Drawings.
1. Basis of Design: Dur-A-Flex, Inc. - Hybri-Flex EB System.
 2. System Thickness: 3/16 inch thick.
 3. Components:
 - a. Base Coat: Cementitious urethane based, with fine aggregate. (Poly-Crete SL)
 - 1) Broadcast:
 - a) Quartz aggregate. (Earthstone)
 - (1) Size/color/blend to be selected by Architect from manufacturer's full range.
 - b. Broadcast Coat: Dur-A-Flex, Inc. Shop Floor, epoxy-based, two-component resin
 - 1) Broadcast:
 - a) Quartz aggregate. (Earthstone)
 - (1) Dur-A-Flex, Inc. Flintshot.

- c. Grout Coat: Dur-A-Flex, Inc. Shop Floor, epoxy-based, two-component resin.
 - d.
 - e. Topcoat: Armor- Top aliphatic urethane multi-component resin.
- 4. Finish Appearance:
 - a. Color:
 - 1) As indicated on Drawings.
 - 2)
 - b. Sheen:
 - 1) Gloss.
 - c. Texture:
 - 1) Slip resistant.
- 5. Resinous Base: Match resinous flooring; seamless with radius cove integral to resinous flooring material.
 - a. Base Height:
 - 1) 4 inches unless indicated otherwise on Drawings.
 - b. Base Top:
 - 1) Zinc metal angle trim sized for thickness of resinous base for termination and protection of top edge of resinous base. To be installed as integral part of resinous base.
 - 2)
- C. Accessories:
 - 1. Waterproofing Membrane: Type recommended by resinous flooring system manufacturer for substrate and flooring system component materials to be installed.
 - 2. Reinforcing Membrane: Type recommended by resinous flooring system manufacturer for substrate and flooring system component materials to be installed.
 - 3. Subfloor Fillers: Types recommended by resinous flooring system manufacturer, specific to the filling, sloping or patching conditions.
 - 4. Primers and Adhesives: Waterproof types recommended by resinous flooring system manufacturer.
 - 5. Joint Sealant: Type recommended or produced by resinous flooring system manufacturer for type of flooring system finish performance, user traffic, service and joint condition indicated.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 73 00 - Execution: Verification of existing conditions before starting Work.
- B. Verify existing conditions are as required before starting Work of the Section.
- C. Verify the installed and finished floor system of this Section will finish flush with the finished level of floor boxes, inserts, devices, and adjacent floors. This flush transition requirement cannot be over emphasized. The transition joints must be tight and flush to eliminate trip hazards.
- D. Verify floor boxes, inserts, utilities, and other floor devices are installed in correct locations.
- E. Verify floor drains are installed, properly aligned, and are at finish elevations to allow flooring application to slope to drains.
 - 1. If floor drains are rectangular in shape, verify that the sides are properly aligned with room features such as dominate walls unless otherwise indicated on Drawings.
- F. Verify all adjacent work, including flooring by others, is completed and that overhead work trades have finished their work in the flooring areas.

- G. Verify building is dry, all openings are closed in, adequate ventilation is provided, and permanent heating and air conditioning is installed operating and providing the required conditioning of the air in the work area.
- H. Verify substrates are free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- I. Verify concrete substrate finishes have been steel troweled to a true level and finished smooth and straight to a tolerance of 1/4 inch in a 10 foot radius. High spots are to be ground level and low spots filled in with approved leveling compounds to achieve the required elevation and level flatness.
 - 1. Sloped Concrete: Levelness is relative to slopes indicated including slopes to drains.
- J. Verify wall surfaces are flat within the tolerances specified for that type of work.
- K. Verify concrete substrates are dry in accordance with industry standard testing procedures.
- L. Verify substrates are free of dust, debris, and deleterious matter.
- M. Cementitious Substrate Surfaces Testing: Verify that substrates are ready for flooring installation by testing for moisture and alkalinity (pH).
 - 1. Alkalinity (pH) Testing: ASTM F710. Measurement for pH range is to be not less than 7 pH and not more than 9 pH, unless written recommendations of flooring manufacturer or adhesive manufacturer are more stringent.
 - 2. Internal Relative Humidity Testing: ASTM F2170. Perform test using in situ probes. Humidity level of substrates is to measure no more than 75 percent relative humidity level unless written recommendations of flooring manufacturer or adhesive manufacturer are more stringent.
 - 3. Moisture Vapor Emission Testing: ASTM F1869. Perform anhydrous calcium chloride test. Moisture vapor emission rate (MVER) from the slab is to be less than or equal to 3 lbs of water per 1,000 sf in 24 hours unless written recommendations of flooring manufacturer or adhesive manufacturer are more stringent.
 - 4. Conduct tests by an independent testing agency acceptable to Owner.
- N. Do not proceed with installation Work until noncompliant conditions have been corrected.

3.2 PREPARATION

- A. Section 01 73 00 - Execution: Prepare field conditions and existing construction for installation of Work of this Section.
- B. Prepare materials to be installed and equipment to be used during installation.
- C. Concrete surfaces shall be free of oil, grease, curing compounds, loose particles, moss, algae growth, laitance, friable matter, dirt, and bituminous products.
- D. Mechanical Surface Preparation: Perform preparation on substrate as recommended by manufacturer and as follows.
 - 1. Shot blast all surfaces to receive flooring system with a mobile steel shot, dust recycling machine (Blastrac or equal). All surface and embedded accumulations of paint, toppings hardened concrete layers, laitance, power trowel finishes, and other similar surface characteristics shall be completely removed leaving a bare concrete surface having a minimum profile of CSP 4-5 in accordance with ICRI 310.2R.
 - 2. Floor areas inaccessible to the mobile blast machines shall be mechanically abraded to the same degree of cleanliness, soundness and profile using diamond grinders, needle guns, bush hammers, or other suitable equipment.
 - 3. Where the perimeter of the substrate to be coated is not adjacent to a wall or curb, a minimum 1/4 inch key cut shall be made to properly seat the system, providing a

- smooth transition between areas. The detail cut shall also apply to drain perimeters and expansion joint edges.
- 4. Remove substrate ridges and bumps.
- 5. Treat non-moving cracks and joints to prevent cracks from reflecting through the flooring system. Perform treatments and repairs in accordance with flooring system manufacturer's recommendations.
- E. At spalled or worn areas, mechanically remove loose or delaminated concrete to a sound concrete and patch per manufactures recommendations.
- F. Apply subfloor filler in accordance with manufacturer's recommendations to fill depressions, minor holes, and to slope floors away from walls and toward floor drains if floor drains are present.
 - 1. Apply, trowel, and float subfloor filler to achieve smooth, flat, hard surface. Grind irregularities above surface level. Prohibit traffic until filler is cured.
- G. Clean substrate.

3.3 INSTALLATION

- A. Section 01 73 00 - Execution: Related to installation of Work.
- B. Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.
 - 1. Apply each coat of flooring system at thickness recommended by flooring system manufacturer.
 - 2. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
 - 3. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
 - 4. Expansion, Isolation and Control Joint Treatment: At substrate expansion and isolation joints, comply with resinous flooring manufacturer's written instructions and details for each joint type and condition. Apply joint sealant to comply with manufacturer's written recommendations.
- C. Primer: Apply primer over prepared substrate at manufacturer's recommended spreading rate.
 - 1. Coordinate use of primer with flooring system manufacturer recommendations at locations where waterproofing membrane and reinforcing membrane are installed.
- D. Waterproofing Membrane: At locations indicated, apply waterproofing membrane over entire substrate surface and including behind integral cove base. Comply with flooring system manufacturer's recommendations for application and thickness.
 - 1. Locations: Elevated floors, shower areas, and other locations indicated on Drawings.
- E. Reinforcing Membrane:
 - 1. Apply reinforcing membrane to non-moving cracks and joints.
- F. Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details, including those for taping, mixing, priming, troweling, sanding, and topcoating of cove base. Round internal and external corners. Transitions in planes, terminations, abutments, and cove formed base are to be carefully crafted with accurate lines and smooth contouring.

3.4 ERECTION TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Maximum Variation from Flat Surface: 1/4 inch in 10 feet.

- C. Maximum Variation from Level: 1/8 inch.
 - 1. Sloped Concrete: Levelness is relative to slopes indicated including slopes to drains.

3.5 CLEANING

- A. Section 01 73 00 - Execution and Section 01 77 00 - Closeout Procedures: Clean installed Work and comply with manufacturer's recommendations.
- B. Clean installed Work in accordance with manufacturer's recommended materials and procedures.

3.6 PROTECTION OF INSTALLED CONSTRUCTION

- A. Section 01 73 00 - Execution: Protecting installed construction.
- B. Prohibit traffic on floor finish until cured; barricade as required.
- C. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring system manufacturer.

END OF SECTION

SECTION 09 68 13

TILE CARPETING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Tile carpeting.
 - 2. Accessories.
- B. Related Requirements:
 - 1. Section 03 30 00 - Cast-In-Place Concrete: Flooring substrate.
 - 2. Section 09 65 00 - Resilient Flooring: Wall base.

1.2 REFERENCES

- A. American Association of Textile Chemists and Colorists (AATCC):
 - 1. AATCC 134 - Test Method for Electrostatic Propensity of Carpets; 2019.
 - 2. AATCC 174 - Test Method for Antimicrobial Activity Assessment of New Carpets; 2022, Editorial Changes 2023.
- B. ASTM International (ASTM):
 - 1. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2023.
 - 2. ASTM D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials; 2016, Reapproval 2021.
 - 3. ASTM D5116 - Standard Guide for Small-Scale Environmental Chamber Determinations of Organic Emissions from Indoor Materials/Products; 2017.
 - 4. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2023.
 - 5. ASTM E662 - Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials; 2021a.
 - 6. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2022.
 - 7. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2023.
 - 8. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.
- C. Carpet and Rug Institute (CRI):
 - 1. CRI 104 - Standard for Installation of Commercial Carpet; 2015.
 - 2. CRI (GLP) - Green Label Plus Testing Program - Certified Products; Current Edition.
- D. National Fire Protection Association (NFPA):
 - 1. NFPA 253 - Standard Method of Test for Critical Radiant Flux for Floor Covering Systems Using a Radiant Heat Energy Source; 2023.

1.3 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this Section. Review the work requirements, application procedures, quality control, testing and inspection and production schedule.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.
- C. Shop Drawings: Indicate layout of joints, direction of carpet tiles, location of moldings and transition edge strips.
- D. Samples for Initial Selection: Two manufacturer's complete sets of color samples illustrating the full range of colors, textures and pattern designs available; submit for Architect's initial selections. Include 6 inches long samples of moldings and transition edge strips.
- E. Samples for Verification: From the Architect's initial selections, prepare and submit two samples for each selected colors, textures, and pattern designs; samples to be same product material type indicated for final Work; each sample 12 x 12 inches. Where finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.
- F. Manufacturer's Installation Instructions: Submit special procedures, perimeter conditions requiring special attention.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 77 00 - Closeout Procedures.
- B. Operation and Maintenance Data: Submit maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this Section with minimum five (5) years documented experience.
- B. Installer Qualifications: Company specializing in performing work of this Section with minimum three (3) years documented experience and approved by carpet manufacturer.
- C. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Store materials in compliance with the manufacturer's recommendations.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements: Requirements before, during and after Work.
- B. Do not install the work of this Section until wet construction work is complete and permanent heat and air conditioning is installed and operating.
- C. Maintain room temperature and humidity levels prior to installation in accordance with manufacturer's recommendations.
- D. Acclimate flooring materials by storing materials in conditioned installation area prior to installation for period recommended by manufacturer, but not less 48 hours.

1.9 WARRANTIES

- A. Section 01 77 00 - Closeout Procedures: Product warranties.
- B. Carpet Tile: Provide manufacturer's warranties covering the following:
 - 1. Lifetime Commercial Limited Warranty: Includes coverage for Fiber Abrasive Wear, Fiber Static Protection, Fiber Stain Warranty, Fiber Colorfastness to Light and Fiber Atmospheric Contaminants.

1.10 SPARE PARTS AND MAINTENANCE PRODUCTS

- A. Section 01 60 00 - Product Requirements: Extra materials, spare parts, and maintenance products.
 - 1. Supply 100 square feet of carpet tiles of each pattern and color installed.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Materials to comply with the following independently tested performance criteria:
 - 1. Surface Flammability Ignition: Pass ASTM D2859 (the "pill test").
 - 2. Critical Radiant Flux (CRF): In compliance with ASTM E648 or NFPA 253.
 - a. Class I, minimum 0.45 watt per square centimeter.
 - 3. Smoke Density: 450 or less in accordance with ASTM E662.
 - 4. Noise Reduction Coefficient: NRC Rating 0.30 (ASTM C423).
 - 5. Slip Resistance: Comply with ADA Guidelines.
 - 6. VOC: Carpet certified as passing the CRI (GLP) indoor air quality testing program.
 - 7. Dimensional Stability: 0.1 % or less change Stability (Aachen Method Din 54318)
 - 8. Static Generation:
 - a. 3.5 kV or less at 20% R.H. at 70° F (AATCC 134 w/ neolite).
 - 9. Antimicrobial: Broad spectrum antimicrobial; permanent application in backing. Application must pass AATCC 174.
 - 10. VOC Limits: Provide carpet tile that complies with the following limits for VOC content when tested according to ASTM D5116:
 - a. Total VOCs: 0.5 mg/sq. m x h.
 - b. 4-PC (4-Phenylcyclohexene): 0.05 mg/sq. m x h.
 - c. Formaldehyde: 0.05 mg/sq. m x h.
 - d. Styrene: 0.4 mg/sq. m x h.
 - 11. Adhesive: Comply with the following criteria unless the manufacturer's warranty requirements indicate otherwise.
 - a. Water-resistant, mildew-resistant, non-staining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.
 - b. Adhesive VOC Limits: Provide adhesives that comply with the following limits for VOC content when tested according to ASTM D5116:
 - 1) Total VOCs: 10.00 mg/sq. m x h.
 - 2) Formaldehyde: 0.05 mg/sq. m x h.
 - 3) 2-Ethyl-1-Hexanol: 3.00 mg/sq. m x h.

2.2 CARPET TILE

- A. Carpet Tile **Type CPT1**: Manufactured in one color dye lot; conforming to the following criteria:

1. Basis of Design: Patcraft - Organic Interruption – I0662 – color reveal – 00440 - Spring Harbor -9"x36"
 2. Alternate 1 : Tarkett: SquareUp II – Blue Spirit 71602– 9"x36"
 3. Alternate 2: Mohawk : Timeless Tailored – Unexpected Detail GT468 – x 535 Cornflower - 9x36.
- B. Carpet Tile **Type CPT2**: Manufactured in one color dye lot; conforming to the following criteria:
1. Basis of Design: Patcraft – Step Inside – 00590 Snow Plow - 18"x36"
 2. Alternate 1 : Mohawk: First Step II – GT315 – 24" x 24"
 3. Alternate 2: Bentley: Rough Idea Shear – Design - 24"x24"

2.3 WALL BASE

- A. Wall Base Type: As indicated in Section 09 65 00 - Resilient Flooring.
1. Color: As selected by Architect from samples submitted under Section 09 65 00.

2.4 ACCESSORIES

- A. Sub-Floor Filler: Factory mixed latex type recommended by manufacturers of flooring and adhesive materials and compatible with substrate materials and conditions.
- B. Primers and Adhesives: Water-resistive type recommended by manufacturer of flooring material and compatible with substrate materials and conditions.
- C. Moldings, Transition, and Edge Strips:
1. Rubber: Colors and profiles to be selected by Architect from manufacturer's full range.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 73 00 - Execution: Verification of existing conditions before starting work.
- B. Verify compliance with the requirements in the PART 1, ENVIRONMENTAL REQUIREMENTS article.
- C. Verify that existing conditions are as required before starting work of the Section.
- D. Verify that the assembled and finished floor system of this Section will finish flush with floor boxes, inserts, devices, and adjacent finished floors. This flush transition requirement cannot be over emphasized. The transition joints must be tight and flush to eliminate trip hazards.
- E. Verify that floor boxes, inserts, utilities, and other floor devices are installed in correct locations.
- F. Verify that overhead work trades have finished their work in the flooring areas.
- G. Verify that the building is dry, all openings are closed in, adequate ventilation is provided, and permanent heating and air conditioning is installed operating and providing the required conditioning of the air in the work area.
- H. Verify that surfaces are free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.

- I. Verify that the concrete finish has been steel troweled to a true level and finished smooth and straight to a tolerance of 1/4 inch in a 10 foot radius. High spots are to be ground level and low spots filled in with approved leveling compounds to achieve the required elevation and level flatness.
- J. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive wall base material.
- K. Verify that the concrete substrate is dry in accordance with industry standard testing procedures, free of foreign materials, and broom cleaned.
- L. Cementitious Substrate Surfaces Testing: Verify that substrates are ready for flooring installation by testing for moisture and alkalinity (pH).
 - 1. Alkalinity (pH) Testing: ASTM F710. Measurement for pH range is to be not less than 7 pH and not more than 9 pH, unless written recommendations of flooring manufacturer or adhesive manufacturer are more stringent.
 - 2. Internal Relative Humidity Testing: ASTM F2170. Perform test using in situ probes. Humidity level of substrates is to measure no more than 75 percent relative humidity level, unless written recommendations of flooring manufacturer or adhesive manufacturer are more stringent.
 - 3. Moisture Vapor Emission Testing: ASTM F1869. Perform anhydrous calcium chloride test. Moisture vapor emission rate (MVER) from the slab is to be less than or equal to 3 lbs of water per 1,000 sf in 24 hours, unless written recommendations of flooring manufacturer or adhesive manufacturer are more stringent.
 - 4. Conduct tests by an independent testing agency acceptable to Owner.
- M. Do not proceed with installation work until noncompliant conditions have been corrected.

3.2 PREPARATION

- A. Section 01 73 00 - Execution: Prepare field conditions and existing construction for installation of work of this Section.
- B. Prepare materials to be installed and equipment to be used during installation.
- C. Remove sub-floor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with sub-floor filler.
- D. Apply filler. Trowel and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.
- E. Clean substrate.

3.3 INSTALLATION

- A. Section 01 73 00 - Execution: Related to installation of Work.
- B. Comply with CRI 104 and manufacturer's recommendations.
- C. Do not mix carpet from different cartons unless from same dye lot.
- D. Cut carpet clean. Fit carpet tight to intersection with vertical surfaces without gaps.
- E. Locate change of color or pattern between rooms under door centerline.
- F. Fully adhere carpet tile to substrate using adhesives and instructions in accordance with carpet manufacturer's recommendations.
- G. Trim carpet neatly at walls and around interruptions.
- H. Complete installation of moldings and transition edge strips, concealing exposed edges.
- I. Install wall base.

3.4 CLEANING

- A. Section 01 73 00 - Execution and Section 01 77 00 - Closeout Procedures: Related to cleaning.
- B. Remove excess adhesive from floor, base, and wall surfaces without damage.
- C. Clean and vacuum carpet surfaces.

3.5 PROTECTION OF INSTALLED CONSTRUCTION

- A. Section 01 73 00 - Execution: Protecting installed construction.
- B. Protect installed construction from damage and soiling.

END OF SECTION

SECTION 09 84 00
ACOUSTIC ROOM COMPONENTS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Wall mounted acoustical panels.
- B. Related Requirements:
 - 1. Section 09 90 00 - Painting and Coating: Field painting of acoustical diffuser panels.

1.2 REFERENCES

- A. American Society of Civil Engineers (ASCE):
 - 1. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- B. ASTM International (ASTM):
 - 1. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2023.
 - 2. ASTM C612 - Specification for Mineral Fiber Block and Board Thermal Insulation; 2014, Reapproval 2019.
 - 3. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.
 - 4. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
 - 5. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.
 - 6. ASTM E336 - Standard Test Method for Measurement of Airborne Sound Attenuation between Rooms in Buildings; 2023.
 - 7. ASTM E413 - Classification for Rating Sound Insulation; 2022.
 - 8. ASTM E795 - Practices for Mounting Test Specimens During Sound Absorption Tests; 2023.
 - 9. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2023.
- C. Underwriters Laboratories, Inc. (UL):
 - 1. UL 723 - UL Standard for Safety Test for Surface Burning Characteristics of Building Materials; Current Editions, Including All Revisions.

1.3 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate requirements for blocking and support with substrate construction to receive the Work of this Section.
- C. Coordinate work with locations of electrical, fire, and safety devices to avoid conflicts.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal requirements.
- B. Product Data: Manufacturer's data sheets, installation instructions, and maintenance recommendations for each type of acoustical panel.

1. Include data indicating coefficients of absorption and Sabines per unit for each type of panel used in the analysis and proposed design layout.
- C. Shop Drawings: Prepared by manufacturer. Include elevations showing acoustic room components sizes, arrangements, and details of each condition of installation. Show fabrication and installation details.
- D. Samples for Initial Selection: Two manufacturer's complete set of color charts illustrating the full range of finishes and colors available; include 12 x 12 inches typical panel with mounting hardware; submit for Architect's initial selections.
- E. Samples for Verification: From the Architect's initial selections, prepare and submit two samples for each finish and color; each sample to be 12 x 12 inches illustrating actual panel construction with mounting hardware. Where finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.
- F. Product Test Reports: Indicating compliance of products with requirements, from a qualified independent testing agency.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five (5) years documented experience.
- B. Installer: Company specializing in performing work of this section with minimum three (3) years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Comply with recommendations of the manufacturers of the products to be used for the Work of this Section.
- C. Deliver, store, and handle acoustic panels in accordance with product manufacturer's recommendations. Ship to jobsite only after roughing-in, painting work, and other related finish work has been completed, installation areas are ready to accept units, and manufacturers' recommended temperature and humidity levels will be maintained during the remainder of construction.

1.7 WARRANTY

- A. Section 01 77 00 - Closeout Procedures: Product warranties.
- B. Special Warranty:
 1. Cementitious Wood Fiber Panels Warranty: Submit manufacturer executed written warranty agreeing to repair or replace panels that fail within the warranty period.
 - a. Failures include, but are not limited to the following:
 - 1) Defects in materials or factory workmanship.
 - b. Warranty Period: Thirty (30) years from date of substantial completion.
 - c. The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

1.8 SPARE PARTS AND MAINTENANCE PRODUCTS

- A. Section 01 60 00 - Product Requirements: Extra materials, spare parts, and maintenance products.

- B. Furnish the following to Owner for each panel size, color, and pattern installed. Include full set of mounting hardware for each panel furnished. Hardware to be same as was used for installed panels.
 - 1. Panels equal to five percent (5%), but not less than one (1) each.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire Performance Characteristics:
 - 1. Comply with ASTM E84 or UL 723, unless otherwise indicated.
 - a. Flame Spread Index: 25 or less.
 - b. Smoke Developed Index: 450 or less.
 - 2. Identify products with appropriate UL labeling.
- B. Seismic Performance:
 - 1. Comply with ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads" based upon seismic design criteria indicated.
- C. Provide a system of sound absorbing and sound diffusing panels to reduce excess sound energy levels and improve sound distribution throughout the space:
 - 1. System components, configurations, and locations to be as indicated on Drawings.

2.2 MANUFACTURERS

- A. Manufacturers:
 - 1. AVL Systems, Inc.
 - 2. Carnegie Fabrics, LLC.
 - 3. Decoustics.
 - 4. Novawall Systems Inc.
 - 5. RPG Acoustical Systems.
 - 6. Sound Seal.
 - 7. Wenger CorporationCementitious Wood Fiber Panels:
 - a. Acoustic Sonic, Inc.
 - b. ASI Architectural.
 - c. Tectum by Armstrong World Industries, Inc.
 - 8. Substitutions: Section 01 60 00 - Product Requirements.

2.3 MATERIALS

- A. Glass Fiber Board: ASTM C612, Type 1A, 6 lbs/cu. ft. (96 kg/cu. m) density molded rigid board, flame spread index 25 maximum, and smoke-developed index 450 maximum.
- B. Thermoplastic Sheet: PVC acrylic plastic sheet, flame spread index 25 maximum, and smoke-developed index 450 maximum.
- C. Fabric Covering Material: Fabric wrapped, coverings, and finishes to be 100 percent woven plain weave polyester 2-ply, with the following characteristics:
 - 1. Light Fastness: AATCC 16, Option 3: 40 hours.
 - 2. Fastness to Crocking: AATCC 8: #4 Wet & Dry.
 - 3. Flammability: ASTM E84, Class A or 1.

2.4 ACOUSTICAL PANELS

- A. Wall and Ceiling Absorber Panels: (FWP1)Fabric covering finish laminated to rigid glass-fiber board. Glass-fiber board to have chemically hardened edges.
 - 1. Basis of Design:

2. Carnegie Fabrics - Xorel Panels Tackable Surface: Panel core is to include a tackable functioning surface material laminated to the core material that provides for Owner to tack sheet media for display.
 3. Panel Size:
 - a. Shape, thickness, width, and length indicated on Drawings.
 4. Fabrics and Colors:
 - a. Basis of Design:
 - 1) As indicated on Drawings.
 5. Wall Panel Mounting Method: Metal wall bracket with panel-mounted Z-bracket.
- B. Wall and Ceiling Absorber Panels: AWP1, AWP2, AWP3, AWP4) Fabric covering finish laminated to rigid glass-fiber board. Glass-fiber board to have chemically hardened edges.
1. Basis of Design: Wenger - Wall Absorber Panel and Ceiling Absorber Panel.
 2. Panel Size:
 - a. Shape, thickness, width, and length indicated on Drawings.
 3. Fabrics and Colors:
 - a. Basis of Design:
 - 1) As indicated on Drawings.
 4. Wall Panel Mounting Method: Metal wall bracket with panel-mounted Z-bracket.
- C. Cementitious Wood Fiber Panels: (AWP5, AWP6) Provide panels fabricated of excelsior wood fibers bonded with water resistant inorganic hydraulic cement.
1. Basis of Design:
 - a. As indicated on Drawings.
 2. Dimensional Stability/Mold Resistance: No significant mold growth when tested in accordance with ASTM D3273.
 3. Surface Burn Characteristics: Acoustical assemblies to be designed and tested to provide the following surface burning characteristics in accordance with the following:
 - a. ASTM E84:
 - 1) Flame Spread: 0.
 - 2) Smoke Developed: 0.
 4. Provide UL labeling indicating panel Surface Burning Characteristics.
 5. Provide UL Classified Acoustical Material labeling indicating panel Noise Reduction Coefficient (NRC).
 6. Noise Reduction Coefficient (NRC) and Mounting Type: Acoustical panel systems to be manufactured, fabricated, and installed to provide Noise Reduction Coefficient (NRC) rating and Mounting type in accordance with ASTM E795 when tested in accordance with ASTM C423:
 - a. As indicated in the following table:

Panel Thickness	Noise Reduction Coefficient				
	Mount A	Mount D20	Mount C20	Mount C40	Mount E400
1 inch	NRC 0.40	NRC 0.45	NRC 0.80	NRC 0.85	NRC 0.85
1-3/8 inch	NRC 0.55	NRC 0.60	NRC 0.85	NRC 0.90	NRC 0.90
1-5/8 inch composite**	NRC 0.85	N/A	N/A	N/A	N/A
2 inch	NRC 0.60	NRC 0.70	NRC 0.90	NRC 0.95	NRC 0.95

**The 1-5/8 inch thickness is a unique composite panel design that creates single panels for Mount Type A application:

Face Panel: 5/8 inch thick wood fiber panel.

Attached Backing: 1 inch thick acoustic absorption material with continuous perimeter closure of 1 inch thick by 2 inch wide wood fiber strip (finished to match

Face Panel).

This composite panel design simulates a 1 inch panel thickness, Mount C40, total 2-5/8 inch thickness; or a 1-3/8 inch panel thickness, Mount C20, total 2-3/16 inch thickness.

7. Panel applications include the following surface types:
 - a. Panels for Wall Surfaces.
8. Panels:
 - a. Material: Aspen wood fibers bonded with inorganic hydraulic cement.
 - b. Panel Thickness:
 - 1) 2 inches.
 - c. Panel Edge Profiles:
 - 1) Square.
 - d. Panel Sizes:
 - 1) As indicated on Drawings.
 - e. Panel Surface Texture: Coarse.
 - f. Paint:
 - 1) Field Applied.
 - a) Paint manufacturer, type, and application method to match that used for factory applied coatings.
 - b) 3 coats to be painted over factory applied coats.
 - c) Color:
 - (1) As indicated on Drawings.
 - g. Surface finished appearance to be uniform from panel to panel.
 - h. Mounting Types:
 - 1) As indicated on Drawings.
 - a) Types Include:
 - (1) Mounting type C40.
9. Supports, Fasteners, and Anchors: To be corrosion resistant and as approved by manufacturer.
10. Touch-Up Paint: Paint manufacturer, type, color, application, and appearance to match finish indicated.
 - a. Apply to field cut conditions.
 - b. Apply to exposed fasteners. Use paint products compatible with fastener material and finish for adhesion.

2.5 ACCESSORIES

- A. Provide accessories as required to complete Work in accordance with the Drawings and as recommended by the manufacturer for application conditions.
- B. Mounting Devices and Anchors:
 1. As required to complete Work in accordance with the Drawings and as recommended by manufacturer.
 2. Designed and installed to anchor and withstand loads imposed by installed components.
 3. Wall Brackets: Galvanized steel rail configured to accept grooved epoxy buttons or Z-brackets attached to panel corners on concealed side.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 73 00 - Execution: Verification of existing conditions before starting work.

- B. Examine acoustical panels installation substrates, supports and surroundings for compliance with requirements for installation securement, tolerances, required overhead clearances, and other existing conditions affecting installation and performance of acoustical panels. Proceed with unit installation upon correction of unsatisfactory conditions.

3.2 PREPARATION

- A. Section 01 73 00 - Execution: Prepare field conditions and existing construction for installation of work of this section.
- B. Prepare materials to be installed and equipment to be used during installation.

3.3 INSTALLATION

- A. Section 01 73 00 - Execution: Related to installation of Work.
- B. Install units plumb, level, and true.
- C. Install units in accordance with the Drawings, manufacturer's recommendations, and as indicated regarding brackets, supports, anchors, and fasteners.
- D. Install wall-mounted acoustical panels utilizing corner mounting Z-brackets or grooved buttons and concealed wall brackets. Where indicated, secure units to wall with fasteners along top of unit.
- E. Install seismic bracing and fastening in accordance with applicable code requirements and as indicated in this Section.

3.4 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Monitor quality of installation, inspection, and testing.
- B. Should completed installation fail to meet requirements, Contractor shall make modifications necessary to correct performance and retest room as directed by Architect to indicate compliance, at Contractor's expense.

3.5 CLEANING

- A. Section 01 73 00 - Execution and Section 01 77 00 - Closeout Procedures: Related to cleaning.
- B. Repair or replace defective Work in a manner acceptable to Architect.
- C. Clean unit surfaces. Touch up, refinish, or replace damaged components in a manner acceptable to Architect.

END OF SECTION

SECTION 09 90 00
PAINTING AND COATING

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes surface preparation and field application of painting and coating systems.
- B. Related Requirements:
 - 1. Sections including work indicated to receive painting and coating.

1.2 REFERENCES

- A. ASTM International (ASTM):
 - 1. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2024.
 - 2. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials; 2020.
- B. California Department of Public Health (CDPH):
 - 1. CDPH Standard Method VOC v1.2 - Standard Method For The Testing And Evaluation Of Volatile Organic Chemical Emissions From Indoor Sources Using Environmental Chambers - Version 1.2; 2017.
- C. GreenSeal, Inc. (GS):
 - 1. GreenSeal GS-11 - Standard For Paints, Coatings, Stains, and Sealers; 2021.
- D. Painting and Decorating Contractors of America (PDCA):
 - 1. PDCA - Architectural Painting Specification Manual; Current Edition.
- E. Society for Protective Coatings (SSPC):
 - 1. SSPC V1 (PM1) - Good Painting Practice: Painting Manual Volume 1; 2016.
 - 2. SSPC V2 (PM2) - Systems and Specifications: Steel Structures Painting Manual Volume 2; 2021.
 - 3. SSPC SP 13 - Surface Preparation of Concrete; 2018.

1.3 DEFINITIONS

- A. Conform to ASTM D16 for interpretation of terms used in this Section.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit data on all finishing products.
- C. Samples for Initial Selection: Submit two paper chip samples; 2 x 3 inches in size; illustrating range of colors, sheens, and textures available for each surface finishing product indicated; submit for Architect's initial selections.
 - 1. For clear top coats on stained wood, samples to illustrate range of colors and sheens available as applied to wood species required in construction.
 - 2. For clear top coats on non-stained wood, samples to illustrate sheens available as applied to wood species required in construction.
- D. Samples for Verification: From the Architect's initial selections, prepare and submit two samples for each selected color, sheen, and texture. Where finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.

1. For opaque paint samples, submit each on tempered hardboard; minimum 8 x 8 inches.
 2. For clear top coats on stained and non-stained wood; submit each on finished wood species required in construction; minimum 8 x 8 inches.
- E. Manufacturer's Installation Instructions: Submit special surface preparation procedures and substrate conditions requiring special attention.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 77 00 - Closeout Procedures.
- B. Operation and Maintenance Data: Submit data on cleaning, touch-up, and repair of painted and coated surfaces.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five (5) years documented experience.
- B. Applicator: Company specializing in performing work of this section with minimum ten (10) years documented experience.

1.7 MOCKUP

- A. Section 01 40 00 - Quality Requirements: Mock-up requirements.
- B. Construct mockup, in one room, illustrating coating color, sheen, texture, and finish.
- C. Locate where directed by Architect.
- D. Incorporate accepted mockup as part of Work.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- C. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- D. Paint Materials: Store at minimum ambient temperature of 45 degrees F and maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements.
- B. Do not apply materials when surface and ambient temperatures are outside temperature ranges required by paint product manufacturer.
- C. Do not apply exterior coatings during rain or snow when relative humidity is outside humidity ranges, or moisture content of surfaces exceed those required by paint product manufacturer.
- D. Minimum Application Temperatures for Latex Paints: 45 degrees F for interiors; 50 degrees F for exterior, unless required otherwise by manufacturer's instructions.
- E. Minimum Application Temperature for Varnish Finishes: 65 degrees F for interior and exterior, unless required otherwise by manufacturer's instructions.

- F. Provide lighting level of 80 ft candle measured mid-height at substrate surface.

1.10 WARRANTY

- A. Section 01 77 00 - Closeout Procedures: Product warranties.
- B. Furnish five (5) year manufacturer warranty for paints and coatings.
- C. Contractor to provide a one (1) year warranty on all defects.
- D. Installer to provide a two (2) year warranty on all materials and workmanship.

1.11 SPARE PARTS AND MAINTENANCE PRODUCTS

- A. Section 01 60 00 - Product Requirements: Extra materials, spare parts, and maintenance products.
 - 1. Supply 1 gallon of each color, sheen, type, and surface texture; store as directed by Owner.
 - 2. Label each container with color, sheen, type, surface texture and room locations, in addition to manufacturer's label.

PART 2 PRODUCTS

2.1 PAINTS AND COATINGS

- A. Manufacturers:
 - 1. Benjamin Moore (BM).
 - 2. PPG Paints (PPG).
 - 3. Sherwin-Williams Company (SW).
 - 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Basis of Design Manufacturer (BOD):
 - 1. Sherwin-Williams Company (SW) unless indicated otherwise as follows:
 - a. Comply with SCHEDULE article in PART 3 of this Section if BOD is indicated other than that indicated above.
 - b. Comply with Drawings if BOD is indicated other than that indicated in this Section.
 - c. Manufacturer, product, and finish sheen to be as indicated in SCHEDULE article in this Section unless indicated otherwise on Drawings.
- C. Provide paints and finishes from the same manufacturer to the greatest extent possible.
 - 1. If a single manufacturer cannot provide specified products, minor exceptions will be permitted provided approval by Architect is obtained using the specified procedures for substitutions.

2.2 COMPONENTS

- A. Conditioners, primers, and other undercoating products are to be of same manufacturer as top coat manufacturer unless top coat manufacturer recommends otherwise in writing.
- B. All materials and paints shall be lead and mercury free and shall have low VOC content where possible.
- C. Coatings: Ready mixed, except field catalyzed coatings. Prepare coatings:
 - 1. Prepare coatings to soft paste consistency, capable of being readily and uniformly dispersed to homogeneous coating.
 - 2. Prepare coatings for consistent flow and brushing properties.
 - 3. Prepare coatings capable of drying and curing free of streaks or sags.

4. Interior Flat and Non-Flat Paints:
 - a. Maximum volatile organic compound content in accordance with CDPH Standard Method VOC v1.2.
 5. Interior Anti-Corrosive Paints:
 - a. Maximum volatile organic compound content in accordance with CDPH Standard Method VOC v1.2.
 6. Interior Clear Wood Finishes: Maximum volatile organic compound content in accordance with CDPH Standard Method VOC v1.2.
- D. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve finishes specified; commercial quality.
1. Interior Clear Wood Finishes: Maximum volatile organic compound content in accordance with CDPH Standard Method VOC v1.2.
- E. Patching Materials: To be compatible with the substrate and paint/coating materials; use latex patching materials where compatible with substrate and paint/coating materials; use tinted or stainable patch materials where wood substrates are indicated to be stained.
- F. Recessed Fastener Head Filler Materials: To be compatible with the substrate and paint/coating materials; use latex filler materials where compatible with substrate and paint/coating materials; use tinted or stainable patch materials where wood substrates are indicated to be stained.

2.3 COLORS, SHEENS, AND LOCATIONS FOR APPLICATION

- A. Drawings and Schedules on Drawings provide additional information regarding Colors, Sheens, Basis of Design (BOD), and Locations.
1. Other Colors and Locations to be as selected by Architect from manufacturer's full range.
- B. Sheen designation indicated on Drawings supersedes sheen designations indicated in this Section.
1. In such case, provide manufacturer and named products indicated in this Section, but with sheen indicated on Drawings.
- C. Indicated color codes in this Section and on Drawings are only for the purpose of color matching and does not alter requirements for products, manufacturers, or named products.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 73 00 - Execution: Verification of existing conditions before starting work.
- B. Verify surfaces are ready to receive Work as instructed by product manufacturer.
- C. Examine surfaces indicated to be finished prior to commencement of work. Report conditions capable of negatively affecting proper application or finished appearance of the work.
- D. Test shop applied primer for compatibility with subsequent cover materials.
- E. Measure moisture content of surfaces using electronic moisture meter. Do not apply finishes unless moisture content of surfaces is in accordance with the coating manufacturer's recommendations and is below the following maximums:
1. Gypsum Wallboard: 12 percent.
 2. Masonry, Concrete and Concrete Unit Masonry: 12 percent.
 3. Interior Wood: 15 percent, measured in accordance with ASTM D4442.

4. Exterior Wood: 15 percent, measured in accordance with ASTM D4442.
5. Concrete Floors and Traffic Surfaces: 8 percent.

3.2 PREPARATION

- A. Section 01 73 00 - Execution: Prepare field conditions and existing construction for installation of work of this section. Prepare materials to be installed and equipment used during installation.
- B. Preparations to be executed with methods and materials compatible with paints and coatings to be applied.
- C. Surface Appurtenances: Remove electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.
- D. Surfaces: Correct defects and clean surfaces thoroughly prior to applications.
- E. Seal marks and surfaces that might cause bleed-through or staining of top coat.
- F. Remove marks and foreign matter from substrates indicated for transparent or semi-transparent coatings.
- G. Impervious Surfaces: Remove mildew by scrubbing with solution of tri-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- H. Aluminum Surfaces Indicated for Paint Finish: Remove surface contamination by steam or high pressure water. Remove oxidation with acid etch and solvent washing. Apply etching primer immediately following cleaning.
- I. Insulated Coverings: Remove dirt, grease, and oil from canvas and cotton.
- J. Gypsum Board Surfaces: Must be clean and dry. All nail heads must be set and spackled. Joints must be taped and covered with a joint compound. Spackled fastener heads and tape joints must be sanded smooth, and all dust removed prior to painting. Exterior surfaces must be spackled with exterior grade compounds. Fill minor defects with filler compound. Spot prime defects after repair.
- K. Galvanized Surfaces: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.
- L. Concrete: Remove release agents, curing compounds, efflorescence, irregular surfacing, foreign matter, stains, chalk, and laitance. Prepare surface as recommended by finishes manufacturer and according to SSPC SP 13. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds the lesser of that permitted in manufacturer's written instructions and that indicated in this Section. Remove stains caused by weathering of corroding metals with solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.
- M. Concrete Floors Requiring Sealed Finish (Does not include Polished Concrete Floor Finishing; refer to Division 3):
 1. Use preparation procedures and products as recommended by manufacturer of sealer finish for concrete floors.
- N. Masonry Surfaces Indicated to Receive Paint Finish: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.

- O. Plaster and Parged Surfaces: Fill hairline cracks, small holes, and imperfections with patching material compatible with the plaster and the indicated coatings. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.
- P. Uncoated Steel and Iron Surfaces: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by hand power tool wire brushing or sandblasting; clean by washing with solvent. Apply treatment of phosphoric acid solution, ensuring welded joints, bolts, and nuts are similarly cleaned. Spot prime paint after repairs.
- Q. Shop Primed Steel Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.
- R. Surfaces Indicated to Receive Fire-Retardant Intumescent Paint: Use preparation procedures and products as recommended by manufacturer of Intumescent Paint system.
- S. Metal Doors and Frames Indicated for Painting: Prime metal door top and bottom edge surfaces.
- T. Wood Surfaces:
 - 1. Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried. Prime filled areas, sanding between coats. For exterior applications, back prime concealed surfaces of material before installation.
 - 2. Transparent Finish: Wipe off dust and grit prior to application of finishing materials. Fill nail holes and cracks with stainable filler or filler tinted to match the intended final wood appearance. For exterior applications, prime concealed surfaces with indicated finish material.
- U. Glue-Laminated Wood Beams Indicated for Field Applied Finishing: Prior to finishing, wash surfaces with solvent, remove grease and dirt.
- V. Floor and Roof Concrete Planks: Where underside of planks is exposed to view, install continuous joint sealant materials to seal joints including joints between planks, around perimeters and voids.
- W. PVC, Vinyl and Architectural Plastic: Clean and lightly sand surfaces to be coated. Use preparation procedures and products as recommended by substrate manufacturer and manufacturer of coating system.

3.3 APPLICATION

- A. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- B. Apply each coat to uniform appearance. Apply each coat of paint slightly darker than preceding coat unless specified otherwise.
- C. For concrete masonry units and other porous masonry and cementitious materials indicated to receive painting/coating, apply the primer coating as needed to fill all pinholes prior to applying finish top coats.
- D. Sand surfaces lightly between coats to achieve required finish.
- E. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- F. Where clear finishes are required, tint fillers to match wood and apply to match wood texture. Remove excess from surface.
- G. Prime concealed surfaces of interior woodwork with primer paint.

- H. Finishing Mechanical and Electrical Equipment:
 - 1. Paint shop primed equipment. Paint shop finished items occurring at interior areas.
 - 2. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately. Reinstall after paint is cured.
 - 3. Prime and paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, except where items are shop finished.
 - 4. Paint interior surfaces of air ducts visible through grilles and louvers with one coat of flat black paint to visible surfaces. Paint dampers exposed behind louvers, grilles, to match face panels.
 - 5. Paint exposed conduit and electrical equipment occurring in finished areas.
 - 6. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.
 - 7. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.
- I. Finishing Overhead Construction Indicated as Open To Structure (exposed to view):
 - 1. This provision includes finishing of overhead construction above suspended ceilings and clouds that do not extend to wall. This condition allows overhead construction to be seen above and over the suspended ceiling or cloud. Therefore, such overhead construction must be painted to eliminate unsightly overhead conditions that are visible.
 - 2. This provision does not include mechanical and electrical utility rooms, unless indicated otherwise on Drawings.
 - 3. Apply fast-drying, flat interior dry-fall type alkyd to all overhead construction Work and surfaces. Such surfaces include, but are not limited to, roof decking, structural steel, bracing and supports, and mechanical and electrical work.
 - a. Dry-Fall application does not apply to the following:
 - 1) Items with manufacturer's fully prefinished final coatings such as light fixtures, life safety devices and required warning postings.
 - 2) Surfaces scheduled to receive manufacturer's fully prefinished final coatings or field applied coatings other than Dry-Fall. Such surfaces may include wood laminated beams and underside of wood plank ceilings.

3.4 CLEANING

- A. Section 01 73 00 - Execution and Section 01 77 00 - Closeout Procedures: Related to cleaning.
- B. Collect waste material which may constitute fire hazard, place in closed metal containers, and remove daily from site.

3.5 SCHEDULE - EXTERIOR SURFACES

- A. Surfaces Indicated to Receive Fire-Retardant Intumescent Paint System:
 - 1. Refer to Drawings for designated locations, required fire-retardant rating, and applicable UL Design.
 - 2. The intumescent paint system includes application of the intumescent paint and its primer.
 - 3. Thicknesses of intumescent paint system components are to be as required to achieve the required fire-retardant rating.
 - 4. Confirm with the intumescent paint system manufacturer, the paint system adhesion compatibility with the substrate material.
 - 5. Intumescent Paint System:
 - a. Albi Clad 800 with primer as recommended by manufacturer.
 - b. Isolatak - WB5 with primer as recommended by manufacturer.

6. Comply with intumescent paint system manufacturer's recommendations for cure time prior to application of finish paint system.
 7. Finish paint system is to be applied over fully cured intumescent paint system and is to be as indicated below in accordance with the substrate type. Confirm compatibility of finish paint system with respective paint system manufacturers.
- B. Exterior Steel - Unprimed:
1. One coat of alkyd primer.
 - a. BM - Super Spec HP Alkyd Metal Primer P06.
 - b. PPG - Pitt-Tech Plus 4020 PF DTM Acrylic Primer.
 - c. SW - All Surface Enamel Interior-Exterior Alkyd Primer.
 2. Two top coats of alkyd enamel finish.
 - a. BM - Advance Waterborne Interior-Exterior Alkyd High Gloss N794.
 - b. PPG - Pitt-Tech Plus EP DTM Acrylic Gloss.
 - c. SW - SWP Exterior Oil Base Gloss.
- C. Exterior Steel - Primed:
1. One coat of alkyd primer.
 - a. BM - Super Spec HP Alkyd Metal Primer P06.
 - b. PPG - Pitt-Tech Plus 4020 PF DTM Acrylic Primer.
 - c. SW - All Surface Enamel Interior-Exterior Alkyd Primer.
 2. Two top coats of alkyd enamel finish.
 - a. BM - Advance Waterborne Interior-Exterior Alkyd High Gloss N794.
 - b. PPG - Pitt-Tech Plus EP DTM Acrylic Gloss.
 - c. SW - SWP Exterior Oil Base Gloss.
- D. Exterior Steel - Primed (Epoxy Coating):
1. One coat of epoxy primer.
 - a. BM - Corotech Surface Tolerant Epoxy Mastic V160.
 - b. PPG - Amerlock 600 Polyamide Epoxy Coating.
 - c. SW - Macropoxy 646 Fast Cure Epoxy Mastic Semi-Gloss.
 2. One coat of epoxy body coat.
 - a. BM - Corotech Surface Tolerant Epoxy Mastic V160.
 - b. PPG - Amerlock 600 Polyamide Epoxy Coating.
 - c. SW - Macropoxy 646 Fast Cure Epoxy Mastic Semi-Gloss.
 3. One top coat of urethane finish.
 - a. BM - Corotech Aliphatic Acrylic Urethane Gloss V500.
 - b. PPG - Pitthane Ultra Acrylic Aliphatic Urethane Gloss 95-812 Series.
 - c. SW - Hi-Solids Polyurethane Gloss B65-300.
- E. Exterior Steel - Galvanized:
1. One coat of alkyd primer.
 - a. BM - Ultra Spec HP Acrylic Metal Primer HP04.
 - b. PPG - Pitt-Tech Plus 4020 PF DTM Acrylic Primer.
 - c. SW - Galvite HS Alkyd Modified Acrylic Primer.
 2. Two top coats of alkyd enamel finish.
 - a. BM - Advance Waterborne Interior-Exterior Alkyd High Gloss N794.
 - b. PPG - Pitt-Tech Plus EP DTM Acrylic Gloss.
 - c. SW - SWP Exterior Oil Base Gloss.
- F. Exterior Aluminum - Mill Finished:
1. One coat of alkyd primer.
 - a. BM - Ultra Spec HP Acrylic Metal Primer HP04.
 - b. PPG - Pitt-Tech Plus 4020 PF DTM Acrylic Primer.
 - c. SW - Galvite HS Alkyd Modified Acrylic Primer.
 2. Two top coats of alkyd enamel finish.

- a. BM - Advance Waterborne Interior-Exterior Alkyd High Gloss N794.
 - b. PPG - Pitt-Tech Plus EP DTM Acrylic Gloss.
 - c. SW - SWP Exterior Oil Base Gloss.
- G. Exterior Concrete Masonry Units:
 - 1. Two coats of block filler.
 - a. BM - Ultra Spec Hi-Build Masonry Block Filler 571.
 - b. PPG - Speedhide Interior-Exterior Masonry Hi Fill Latex Block Filler.
 - c. SW - Loxon Acrylic Block Surfacer A24/LX01 Series.
 - 2. Two top coats of latex finish.
 - a. BM - Ultra Spec EXT Finish Satin N448.
 - b. PPG - Speedhide Exterior Acrylic Flat.
 - c. SW - SuperPaint Exterior Acrylic Latex Flat.

3.6 SCHEDULE - INTERIOR SURFACES

- A. Interior Surfaces Indicated to Receive Fire-Retardant Intumescent Paint System:
 - 1. Refer to Drawings for designated locations, required fire-retardant rating, and applicable UL Design.
 - 2. The intumescent paint system includes application of the intumescent paint and its primer.
 - 3. Thicknesses of intumescent paint system components are to be as required to achieve the required fire-retardant rating.
 - 4. Confirm with the intumescent paint system manufacturer, the paint system adhesion compatibility with the substrate material.
 - 5. Intumescent Paint System:
 - a. Albi Clad 800 with primer as recommended by manufacturer.
 - b. Isolatek - WB5 with primer as recommended by manufacturer.
 - 6. Comply with intumescent paint system manufacturer's recommendations for cure time prior to application of finish paint system.
 - 7. Finish paint system is to be applied over fully cured intumescent paint system and is to be as indicated below in accordance with the substrate type. Confirm compatibility of finish paint system with respective paint system manufacturers.
- B. Interior Concrete Masonry Units:
 - 1. Two coats of block filler unless indicated otherwise.
 - a. BM - Ultra Spec Hi-Build Masonry Block Filler 571.
 - b. PPG - Speedhide Interior-Exterior Masonry Hi Fill Latex Block Filler.
 - c. SW - PrepRite Interior-Exterior Latex Block Filler.
 - 2. Two top coats of latex finish.
 - a. BM - Ultra Spec 500 Interior Acrylic Finish Eggshell T538.
 - b. PPG - Speedhide Zero VOC Interior Latex Eggshell.
 - c. SW - ProMar 200 Zero VOC Interior Latex Eg-Shel.
 - 3. Special Requirement:
 - a. Three coats block filler.
 - b. Two top coats finish.
 - c. Locations:
 - 1) Lobby Areas.
 - 2) Corridors.
 - 3) Stair Areas.
- C. Interior Concrete Masonry Units (Epoxy Coating):
 - 1. Two coats of epoxy block filler, unless otherwise indicated.
 - a. BM - Corotech Acrylic Block Filler V114.
 - b. PPG - Speedhide Interior-Exterior Masonry Hi Fill Latex Block Filler 6-15XI.

- c. SW - Pro Industrial Heavy Duty Block Filler.
- 2. Two top coats of acrylic epoxy finish.
 - a. BM - Corotech Pre-Catalyzed Waterborne Epoxy Semi-Gloss.
 - b. PPG - Pitt-Glaze WB1 Interior Pre-Catalyzed Acrylic Epoxy Semi-Gloss.
 - c. SW - Pro Industrial Pre-Catalyzed Waterbased Epoxy Semi-Gloss.
- 3. Special Requirement:
 - a. Three coats minimum, block filler.
 - b. Two top coats minimum, finish.
 - c. Locations:
 - 1) Food Preparation and Dining Areas such as:
 - a) Kitchen Areas.
 - b) Food Serving Areas.
 - c) Dishwashing Areas.
 - d) Food Storage Areas.
 - e) Kitchen Office Areas.
 - f) Kitchen Toilet and Locker Areas.
 - g) Dining Areas.
 - h) Cafeterias.
 - 2) Toilets and Janitor Closets.
 - 3) Locker Rooms.
 - d. Apply additional coats as required to achieve even surface finish acceptable to the local Health Department having jurisdiction.
 - e. All surfaces must be acceptable to Health Department officials and pass the “ketchup test” requirements.
- D. Interior Parge Finished Masonry (Epoxy Coating):
 - 1. One coat, minimum of epoxy block filler.
 - a. BM - Corotech Acrylic Block Filler V114.
 - b. PPG - Speedhide Interior-Exterior Masonry Hi Fill Latex Block Filler 6-15XI.
 - c. SW - Pro Industrial Heavy Duty Block Filler.
 - 2. Two top coats, minimum of acrylic epoxy finish.
 - a. BM - Corotech Pre-Catalyzed Waterborne Epoxy Semi-Gloss.
 - b. PPG - Pitt-Glaze WB1 Interior Pre-Catalyzed Acrylic Epoxy Semi-Gloss.
 - c. SW - Pro Industrial Pre-Catalyzed Waterbased Epoxy Semi-Gloss.
 - 3. Apply additional coats as required to achieve even surface finish acceptable to the local Health Department having jurisdiction.
 - 4. All surfaces must be acceptable to Health Department officials and pass the “ketchup test” requirements.
- E. Interior Concrete Floors Requiring Sealed Finish: This provision is only for concrete floors indicated to have Sealed Concrete Finish. It is not intended for Stained and Polished Concrete Floors that would be indicated in Section 03 35 43 - Polished Concrete Finishing.
 - 1. One coat Liquid Densifier: Penetrating lithium silicate sealer, hardener, and densifier.
 - a. Prosoco - Consolideck LS Hardener/Densifier. (Basis of Design)
 - b. Convergent Concrete Technologies - Pentra-Sil (HD).
 - c. Ameripolish - Ameripolish 3D HS.
 - d. Substitutions: Section 01 60 00 - Product Requirements.
 - 2. Two coats Protective Treatment: Penetrating lithium silicate protective treatment.
 - a. Prosoco - Consolideck PolishGuard Finish. (Basis of Design)
 - b. Convergent Concrete Technologies - Pentra-Finish (HG).
 - c. Ameripolish - Ameripolish SR2.
 - d. Substitutions: Section 01 60 00 - Product Requirements.
- F. Interior Steel - Unprimed:
 - 1. One coat of acrylic primer.

- a. BM - Corotech Acrylic Metal Primer V110.
 - b. PPG - Pitt-Tech Plus 4020 PF DTM Acrylic Primer.
 - c. SW - Pro Industrial Pro-Cryl Universal Primer.
 - 2. Two top coats of acrylic enamel finish.
 - a. BM - Corotech Acrylic DTM Enamel Semi-Gloss V331.
 - b. PPG - Pitt-Tech Plus EP DTM Acrylic Semi-Gloss.
 - c. SW - Pro Industrial Waterbased Alkyd Urethane Enamel Semi-Gloss.
- G. Interior Steel - Primed:
- 1. One coat of acrylic primer.
 - a. BM - Corotech Acrylic Metal Primer V110.
 - b. PPG - Pitt-Tech Plus 4020 PF DTM Acrylic Primer.
 - c. SW - Pro Industrial Pro-Cryl Universal Primer.
 - 2. Two top coats of acrylic enamel finish.
 - a. BM - Corotech Acrylic DTM Enamel Semi-Gloss V331.
 - b. PPG - Pitt-Tech Plus EP DTM Acrylic Semi-Gloss.
 - c. SW - Pro Industrial Waterbased Alkyd Urethane Enamel Semi-Gloss.
- H. Interior Steel - Galvanized:
- 1. One coat acrylic primer.
 - a. BM - Ultra Spec HP Acrylic Metal Primer HP04.
 - b. PPG - Pitt-Tech Plus 4020 PF DTM Acrylic Primer.
 - c. SW - Pro Industrial Pro-Cryl Universal Primer.
 - 2. Two top coats of acrylic enamel finish.
 - a. BM - Advance Waterborne Interior Alkyd Semi-Gloss.
 - b. PPG - Pitt-Tech Plus EP DTM Acrylic Semi-Gloss.
 - c. SW - Pro Industrial Waterbased Alkyd Urethane Enamel Semi-Gloss.
- I. Interior Aluminum - Mill Finished:
- 1. One coat acrylic primer.
 - a. BM - Ultra Spec HP Acrylic Metal Primer HP04.
 - b. PPG - Pitt-Tech Plus 4020 PF DTM Acrylic Primer.
 - c. SW - Pro Industrial Pro-Cryl Universal Primer.
 - 2. Two top coats of acrylic enamel finish.
 - a. BM - Advance Waterborne Interior Alkyd Semi-Gloss.
 - b. PPG - Pitt-Tech Plus EP DTM Acrylic Semi-Gloss.
 - c. SW - Pro Industrial Waterbased Alkyd Urethane Enamel Semi-Gloss.
- J. Interior Gypsum Board - Walls:
- 1. One coat latex primer sealer.
 - a. BM - Ultra Spec 500 Interior Latex Primer.
 - b. PPG - Pure Performance Interior Acrylic Primer.
 - c. SW - ProMar 200 Zero VOC Interior Latex Primer.
 - 2. Two top coats of latex finish.
 - a. BM - Ultra Spec 500 Interior Latex Finish Eggshell
 - b. PPG - Speedhide Zero VOC Interior Latex Eggshell.
 - c. SW - ProMar 200 Zero VOC Interior Latex Eg-Shel.
- K. Interior Gypsum Board - Walls (Epoxy Coating):
- 1. One coat of epoxy primer sealer.
 - a. BM - INSL-X Aqua Lock Plus.
 - b. PPG - Pure Performance Interior Acrylic Primer.
 - c. SW - ProMar 200 Zero VOC Interior Latex Primer.
 - 2. Two top coats of acrylic epoxy finish.
 - a. BM - Corotech Pre-Catalyzed Waterborne Epoxy Semi-Gloss.
 - b. PPG - Pitt-Glaze WB1 Interior Pre-Catalyzed Acrylic Epoxy Semi-Gloss.

- c. SW - Pro Industrial Pre-Catalyzed Waterbased Epoxy Semi-Gloss.
 - 3. Locations Include:
 - 1) As indicated on Drawings.
 - b. Toilets and Janitor Closets.
 - c. Locker Rooms.
- L. Interior Gypsum Board - Ceilings and Bulkheads:
 - 1. One coat latex primer sealer.
 - a. BM - Ultra Spec 500 Interior Latex Primer.
 - b. PPG - Pure Performance Interior Acrylic Primer.
 - c. SW - ProMar 200 Zero VOC Interior Latex Primer.
 - 2. Two top coats of latex finish.
 - a. BM - Ultra Spec 500 Interior Latex Finish Eggshell.
 - b. PPG - Speedhide Zero VOC Interior Latex Eggshell.
 - c. SW - ProMar 200 Zero VOC Interior Latex Eg-Shel.
- M. Interior Insulated Coverings - Canvas and Cotton:
 - 1. One coat of latex primer sealer.
 - a. Same as Gypsum Board - Ceilings and Bulkheads.
 - 2. Two top coats of latex finish.
 - a. Same as Gypsum Board - Ceilings and Bulkheads.
 - 1) Sheen: Flat.
- N. Interior Dry Fall (Dry Fog):
 - 1. One coat of primer sealer.
 - a. Product recommended by top coat manufacturer for each substrate type.
 - 2. Two top coats of acrylic finish.
 - a. BM - Coronado Super Kote 5000 Dry Fall Acrylic Latex Flat.
 - b. PPG - Speedhide Super Tech WB Interior Dry Fog Flat.
 - c. SW - Pro Industrial Waterborne Acrylic Dryfall Flat.
- O. Interior Wood (Paint Coating):
 - 1. One coat of primer sealer.
 - a. BM - Ultra Spec 500 Interior Latex Primer.
 - b. PPG - Pure Performance Interior Acrylic Primer.
 - c. SW - PrepRite ProBlock Interior-Exterior Latex Primer.
 - 2. Two top coats of latex finish.
 - a. BM - Ultra Spec 500 Interior Semi-Gloss
 - b. PPG - Speedhide Interior Latex Semi-Gloss
 - c. SW - ProMar 200 Zero VOC Interior Latex Semi-Gloss.
- P. Interior Wood (Stain):
 - 1. Stain:
 - a. BM - Product recommended by top coat manufacturer for substrate type.
 - b. PPG - DEFT Interior Oil Based Stain.
 - c. SW - Minwax Performance Series Tintable Interior Wood Stain.
 - 2. Three top coats finish:
 - a. Refer to Wood - Transparent Top Coat on Stained below.
- Q. Interior Wood (Transparent Top Coat on Stained Wood and Non-Stained Wood):
 - 1. One coat sealer.
 - a. Product recommended by top coat manufacturer for substrate type.
 - 2. Three top coats of transparent acrylic coating.
 - a. BM - Lenmar Aqua-Plastic Acrylic Urethane Clear Semi-Gloss.
 - b. PPG - DEFT Interior Polyurethane Water Based Acrylic Semi-Gloss.
 - c. SW - Minwax Water-Based Oil-Modified Polyurethane Clear Semi-Gloss.

END OF SECTION

SECTION 10 11 00
VISUAL DISPLAY UNITS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Porcelain Marker Board Units.
 - 2. Glass Marker Board Units.
 - 3. Tack Board Units.
 - 4. Map Rails.
- B. Related Requirements:
 - 1. Section 04 20 00 - Unit Masonry: Substrate construction.
 - 2. Section 09 21 16 - Gypsum Board Assemblies: Substrate construction.

1.2 REFERENCES

- A. American Architectural Manufacturers Association (AAMA):
 - 1. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2020.
 - 2. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- B. American National Standards Institute (ANSI):
 - 1. ANSI A135.4 - Basic Hardboard; 2012, Reapproval 2020.
 - 2. ANSI A208.1 - Particleboard; 2022.
 - 3. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015, Reapproval 2020.
- C. ASTM International (ASTM):
 - 1. ASTM A424/A424M - Standard Specification for Steel, Sheet, for Porcelain Enameling; 2018.
 - 2. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
 - 3. ASTM C208 - Standard Specification for Cellulosic Fiber Insulating Board; 2022.
 - 4. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass; 2019.
 - 5. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
 - 6. ASTM F793/F793M - Standard Classification of Wall Coverings by Use Characteristics; 2020.
- D. The Engineered Wood Association (APA):
 - 1. APA PS 1 - Structural Plywood; 2022, Revised 2023.
- E. California Department of Public Health (CDPH):
 - 1. CDPH Standard Method VOC V1.2 - Standard Method For The Testing And Evaluation Of Volatile Organic Chemical Emissions From Indoor Sources Using Environmental Chambers - Version 1.2; 2017.
- F. Code of Federal Regulations (CFR):
 - 1. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Current Edition.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Provide data for each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, finishes, and accessories for visual display units.
- C. Shop Drawings: Provide dimensioned drawings for each visual display unit.
 - 1. Include plans, elevations, sections, and attachment/anchor details per substrate type.
 - 2. Include schedule of unit descriptions sorted by room numbers from Drawings.
 - 3. Show locations and details of factory-assembled joints. Show locations of field-assembled joints for factory-fabricated units too large to ship in one piece.
 - 4. Show locations and layout of graphics indicated.
 - 5. Include sections of typical trim members.
- D. Samples for Initial Selection: Two manufacturer's complete sets of color samples illustrating the full range of finishes, colors, and patterns available for products. Submit for Architect's initial selections.
- E. Samples for Verification: From the Architect's initial selections, prepare and submit two samples for each selection; samples to be same product material type indicated for final Work; each sample 12 x 12 inches. Where finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 77 00 - Closeout Procedures.
- B. Operation and Maintenance Data: Manufacturer recommendations to include:
 - 1. Care and maintenance instructions.
 - 2. Installation instructions.
 - 3. Specifications for recommended surface markers and erasers.
 - 4. Replacement parts data and optional accessories data.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three (3) years documented experience.

1.6 WARRANTY

- A. Section 01 77 00 - Closeout Procedures: Product warranties.
- B. Warranty period is to begin on the project's date of Substantial Completion.
- C. General: Provide warranty for visual display units not indicated otherwise.
 - 1. Provide five (5) year manufacturer's warranty for visual display surfaces in which manufacturer agrees to replace defective materials or installation.
- D. Porcelain Marker Boards: Provide fifty (50) year manufacturer's warranty in which manufacturer agrees to replace marker boards that exhibit any of the following defects:
 - 1. Defects in materials or workmanship.
 - 2. Discoloration, staining, ghosting or excessive fading of color.
 - 3. Cracking, cracking, or flaking.
 - 4. Warranty does not cover the cost of removal or reinstallation.

1.7 SPARE PARTS AND MAINTENANCE PRODUCTS

- A. Section 01 60 00 - Product Requirements: Extra materials, spare parts, and maintenance products.
 - 1. Porcelain Marker Boards: Furnish the following for each marker board installed. Products are to be compatible with marker boards and as recommended by board manufacturer.
 - a. One (1) pack of color markers; black, red, blue, and green colors.
 - b. One (1) block type dry eraser.
 - c. One (1) cloth type dry eraser.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Visual display units to be manufactured and factory assembled units.
- B. Laminated components are to be factory laminated, not field laminated.
- C. Surface-Burning Characteristics: Comply with ASTM E 84.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 50 or less.

2.2 MANUFACTURERS

- A. Manufacturers:
 - 1. AJW Architectural Products.
 - 2. ASI Visual Display Products.
 - 3. Clarus.
 - 4. Claridge Products and Equipment.
 - 5. Egan Visual Corporation.
 - 6. Ghent Manufacturing Inc.
 - 7. Marsh by Polyvision.
 - 8. Nelson Adams NACO.
 - 9. Substitutions: Section 01 60 00 - Product Requirements.

2.3 PORCELAIN MARKER BOARD UNITS

- A. Porcelain Marker Boards:
 - 1. Outer Face Sheet: Porcelain enameled steel sheet.
 - a. Colors: As selected by Architect from manufacturer's full range.
 - 2. Core: Particle board, 1/2 inch thick.
 - 3. Vapor Barrier Backing: Aluminum sheet backing laminated to panel back.
 - 4. Sizes and Configurations:
 - a. As indicated on Drawings.
 - 5. Splice Joints: Used only as indicated on Drawings or otherwise approved by Architect.
 - a. Concealed Splice Joint: Extruded aluminum to be factory applied. Finished joint is to be hairline tight with flush aligned face planes of joined panels.
 - 1) Continuous metal spline type.
 - 6. Edge Treatment:
 - a. Frame: Extruded aluminum; 3/4 inch width.
 - 7. Divider Joint: Extruded aluminum; continuous along full length of joint.
 - a. Style:
 - 1) H-style bar with flat face and integral wall anchor flange on back.

- 2)
 - b. Exposed Finish:
 - 1) Match frame.
- 8. Mount: Anchor marker board to support construction.
 - a. Concealed continuous cleat anchor Z-rails.
 - b. Concealed continuous anchor flange integral to extruded frame assembly.
- 9. Marker Tray: Extruded aluminum, one-piece full length of marker board, concealed fasteners, and cast aluminum end caps.
 - a. Profile:
 - 1) Shape to be one piece triangular box profile.
 - b. In physical activity spaces such as weightlifting rooms, dance studios, gyms, and multi-purpose rooms, do not provide protruding marker trays. Provide recessed type marker trays.
- 10. Map Rail: Provide at top and full length of each marker board.
 - a. Provide as indicated in Map Rail article of this Section.
- 11. Cleaning Instruction Plate: Provide instructions for marker board cleaning on metal plate fastened to perimeter frame near marker tray.
- 12. Accessories: As recommended by marker board manufacturer.
 - a. Dry Erase Markers: Provide for each marker board.
 - 1) One (1) pack of color markers; black, red, blue, and green colors.
 - b. Dry Erase Marker Erasers: Provide for each marker board.
 - 1) Two (2) cloth type or microfiber shag type erasers.
 - 2) Two (2) block type erasers.

2.4 GLASS MARKER BOARD UNITS

- A. Glass Marker Boards: Coated or treated for use as dry erase marker board without staining or ghosting.
 - 1. Glass: 1/4 inch (6 mm) thick.
 - a. Fully tempered safety glass, low iron; 1/4 inch (6 mm) thick.
 - 2. Glass Edges:
 - a. Pencil polished edges.
 - 3. Glass Corners:
 - a. Eased radius corners.
 - 4. Glass Back Coating Finish:
 - a. Color:
 - 1) As indicated on drawings.
 - b. Gloss:
 - 1) As indicated on drawings.
 - 5. Magnetic Function:
 - a. Glass to be laminated to steel sheet backing to allow magnetized objects to affix to glass surface.
 - 6. Sizes and Configurations:
 - a. As indicated on Drawings.
 - 7. Frame:
 - 1) Frame Material and Finish: Extruded Aluminum.
 - a) Anodized finish.
 - 8. Mount: Anchor marker board to support construction.
 - a. Concealed continuous cleat anchor Z-rails.
 - 1) As indicated on drawings. .
 - 9. Accessories: As recommended by marker board manufacturer.
 - a. Dry Erase Markers: Provide for each marker board.
 - 1) One (1) pack of color markers; black, red, blue, and green colors.
 - b. Dry Erase Marker Erasers: Provide for each marker board.

- 1) Two (2) block type erasers.
- c. Magnetic Pins: Provide for each marker board.
 - 1) Formed shape to provide firm finger-grip pull function.
 - 2) Colors: Equal quantity of black, red, blue, and green.
 - 3) Quantity: Eight (8) magnetic pins.
- d. Magnetic Caddy: Provide for each marker board.
 - 1) Formed to hold markers and erasers with double compartment.
 - 2) Size: 7 W x 5 H x 3-1/2 D inches with open top.
 - 3) Wire mesh sides, bottom, and compartment divider; open top.
 - 4) Finish: Powder coat finish; black color.
 - 5) Quantity: One (1) magnetic caddy.

2.5 TACK BOARD UNITS

- A. Laminated Components:
 - 1. 1/4 inch composition cork; 1/4 inch hardboard; aluminum foil backing.
- B. Board Sizes and Configurations:
 - 1. As indicated on Drawings.
- C. Edge Treatment:
 - 1. Frame: Extruded aluminum; 3/4 inch width.
 - 2. No treatment at the reception desk in room 101.
- D. Corner Style:
 - 1. Square; mitered joint.
- E. Divider Joint: Extruded aluminum; continuous along full length of joint.
 - 1. Style:
 - a. H-style bar with flat face and integral wall anchor flange on back.
 - 2. Exposed Finish:
 - a. Match frame.
- F. Colors and Patterns: As selected by Architect from manufacturer's full range.
- G. Mount: Anchor tack board to support construction.
 - 1. Concealed continuous cleat anchor Z-rails.
 - 2. Concealed continuous anchor flange integral to extruded frame assembly.
- H. Map Rail: Provide at top and full length of each tack board.
 - 1. Provide as indicated in Map Rail article of this Section.

2.6 MAP RAILS

- A. Map Rails: Extruded aluminum rails; tackable insert; top and bottom track flanges for mounting map rail accessories; concealed fasteners; end caps.
 - 1. Size: Length as indicated in this Section, unless indicated otherwise on Drawings.
 - a. 1 inch wide.
 - 2. Tackable Insert: Applied to full length of rail.
 - a. Composition cork.
 - 3. Map Rail Accessories: Aluminum and sized to securely fit and slide along rail size indicated. Provide the following for each map rail.
 - a. 1 flag holder, and 1 for each additional 20 linear feet of rail.
 - b. 1 pair of map hooks, and 1 pair for each additional 10 linear feet of rail.
 - c. 1 pair of roller brackets, and 1 pair for each additional 10 linear feet of rail.
 - 4. Colors: As selected by Architect from manufacturer's full range.

2.7 MATERIALS

- A. Porcelain Enameled Steel Sheet: ASTM A424/A424M, Type I, Commercial Steel, with fired-on porcelain enamel finish.
 - 1. Steel Sheet Thickness:
 - a. 24 gauge (0.024 inch) (0.61 mm).
 - 2. Porcelain Enameling System: Coat faces and edges with three coat porcelain enameling system consisting of primer, ground coat, and color cover coat. Total thickness of coating system to be not less than 4 mil (0.10 mm) thick.
 - a. System to be fusion bonded to steel sheet at suitable temperature as to reduce steel and porcelain stresses, and to achieve superior enamel bond and hardness.
 - b. Writing surface is to be non-porous, provide magnetic function, is to be uniform in hardness, color, and texture, and is to wipe clean with dry eraser or cloth without staining or ghosting.
- B. Wood Composite Materials: Sanded smooth on all sides. Maximum volatile organic content to comply with CDPH Standard Method VOC V1.2.
 - 1. Hardboard: ANSI A135.4, Class 1 - Tempered.
 - 2. Fiber Board: ASTM C208, cellulosic fiber insulating board.
 - 3. MDF Board: ANSI A208.2, Grade 130 minimum.
 - 4. Particleboard: ANSI A208.1, Grade M-1, wood chips, with waterproof resin binder.
 - 5. Plywood:
 - a. APA PS 1 Grade A-B, softwood.
- C. Aluminum Foil Backing: 0.005 inch (0.13 mm) thick minimum.
- D. Aluminum Sheet Backing: 27 gauge (0.014 inch) (0.36 mm) thick minimum.
- E. Steel Sheet Backing: 28 gauge (0.015 inch) (0.38 mm) thick minimum, galvanized.
- F. Cork Materials: Seamless application. Colors as selected by Architect from manufacturer's full range.
 - 1. Composition Cork: Formulation of finely ground cork, oxidized linseed oils, rosin binders, and pigments forming a solid uniform colored composition cork; 1/4 inch thick and burlap back reinforcing.
 - 2. Natural Cork: Fine grain natural cork, homogeneous composition. 1/4 inch thick.
- G. Fabric Materials: Seamless application. Colors and patterns as selected by Architect from manufacturer's full range.
 - 1. Vinyl Coated Fabric: Vinyl coated fabric complying with ASTM F793 Category VI.
 - 2. Woven Fabric: 100 percent polyester; weighing not less than 15 oz/sq yd.
- H. Extruded Aluminum: Comply with ASTM B221, 6063 alloy, T5 temper. Free of extruding draw marks and surface scratches.
 - 1. Extruded Aluminum Frames, Trim, and Components: Sizes and shapes as indicated and to suit use and installation type; factory applied to visual display units; single length extrusions when possible; keep joints to a minimum; concealed fasteners; mitered corners to an aligned and hairline closure and without sharp edges.
 - a. Extrusion Wall Thickness:
 - 1) 0.062 inch thick minimum.
 - b. Color:
 - 1) As selected by Architect from manufacturer's full range, unless indicated otherwise.
- I. Adhesives: Products recommended by manufacturer of visual display item for substrate to which item is to be adhered. Maximum volatile organic compound content in accordance with CDPH Standard Method VOC V1.2.

- J. Temporary Protective Cover: 8 mil polyethylene protective sheet factory applied to finish surfaces of products. Cover to be removable without damage to finishes.
- K. Magnetized Devices and Accessories: Magnets to be of magnetic alloy of rare earth elements. Functions to affix devices to marker boards that include steel sheet material.

2.8 ALUMINUM FINISHES

- A. Class II Natural Anodized Finish: AAMA 611 AA-M12C22A31 Clear anodic coating not less than 0.4 mils (0.01 mm) thick.
- B. Class II Color Anodized Finish: AAMA 611 AA-M12C22A32 integrally colored or AA - M12C22A34 electrolytically deposited colored anodic coating not less than 0.4 mil (0.01 mm) thick.
- C. Baked-Enamel or Powder-Coat Finish: AAMA 2603, except with a minimum dry film thickness of 1.5 mil (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 73 00 - Execution: Verification of existing conditions before starting Work.
- B. Verify that surfaces and conditions are ready to accept the Work of this Section. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Verify substrate support construction and required internal support blocking are sufficient and ready to receive Work.
- D. Verify that positioning dimensions are as indicated on Drawings and that substrates are free of obstructions.
- E. Examine products to be installed for damage and other conditions detrimental to completion of the Work.

3.2 PREPARATION

- A. Section 01 73 00 - Execution: Prepare field conditions and existing construction for installation of work of this Section.
- B. Prepare materials to be installed and equipment to be used during installation.

3.3 INSTALLATION

- A. Section 01 73 00 - Execution: Related to installation of Work.
- B. Install visual display units at locations and heights indicated on Drawings.
- C. Install visual display units level and plumb with concealed fastening hardware and anchor securely to support construction.
- D. Panels indicated to be joined with concealed spline are to be butted tightly. Finished joint is to be hairline tight with flush aligned face planes of joined panels.

3.4 CLEANING

- A. Section 01 73 00 - Execution and Section 01 77 00 - Closeout Procedures: Related to cleaning.

- B. Cover visual display unit surfaces with protective cover. Protective cover to be removable without damage to surfaces.
- C. Remove temporary protective cover at Final Inspection.

3.5 PROTECTION OF INSTALLED CONSTRUCTION

- A. Section 01 73 00 - Execution: Protecting installed construction.
- B. Protect installed construction from damage.

END OF SECTION

SECTION 10 14 00

SIGNAGE

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Room Identification Signs.
 - 2. Applied Vinyl Graphics.
 - 3. Custom Artwork Applied Vinyl Graphics.
 - 4. Dimensional Letter Signs.
 - 5. Notification Signs.
 - 6. Fire Protection Signs.
 - 7. Warning Stencils.
 - 8. Dedication Plaque.
 - 9. LED Screen Marquee Signs: For digital information display.
- B. Related Requirements:
 - 1. Sections related to identification of Plumbing, HVAC, and Electrical work.
 - 2. Sections related to Civil and Site work.

1.2 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. ANSI Z97.1 - Safety Glazing Materials Used In Buildings - Safety Performance Specifications And Methods Of Test; 2015, Reaffirmed 2020.
- B. Americans with Disabilities Act (ADA):
 - 1. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; Current Edition.
- C. ASTM International (ASTM):
 - 1. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
 - 2. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
 - 3. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass; 2019.
- D. Code of Federal Regulations (CFR):
 - 1. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; Current Edition.
- E. International Code Council (ICC):
 - 1. ICC A117.1 - Accessible and Usable Building and Facilities; 2017.
- F. International Electrotechnical Commission (IEC):
 - 1. IEC 60529 - Degrees of Protection Provided by Enclosures (IP Code); 1989, With Amendments Through 2013.
- G. UL Standards (UL):
 - 1. UL 48 - Electric Signs; Edition 15, 2011, With Revisions Through 2023.
 - 2. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit data describing the material, fabrication standards and characteristics of the sign systems indicated in the Section and other Contract Documents.
- C. Shop Drawings: Indicate sign types, styles, lettering font, copy, graphics, features, foreground and background colors, locations, overall dimensions of each sign and attachment method.
 - 1. Indicate connection locations for signage requiring electrical or communication wiring.
- D. Samples for Initial Selection: Two manufacturer's color charts illustrating the full range of finishes and colors available for each sign type; include color options for backgrounds, graphics, and copy; submit for Architect's initial selections.
- E. Samples for Verification: From the Architect's initial selections, prepare and submit two samples for each selected finish and color; samples on same product material type indicated for final Work; each sample 6 x 8 inches illustrating sign type, sign features, graphics, and method of attachment. Where finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.
- F. Manufacturer's Installation Instructions: Submit installation template and attachment devices.

1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum five (5) years documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Package signs, labeled in name groups.
- C. Store adhesive attachment tape at ambient room temperatures.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.
- B. Do not install signs when ambient temperature is lower than recommended by manufacturer.
- C. Maintain this minimum temperature during and after installation of signs.

1.7 WARRANTY

- A. Section 01 77 00 - Closeout Procedures: Product warranties.
- B. LED Marquee Signs: Provide warranties indicated in the description of the LED Marquee Sign in this Section.

1.8 SPARE PARTS AND MAINTENANCE PRODUCTS

- A. Section 01 60 00 - Product Requirements: Extra materials, spare parts, and maintenance products.
- B. Furnish spare signs of the following Type as indicated on Drawings. Include mounting hardware for each spare sign.

1. Submit request to Architect for graphics, copy, braille, and colors:
2. Type: ____ . Quantity: ____ signs.
3. Type: ____ . Quantity: ____ signs.
4. Type: ____ . Quantity: ____ signs.

PART 2 PRODUCTS

2.1 PERFORMANCE AND DESIGN REQUIREMENTS

- A. Conform to current local and state building codes; ADA Standards; 36 CFR 1191; and ICC A117.1 guidelines for manufacture and installation of interior identification signs.
- B. Conform to current International Fire Code requirements.

2.2 MANUFACTURERS

- A. Manufacturers:
 1. Acorn Sign Graphics.
 2. APCO Graphics.
 3. ASI Sign Systems.
 4. Bayuk Graphic Systems, Inc.
 5. Best Sign Systems.
 6. Gemini, Inc.
 7. Interface Architectural Signage, Inc.
 8. InPro Corporation (Signscape).
 9. Mohawk Sign Systems.
 10. Rowmark, LLC.
 11. Scott Sign Systems, Inc.
 12. Signage Industries Corporation.
 13. Substitutions: Section 01 60 00 - Product Requirements.

2.3 ROOM IDENTIFICATION SIGNS

- A. Includes signs for rooms and area identification, fire extinguishers and fire extinguisher cabinets, unlighted exit signs, room capacity signs, areas of refuge, and elevators and stairs related signs as indicated on Drawings.
 1. Photopolymer face fused to phenolic sheet; 0.145 inch total thickness; matte finish.
 2. "Tactile" signage, with copy raised minimum 1/32 inch above sign surface using photopolymer bonded process and with Grade II Braille located below copy.
 3. Clear Window Insertion Slots: As indicated on Drawings.
 4. Copy and graphics to be uniformly opaque.
 5. Copy Font: Helvetica Medium, uppercase.
 6. Copy Height: As indicated on Drawings.
 7. Braille Height: As indicated on Drawings.
 8. Symbol Size: As indicated on Drawings.
 9. Total Thickness: As indicated on Drawings, but not less than 0.145 inch.
 10. Size and Configuration: As indicated on Drawings.
 11. Corners: 1/2 inch radius unless indicated otherwise on Drawings.
 12. Edges: Beveled and smooth.
 13. Graphic Style: International type.
 14. Colors:
 - a. Background: As selected by Architect from submitted samples.
 - b. Copy:
 - 1) As selected by Architect from submitted samples.

- c. Symbols and Graphics:
 - 1) As selected by Architect from submitted samples.
- 15. Room Identification Sign Types:
 - a. Drawings indicate Sign Type Designations, Size, Copy, Symbols, and Insert Window requirements.
 - b. Signs required at all door openings and spaces and as indicated on Drawings.
 - c. Refer to Signage Schedule, Elevations, and Details on Drawings.
 - d. Include twelve (12) additional identification signs with graphics to be determined during construction. Type to be the type with insert window.
 - e. Back Cover Plate: Where sign must be secured to glass, acquire Architect approval prior to fabrication and installation of a Backing Cover (blank solid sign) on the opposite side of the glass. The backing cover material shall match the size, shape, base color, thickness, and finish of the sign. The intent is to hide the unsightly back view of the sign when viewed on the opposite side of the glass. (Back Cover Plate, also referenced in ACCESSORIES, and INSTALLATION articles in this Section.)

2.4 APPLIED VINYL GRAPHICS

- A. Vinyl film, die-cut characters; 2 inches high, 3 mils thick.
 - 1. Adhesive backing to be pressure-sensitive and exterior application grade type.
- B. Provide door graphics for each of the following:
 - 1. Copy: **VISITORS REPORT TO MAIN OFFICE** (10 signs required)
 - 2. Copy: **TOBACCO FREE PROPERTY** (10 signs required)
 - 3. Copy: **DELIVERIES ONLY** (2 signs required)

2.5 CUSTOM ARTWORK APPLIED VINYL GRAPHICS (ALTERNATE 2)

- A. Permanent Applied Custom Vinyl Graphics:
 - 1. Manufacturers:
 - a. Avery Dennison.
 - b. Substitutions: Section 01 60 00 - Product Requirements.
 - 2. Smooth Substrate Applications: Graphics to be applied to smooth substrates including Level 5 finished and painted gypsum board or plaster.
 - a. Basis of Design: Avery Dennison MPI 1405 with DOL 6460.
 - 3. Textured Substrate Applications: Graphics to be applied to textured substrates including concrete, brick masonry units, and concrete masonry units.
 - a. Basis of Design: Avery Dennison MPI 1105 with DOL 1300z.
 - 4. Substrate Finish: Finish and paint requirements are to be completed and fully cured/dry prior to application of graphics.
 - a. Paint cure/dry time for smooth substrates to be not less than five (5) days or as required for full cure.
 - b. Paint cure/dry time for textured substrates to be not less than seven (7) days or as required for full cure.
 - c. Do not use Low VOC paint on substrate receiving graphics application.
 - d. Behind graphics application, paint sheen is to be semi-gloss.
 - e. Substrate is to be free from defects and contaminants including debris, dirt, grease, and other foreign matter.
 - 5. Graphic Designs: Design is to include custom imagery and colors.
 - a. Designs to be provided by Architect.
 - 1) Each graphics application to be of different and unique design.
 - b. Designs to be coordinated with installer.
 - 6. Locations: As indicated on Drawings.

2.6 DIMENSIONAL LETTER SIGNS

- A. Exterior Metal Letters: Architectural grade aluminum.
 - 1. Copy Style: Helvetica Medium, unless indicated otherwise on Drawings.
 - 2. Finish: Brushed.
 - 3. Copy and Locations: Characters to be designated by Architect.
 - a. Building Face - Address Identification (AHJ requirement)):
 - 1) Copy text, height, and location on building exterior to be as required and designated by the local Fire Marshal and IBC 501.2 code.
 - b. Building Face - Building Name.
 - 1) Location: Mounted on building wall; height and location as follows:
 - a) To be designated by Architect:
 - 2) Character Thickness:
 - a) 1 inch.
 - 3) Characters:
 - a) E.B. FRINK MIDDLE SCHOOL, 18 inches high.
 - c. Primary Monumental Site Sign.
 - 1) Location: Mounted on two sides of Primary Monumental Site Sign.
 - a) Character Thickness:
 - (1) 1 inch.
 - b) Characters:
 - (1) 24 upper case, 12 inches high. (48 total characters)
 - (2) 10 upper case, 8 inches high. (20 total characters)
 - d. Building Face – Emergency Door Numbers
 - 1) Location: Coordinated with architect.
 - a) Character Thickness
 - (1) 1 inch.
 - b) 1,2,3,4,5,6, 16 inches high (7 total characters)
 - c) Finish to be selected from the full range of standard powder coated options. To be high contract characters from building face location.
- B. Interior Metal Letters: Architectural grade aluminum.
 - 1. Copy Style: Helvetica Medium, unless indicated otherwise on Drawings.
 - 2. Finish:
 - a. Painted: Manufacturer's standard finish paint system; color to be as selected by Architect from manufacturer's full range. Unless noted otherwise on the drawings.
 - 3. Character Thickness:
 - a. 1 inch.
 - 4. Character Height:
 - a. 8 inches, unless indicated otherwise on Drawings.
 - 5. Copy:
 - a. Copy: **DINING** (2 signs required)
 - b. Copy: **E.B. FRINK MIDDLE SCHOOL** (1 signs required)
 - c. Copy: **GUIDANCE** (1 signs required)
 - d. Copy: **MEDIA CENTER** (2 signs required)
 - e. Copy: **GYMNASIUM** (1 signs required)
 - f. Copy: **GRADE "X" CLASSROOMS** (3 signs required; X is to be a 1 digit prefix number as determined by Architect)
 - g. Copy: **BAND** (2 signs required)
 - h. Copy: **AGRICULTURE** (2 signs required)
 - i. Copy: **ART** (2 signs required)
 - j. Copy: **CHORUS** (2 signs required)

- k. Copy: **BUSINESS** (2 signs required)
 - l. Copy: **STEM** (2 signs required)
 - m. Copy: **HEALTH** (2 signs required)
 - n. Copy: **GIRLS** (6 signs required)
 - o. Copy: **BOYS** (6 signs required)
 - p. Provide 25 additional upper case characters; copy to be provided by Owner.
- C. Interior Acrylic Letters: Architectural grade acrylic, mitered at corners.
 - 1. Copy Style: Helvetica Medium, unless indicated otherwise on Drawings.
 - 2. Finish:
 - a. Manufacturer's standard finish system; color to be as selected by Architect from manufacturer's full range. Unless noted otherwise on the drawings.
 - 3. Character Thickness:
 - a. 1 inch.
 - 4. Character Height:
 - a. 96 inches, unless indicated otherwise on Drawings.
 - 5. Copy:
 - a. 6 (1 signs required)
 - b. 7 (1 signs required)
 - c. 8 (1 signs required)

2.7 NOTIFICATION SIGNS

- A. Material: Plastic with radius corners.
 - 1. Size: 1/8 inch thick; H x W to be as required for Copy.
 - 2. Color: White background.
 - 3. Letters: 2 inch high black letters.
 - 4. Copy: **DELIVERIES ONLY** (1 sign required)

2.8 FIRE PROTECTIONS SIGNS

- A. Engineering Grade (Type I) Reflective Aluminum: Red reflective lettering on white background, unless indicated otherwise on Drawings.
- B. Comply with requirements of International Fire Code requirements.
- C. Size: As indicated on Drawings.
- D. Characters: Style and copy as required by NCBC 2018 standards.
- E. Sign Types: Sign and Copy sizes vary; refer to Drawings.
 - 1. Fire Department Connection Sign with directional arrows as required. (2 signs required)
 - a. Copy: **FDC**
 - 2. Fire Sprinkler Riser Room Sign. (2 signs required)
 - a. Copy: **FIRE SPRINKLER RISER ROOM**
 - 3. Fire Alarm Control Panel Sign. (2 signs required).
 - a. Copy: **FACP**
 - 4. Fire Hose Valve Connection Sign. (4 signs required; locations and final copy to be determined).
 - a. Copy: **FIRE HOSE VALVE CONNECTION**

2.9 WARNING STENCILS

- A. Reusable stencils for painting warning on both sides of rated walls, above hung ceiling.
 - 1. Copy: **X-HOUR RATED WALL - PROTECT ALL OPENINGS** (X is to be the actual numeral that represents the wall fire rated time designation.

2. Letter Color: Red.
3. Letter Size: 3 inches tall.
4. Spacing: Apply at 15 feet o.c. at all rated walls above ceilings on both sides of walls.
5. Quantity: Since stencils are reusable, quantity is determined by Contractor.

2.10 DEDICATION PLAQUE

- A. Dedication Plaque:
 1. Material: Cast bronze.
 2. Quantity: One.
 3. Size:
 - a. 18 x 24 inches.
 4. Border:
 - a. Single line type.
 5. Finish: Pebble texture, oxidized finish.
 6. Letter Finish: Satin polish.
 7. Mounting: Standard concealed mounting to comply with the manufacturer's written instructions for type of wall surface indicated.
 8. Characters: Style and copy to be selected by Architect and Owner from manufacturer's full range of options.
 - a. Plaque to include the following information:
 - 1) Project Name. To be determined by Architect and Owner.
 - 2) Date of Construction.
 - 3) School System Information:
 - a) Names and Title of all the Board of Education Members.
 - b) Name and Title of the School System Superintendent.
 - 4) Names and Titles of Persons to be determined by Owner. Allow for twenty (20) names and titles. Person groups may require headings such as board member groups or commission member groups or director member groups.
 - 5) Architect's Name and Location.
 - 6) Construction Manager's Name.
 - 7) General Contractor's Name.

2.11 LED SCREEN MARQUEE SIGNS

- A. Provide exterior type sign system; exposed to weather.
 1. Manufacturers:
 - a. Daktronic - LED GS6 Series.
 - b. Entech Signs - Alpha LED.
 - c. ThinkSIGN, Inc. - LED Extreme 16 Series.
 - d. Substitutions: Section 01 60 00 - Product Requirements.
 2. Basis of Design:
 - a. Entech Signs - Alpha LED: Excite.
 3. Viewable Display Screens:
 - a. Two (2) display screens.
 4. Location:
 - a. To be installed at front of property, adjacent to public roadway, and location directed by Architect.
 5. Design Requirements:
 - a. Sign System Includes:
 - 1) Sign, housing, seals, anchorage, and all components for operational sign system assembly.

- b. Sign System Design: To be designed and sealed by a licensed Professional Engineer experienced in design of work of this type and licensed in the State in which the project is located. The engineer is to certify that all applicable code requirements have been met. The engineer may be in the employ of the manufacturer of the sign system, provided the Engineer is compliant with the above registration requirement.
 - 1) Design sign system to safely withstand wind loads as indicated on Drawings for the Structural Design Criteria and in compliance with the current State Building Code for the State in which the project is located.
 - 2) Comply with the design requirements on the Drawings regarding sign system size and configuration.
 - 3) Include engineered sign system design in the Shop Drawings submittals.
- 6. LED Digital Sign: Configuration to be as indicated on Drawings and as follows.
 - a. LED Screen Display: Full color.
 - 1) LED Pixel Pitch: 16mm (0.63 inch).
 - 2) LED Pixel Color: 1 Red/1 Green/1 Blue LED per pixel.
 - 3) LED Color: PureColor, 16.7 million colors.
 - 4) Viewability & Intensity: 160 degrees horizontal/60 degrees vertical; 6500 nits.
 - 5) Digital Display Size:
 - a) Height: 50.40 inches (80 pixel rows @ 0.63 inch per row).
 - b) Width: 80.64 inches (128 pixel columns @ 0.63 inch per column).
 - c) Digital Display Matrix: 80 pixels high x 128 pixels wide.
 - b. Video Frame Rate:
 - 1) Message marquee version: 20 fps.
 - c. Dimming: 10 percent to 100 percent; automatic light sensor.
 - d. Screen Display Case:
 - 1) Material: Mill finish aluminum.
 - 2) Depth: 10.2 inches deep (including metal angle for mounting).
 - 3) IP (ingress protection) Code Rated: IP24 minimum rating in accordance with IEC 60529.
 - 4) UL Listed: UL 50 type 3R.
 - e. Programming Software and Hardware: Provide current version of Ooh!Media Pro Version software, hardware and all wiring connections required for fully operational sign system.
 - f. Controller: Embedded PC, DVI link to the sign monitor.
 - g. Connectivity to Controller: Wired Ethernet with optional wireless and DSL modem (phone company requirement).
 - h. Operating Temperature: -22 degrees to 122 degrees F (-30 degrees to 50 degrees C).
 - i. Service Access: Front-serviceable components. Display drivers (16 x 16) are to be removable without opening the front access door.
 - j. Mounting Components: Stainless steel mounting components and fasteners to be used for anchoring sign system to superstructure and foundation.
 - k. Miscellaneous Fasteners: Stainless steel.
 - l. Agency Approvals: UL 48.
 - m. Special Features Required:
 - 1) Industry standard 1GB compact flash memory for message storage.
 - 2) External temperature probe.
 - 3) DVI monitor capability.
 - 4) Protector Case: Ventless enclosure designed to reflect solar radiation and sealed against intrusion by rain, salt, fog, fumes, and dust.
 - 5) Automatic thermal protection for all electronics.

- 6) Thermostatically controlled fans for each module/case for internal air mixing.
- n. Warranty:
 - 1) Sign System Warranty: Provide manufacturer's five (5) year limited warranty.
 - 2) Programming Software and Hardware Warranty: Provide manufacturer's standard warranty; not less than one (1) year duration.

2.12 ACCESSORIES

- A. Mounting Hardware: Screws; stainless steel; countersunk phillips flat head screws.
- B. Tape Adhesive: Double sided foam tape; permanent adhesive.
- C. Back Cover Plate: Where sign must be secured to glass, acquire Architect approval prior to fabrication and installation of a Backing Cover (blank solid sign) on the opposite side of the glass. The backing cover material shall match the size, shape, base color, thickness, and finish of the sign. The intent is to hide the unsightly back view of the sign when viewed on the opposite side of the glass. (Back Cover Plate, also referenced in ROOM IDENTIFICATION SIGNS and INSTALLATION articles in this Section.)

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 73 00 - Execution: Verification of existing conditions before starting work.
- B. Verify substrate if finished to include finish coating(s).
- C. Verify adequate blocking and supports to structure are installed and ready to receive work.
- D. Verify that electrical and communications wiring requirements are provided for connectivity.

3.2 PREPARATION

- A. Section 01 73 00 - Execution: Prepare field conditions and existing construction for installation of work of this section.
- B. Prepare materials to be installed and equipment to be used during installation.

3.3 INSTALLATION

- A. Section 01 73 00 - Execution: Related to installation of Work.
- B. Install work at locations indicated on Drawings. Install signs level and plumb unless indicated otherwise.
- C. Room Identification Signs: Mount with double sided foam tape and countersunk phillips flat head screws. Screw head is to finish flush with sign surface. Finish of screw heads is to match the color and finish of the portion of the sign that the screw is seated into.
 - 1. Position of Room Identification Signs:
 - a. Signage mounting heights must conform to ADA accessibility requirements including the height of Braille notations. Mount center of sign 9 inches from strike side of door and top of sign at 60 inches from floor.
 - 2. Where sign must be secured to glass, acquire Architect approval prior to fabrication and installation of a Backing Cover (blank solid sign) on the opposite side of the glass. The backing cover material shall match the size, shape, base color, thickness, and finish of the sign. The intent is to hide the unsightly back view of the sign when

viewed on the opposite side of the glass. (Back Cover Plate, also referenced in ROOM IDENTIFICATION SIGNS and ACCESSORIES articles in this Section.)

- D. Applied Vinyl Graphics: Mount on exterior of glass doors.
- E. Custom Artwork Applied Vinyl Graphics: Prepare substrate for vinyl graphics application.
 - 1. Substrate is to be free from all contaminants that interfere with adhesion of preparation coatings and application of vinyl graphics.
 - 2. Substrate surface is to be finished to smoothness and characteristics as recommended by vinyl graphics manufacturer and as follows:
 - a. Gypsum Wallboard: To be finished to Level 5 finish.
 - b. Concrete Masonry Units: As recommended by vinyl graphics manufacturer.
 - 3. Paint Coatings: Surface of application area is to be painted prior to vinyl application.
 - a. Do not use Low VOC type paint.
 - b. Paint topcoat is to have semi-gloss sheen.
 - c. Paint primers and topcoats are to have been applied and cured for the follow duration prior to application of vinyl graphics:
 - 1) Gypsum Wallboard: Five (5) days minimum.
 - 2) Concrete Masonry Units (CMU): Seven (7) days minimum.
- F. Dimensional Letter Signs: Mount with stainless steel threaded rods into expansion shields. All hardware shall be stainless steel.
- G. Mount fire protection system signage in accordance with International Fire Code requirements.
- H. Dedication Plaque: Mount with stainless steel threaded rods into expansion shields.
- I. LED Marquee Sign: Construct and install sign system, including programming software and hardware, in compliance with the engineer's design, manufacturer's recommendations and the Drawings.

3.4 CLEANING

- A. Section 01 73 00 - Execution and Section 01 77 00 - Closeout Procedures: Clean installed work and comply with manufacturer's recommendations.

3.5 PROTECTION OF INSTALLED CONSTRUCTION

- A. Section 01 73 00 - Execution: Protecting installed construction.

3.6 DEMONSTRATION AND TRAINING

- A. Section 01 79 00 - Demonstration and Training: Provide demonstration and training to the Owner regarding operation and maintenance of components of the installed Work.
- B. LED Screen Marquee Sign:
 - 1. Demonstrate programming and operation of signage to Owner.

END OF SECTION

SECTION 10 21 13.19
PLASTIC TOILET COMPARTMENTS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes solid plastic toilet compartments and urinal screens.
- B. Related Requirements:
 - 1. Section 10 28 13 - Toilet Accessories.

1.2 REFERENCES

- A. ASTM International (ASTM):
 - 1. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
 - 2. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- B. International Code Council (ICC).
- C. National Fire Protection Association (NFPA):
 - 1. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2024.

1.3 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Coordinate Work with placement of support framing and anchors in wall.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit data on panel construction, hardware, and accessories.
- C. Shop Drawings: Indicate partition plans, door swings, elevation views, dimensions, details of wall and floor supports.
- D. Samples for Initial Selection: Two manufacturer's complete sets of color samples illustrating the full range of finishes and colors available. Submit for Architect's initial selections.
- E. Samples for Verification: From the Architect's initial selections, prepare and submit two samples for each selected finish and color; samples to be same product material type indicated for final Work; each sample 4 x 4 inches. Where finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.
- F. Manufacturer's Installation Instructions: Include special procedures and perimeter conditions requiring special attention.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS:

- A. Fire Resistance: Partition materials shall comply with the following requirements, when tested in accordance with ASTM E84:

1. Class A: 25 maximum flame spread index; 450 maximum smoke developed index.
- B. Material Fire Ratings:
 1. NFPA 286: Pass.
 2. International Code Council (ICC): Class B.

2.2 SOLID PLASTIC TOILET COMPARTMENTS

- A. Manufacturers:
 1. All American Metal Corp - AAMCO.
 2. ASI Accurate Partitions.
 3. Metpar Corporation.
 4. Partition Systems International of South Carolina (PSiSC).
 5. Scranton Products.
 6. Substitutions: Section 01 60 00 - Product Requirements.

2.3 COMPONENTS

- A. Toilet Compartments: Solid, molded thermoset, and waterproof; high-density polyethylene (HDPE) plastic panels, doors, and pilasters. Dimensions to be as indicated unless indicated otherwise on Drawings.
 1. Panels:
 - a. Thickness: 1 inch.
 - b. Width: As indicated on Drawings.
 - c. Height:
 - 1) As indicated on Drawings.
 2. Doors:
 - a. Thickness: 1 inch.
 - b. Width: Opening clearance as follows unless indicated otherwise on Drawings.
 - 1) Accessible (H/C) Compartment Doors: Out-swinging with opening clearance complying with ADA standards.
 - 2) Standard Compartment Doors: 28 inches.
 - c. Height:
 - 1) Match compartment panels.
 3. Urinal Screens:
 - a. Thickness: 1 inch.
 - b. Width: Total projection from wall to be 23 inches. Dimension includes pilaster assembly where pilaster is indicated on Drawings.
 - c. Height:
 - 1) As indicated on Drawings.
 4. Pilasters:
 - a. Thickness: 1 inch.
 - b. Widths: As required to fit space and not less than 3 inches.
 - c. Height:
 - 1) As indicated on Drawings.
 5. Color:
 - a. As selected by Architect from manufacturer's full range.

2.4 ACCESSORIES

- A. All finish metal components and accessories to be as follows, unless otherwise indicated:
 1. Satin Finish.
- B. Pilaster Shoe: Formed ASTM A666 Type 304 stainless steel, 3 inches high, concealing floor mounting and adjustment hardware. Provide adjustment for floor variations with screw jack

- through steel saddles integral with pilaster. All metal mounting and adjustment hardware to be stainless steel.
- C. Head Rails: Extruded aluminum tube, color clear anodized 1 x 1-5/8 inch size, with anti-grip profiles and cast socket wall brackets. Maximum lengths practical. Head Rails to extend to wall and be anchored securely to wall frame blocking.
- D. Vertical Brackets: Double flange type.
 - 1. Extruded aluminum; color clear anodized.
 - a. Continuous length.
- E. Attachments, Screws, and Bolts: Stainless steel, tamper proof type.
 - 1. Attaching panels and pilasters to brackets: Binding Post through-bolts and nuts.
 - 2. Attaching hardware: Binding Post through-bolts and nuts; tamper proof.
- F. Hardware:
 - 1. Material:
 - a. Stainless steel.
 - 2. Hinges:
 - a. Continuous hinges, self-closing.
 - 3. Door Latch: Slide type with exterior emergency access feature.
 - 4. Door Strike and Keeper: Include rubber bumper; mounted on pilaster in alignment with door latch.
 - 5. Door Stop: Provide door stop for each door, mounted on door face to prevent door assembly from hitting wall or other finishes. Door stop design to be coat hook type, rubber tip, four (4) screw mounting base, and finish to match other door hardware.
 - 6. Door Pulls: Provide ADA compliant door pull on each side of door for out-swinging doors.
 - 7. Provide metal heat sink at bottom of doors and partitions.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 73 00 - Execution: Verification of existing conditions before starting work.
- B. Verify field measurements are as indicated.
- C. Verify correct spacing of and between plumbing fixtures.
- D. Verify correct location and adequate support of built-in framing, anchorage, and bracing.

3.2 INSTALLATION

- A. Section 01 73 00 - Execution: Related to installation of Work.
- B. Install work level and plumb.
- C. Attach panel brackets securely to support framing and anchor points using anchor devices.
- D. Attach panels and pilasters to brackets.
- E. Locate head rail joints at pilaster center lines.
- F. Adjust pilaster shoe leveling screws to produce level and plumb panel construction on sloped floors.

3.3 ERECTION TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.

- B. Maximum Variation from Indicated Position: 1/4 inch.
- C. Maximum Variation from Plumb: 1/8 inch.

3.4 ADJUSTING

- A. Section 01 73 00 - Execution: Adjusting.
- B. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch.
- C. Adjust hinges to position in-swinging doors in partial open position (about 3 inches open) when unlatched. Return out-swinging doors to closed position.
- D. Adjust adjacent components for consistency of line or plane.

3.5 CLEANING

- A. Section 01 73 00 - Execution and Section 01 77 00 - Closeout Procedures: Clean installed work and comply with manufacturer's recommendations.
- B. Clean installed work in accordance with manufacturer's recommended materials and procedures.

3.6 PROTECTION OF INSTALLED CONSTRUCTION

- A. Section 01 73 00 - Execution: Protecting installed construction.

END OF SECTION

SECTION 10 26 23.14

WALL PROTECTION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Wall Corner Guards.

1.2 REFERENCE STANDARDS

- A. ASTM International (ASTM):
 - 1. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics; 2023, Editorial Revision 2023.
 - 2. ASTM D543 - Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents; 2021.
 - 3. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
 - 4. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, Editorial Revision 2021.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate installation of appropriate strength concealed blocking with the anchoring requirements for attaching the work of this Section to substrate.
- C. Coordinate installation of wall coating and wall cover finishes to be complete prior to installation of the work of this Section.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit data on unit construction, sizes, configuration, jointing methods and locations when applicable, and attachment method.
- C. Shop Drawings: Submit shop drawings including profiles, elevations, locations, attachment to substrate, and accessories.
- D. Samples for Initial Selection: Two manufacturer's color charts illustrating the full range of finishes and colors available for products with factory-applied color finishes; submit for Architect's initial selections.
- E. Samples for Verification: From the Architect's initial selections, prepare and submit two samples for each selected finish and color; samples on same product material type indicated for final Work; each sample 4 x 4 inches. Where finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.
- F. Manufacturer's Installation Instructions: Indicate special installation criteria and interface with adjacent components.

1.5 QUALITY ASSURANCE

- A. Provide protection systems of each type from a single source and manufacturer.

1.6 QUALIFICATIONS

- A. Manufacturer Qualifications: Company specializing in manufacturing Products specified in this Section with minimum seven (7) years documented experience.
- B. Installer Qualifications: Company specializing in performing work of this Section and with minimum five (5) years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Deliver products in manufacturer's original packaging. Store materials in a dry, protected, well-vented area. Inspect product upon receipt and report damaged material immediately to delivering carrier and note such damage on the carrier's freight bill of lading.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with the following unless otherwise indicated:
 - 1. Impact Strength: Applicable provisions of ASTM D256.
 - 2. Lateral Impact: Resists lateral impact force of 100 lbs (445 N) at any point without damage or permanent set.
 - 3. Surface Burning Characteristics: Flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
 - 4. Chemical and Stain Resistance: Applicable provisions of ASTM D543.
 - 5. Fungal Resistance: Passes ASTM G21 testing.

2.2 WALL CORNER GUARDS

- A. Metal Wall Corner Guards:

Architect, at the time this work was added to spec (Hoke HS 2023), the Architect provided no acceptable mfrs or BOD. Verify that mfrs listed are acceptable to your design and/or add others per your design.

- 1. Manufacturers:
 - a. Construction Specialties, Inc.
 - b. Inpro.
 - c. Wallprotex.
 - d. Western Fabricating, LLC.
 - e. Substitutions: Section 01 60 00 - Product Requirements.
- 2. Basis of Design: Inpro.
- 3. Corner Guard Material: Stainless Steel, Type 304.
- 4. Thickness:
 - a. 16 gauge.
- 5. Edges: Factory formed edges to fit snug to wall surface.
- 6. Attachment:
 - a. Fasteners: Stainless steel of length required to anchor corner guard.
 - 1) Screw heads to be flat head, Phillips drive style.
- 7. Lengths: One piece.
 - a. As indicated on Drawings.
- 8. Width of Wings:
 - a. 2 inches.
- 9. Corners:

- a. 1/8 inch radius.
- 10. Finish:
 - a. No. 4, stainless steel.
- 11. Protective Film: Factory apply removable film to protect finish during handling.
- 12. Application Locations:
 - a. As indicated on Drawings.

Architect, the following alternative allows you to indicate quantities with locations to be determined later. Simply indicate here your quantities/wall types and delete the "...Drawings" paragraph above.

- b. Locations to be directed by Architect.

2.3 Quantity of ____ to be installed on metal framed wall corners ACCESSORIES

- A. Accessories are to be appropriate to component, substrate and as indicated in this Section.
 - 1. Mounting Brackets and Attachment Hardware: As recommended by manufacturer.

2.4 FABRICATION

- A. Fabricate components free of visual distortion and free of defects.
- B. Fabricate components with tight joints, corners, and seams.
- C. Pre-drill holes for attachment.
- D. End closures are to be factory fabricated to match components.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 73 00 - Execution: Verification of existing conditions before starting work.
- B. Verify that rough openings, concealed blocking, and anchors are correctly sized and located.
- C. Verify that field measurements are as required.
- D. Verify that surfaces and conditions are ready to accept the Work of this Section.
- E. Examine products to be installed for damage and other conditions detrimental to completion of the Work.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Section 01 73 00 - Execution: Prepare field conditions and existing construction for installation of Work of this Section.
- B. Prepare materials to be installed and equipment to be used during installation.

3.3 INSTALLATION

- A. Section 01 73 00 - Execution: Related to installation of Work.
- B. Install the Work in compliance with the design requirements, applicable codes, manufacturer's recommendations, and the Contract Documents.
- C. Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position to supporting construction.
- D. Position bottom of corner guards 4 inches above finished floor unless indicated otherwise.

3.4 TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Maximum Variation From Required Height: 1/4 inch (6 mm).

3.5 CLEANING

- A. Section 01 73 00 - Execution and Section 01 77 00 - Closeout Procedures.
- B. Clean installed Work in accordance with manufacturer's recommendations including cleaning procedures and materials.

3.6 PROTECTION OF INSTALLED CONSTRUCTION

- A. Section 01 73 00 - Execution: Protecting installed construction.
- B. Protect installed construction from damage and unauthorized tampering.

END OF SECTION

SECTION 10 28 00
TOILET ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Toilet room accessories.
 - 2. Shower accessories.
 - 3. Utility room accessories.
- B. Related Requirements:
 - 1. Section 04 20 00 - Unit Masonry.
 - 2. Section 06 10 53 - Miscellaneous Rough Carpentry: Blocking in framed walls.
 - 3. Division 09 - Finishes: Sections describing wall materials and finishes.
 - 4. Division 10 - Specialties: Sections describing Toilet Compartments.
 - 5. Division 26 - Electrical: Construction related to electric devices.

1.2 REFERENCES

- A. Americans with Disabilities Act (ADA):
 - 1. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; current edition.
- B. ASTM International (ASTM):
 - 1. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
 - 2. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service, 2022.
 - 3. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
 - 4. ASTM A666 - Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar, 2023.
 - 5. ASTM B86 - Standard Specification for Zinc and Zinc-Aluminum (ZA) Alloy Foundry and Die Castings; 2023.
 - 6. ASTM B456 - Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium; 2017, Reapproval 2022.
 - 7. ASTM C1036 - Standard Specification for Flat Glass; 2021.
 - 8. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.
 - 9. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2024.
 - 10. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs; 2022.

1.3 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Coordinate the Work with placement of internal wall reinforcement and reinforcement of toilet partitions to receive anchor attachments.
- C. Coordinate electrical requirements with electrical service construction.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit data on accessories describing size, finish, details of function, attachment methods.
- C. Manufacturer's Installation Instructions: Submit special procedures, conditions requiring special attention.

1.5 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide products of same manufacturer unless otherwise acceptable to Architect.
 - 1. Exception: Products whose Basis of Design manufacturer differs from majority of other indicated products.

1.6 SPARE PARTS AND MAINTENANCE PRODUCTS

- A. Section 01 60 00 - Product Requirements: Extra materials, spare parts, and maintenance products.
 - 1. Two (2) keys for each accessory.
 - 2. One (1) master key for all accessories.
 - 3. Two (2) of each type of dispenser of paper and liquid products.
 - 4. Two (2) of each specialty tool required for installation and maintenance.
 - 5. Ten percent (10%) extra nuts, bolts, screws, and other similar installation hardware.
 - 6. Two (2) of each type of electric hand dryer.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. All devices to be compliant with applicable codes and ADA standards.
- B. Manufactured and shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
 - 1. Grind welded joints smooth.
 - 2. Fabricate units made of metal sheet of seamless sheets, with flat surfaces.
- C. Design grab bars, attachments, anchors and provide blocking to resist minimum 250 lbs concentrated load applied at any point in any direction.
- D. Keys: Furnish two (2) keys for each accessory to Owner; master key lockable accessories.

2.2 TOILET AND BATH ACCESSORIES

- A. Manufacturers:
 - 1. American Specialties, Inc. (ASI).
 - 2. Bobrick Washroom Accessories.
 - 3. Bradley Corporation.
 - 4. Electric Hand Dryers:
 - a. Bobrick Washroom Accessories.
 - b. Dyson.
 - c. Excel Dryer, Inc.
 - d. Pinnacle Dryer Corporation.
 - 5. Substitutions: Section 01 60 00 - Product Requirements.

2.3 MATERIALS

- A. Stainless Steel Sheet: ASTM A666, Type 304.
- B. Stainless Steel Tubing: ASTM A269/A269M, Grade T316.
- C. Galvanized Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating.
- D. Zinc Alloy: Die cast, ASTM B86.
- E. Mirror Glass:
 - 1. Fully tempered safety glass, ASTM C1048; and ASTM C1036 Type I, Class 1, Quality Q2, with silvering as required.
- F. Adhesive: Two component epoxy type, waterproof.
- G. Fasteners, Screws, and Bolts: Stainless steel, ASTM F593; tamper-proof, security type.
- H. Expansion Shields: Fiber, lead, stainless steel, or rubber as recommended by accessory manufacturer for component and substrate.

2.4 TOILET ROOM ACCESSORIES

- A. Toilet Tissue Dispenser (TD): Open roll type with both rolls accessible.
 - 1. Furnished by Owner. Installed by Contractor.
 - 2. Double Roll Type: Surface mounted bracket, satin finished cast aluminum brackets.
 - a. Controlled Delivery Type: To be in all stalls and toilets except ADA accessible stalls and toilets. Eccentric-shaped plastic spindles for 1/2 revolution delivery, designed to prevent theft of tissue roll.
 - 1) Basis of Design:
 - a) [Bobrick B-274](#) (surface mounted).
 - b. Non-Controlled Delivery Type: To be in all ADA accessible stalls and toilets. Eccentric-shaped plastic spindles, designed to prevent theft of tissue roll.
 - 1) Basis of Design:
 - a) [Bobrick B-2740](#) (surface mounted).
- B. Paper Towel Dispenser (PTD):
 - 1. Furnished by Owner. Installed by Contractor.
 - 2. In addition to locations indicated on Drawings, provide PTD at all sinks where PTD or EHD is not indicated.
 - 3. Folded paper type, stainless steel, hinged door with tumbler lock, minimum capacity of 350 C-fold towels.
 - a. Basis of Design:
 - 1) [Bobrick B-262](#) (surface mounted, view slot).
- C. Soap Dispenser (SD):
 - 1. Furnished by Owner. Installed by Contractor.
 - 2. In addition to locations indicated on Drawings, provide SD at all sinks where SD is not indicated.
 - 3. Liquid soap dispenser; stainless steel body, back, lid and working parts; lid hinged and special key access; push type soap valve; window gage refill indicator; 40 ounces minimum capacity.
 - a. Basis of Design:
 - 1) [Bobrick B-4112](#) (surface mounted, horizontal tank).
- D. Framed Mirrors (MIR):
 - 1. Mirror Glass: 1/4 inch thick tempered mirror glass; ASTM C1048, abrasion-resistant coated mirror.

2. Frame: Stainless steel; 3/4 inch angle shapes (0.05 inch thick); mitered and welded and ground corners; satin finish; tamperproof hanging system.
 3. Backing: Full-mirror sized, minimum 0.03 inch galvanized steel sheet and non-absorptive filler material.
 4. Size and Configuration: As indicated on Drawings.
 5. Basis of Design:
 - a. [Bobrick B-2908 Series](#).
- E. Grab Bars (GB):
1. Stainless steel, 1-1/2 or 1-1/4 inch outside diameter, minimum 0.05 inch (18 gauge) wall thickness, safety grip peened grasping surface finish; concealed flange mounting; 1-1/2 inches clearance between wall and inside of grab bar.
 2. Push/Pull Point Load: 250 pound-force (1112 N), minimum.
 3. Length and Configuration: As indicated on Drawings.
 4. Basis of Design:
 - a. [Bobrick B-6806.99](#) (1-1/2 O.D.).
- F. Sanitary Napkin Disposal Unit (SND):
1. Stainless steel; self-closing door; locking bottom panel with full-length stainless steel piano-type hinge and removable receptacle.
 2. For thru-partition, 2 side access units, coordinate fit with toilet partition thickness.
 3. Basis of Design:
 - a. [Bobrick B-254](#) (surface mounted).
- G. Electric Hand Dryers (EHD): Coordinate electrical requirements.
1. Operation: Automatic sensor-operated on and off.
 2. Air Nozzle: Fixed downward direction.
 3. Basis of Design:
 - a. ADA Compliant - Surface Mount:
 - 1) [Dyson Airblade V](#) - Polycarbonate case; No heated air.
- H. Baby Changing Table (BCT):
1. Basis of Design:
 - a. [Bradley 963](#) Series: Plastic; color as selected by Architect (surface mounted).
- I. Adult Changing Table (ACT):
1. Basis of Design:
 - a. [Koala Care KB3000](#) : Surface mounted.
- J. Coat Hook (CH): Solid aluminum casting, matte finish; rubber bumper protects wall and partition surfaces; 4 screws attachment base.
1. Provide coat hook on each toilet compartment door, inside compartment.
 - a. Secure coat hooks with machine screws from hook side and pan head sleeve nuts (hex socket) from opposite end for thru-bolt assembly.
 2. Provide coat hooks in locations indicated on Drawings.
 3. Basis of Design:
 - a. [Bobrick B-212](#).

2.5 SHOWER ACCESSORIES

- A. Grab Bars (GB):
1. Stainless steel, 1-1/2 or 1-1/4 inch outside diameter, minimum 0.05 inch (18 gauge) wall thickness, safety grip peened grasping surface finish; concealed flange mounting; 1-1/2 inches clearance between wall and inside of grab bar.
 2. Push/Pull Point Load: 250 pound-force (1112 N), minimum.
 3. Length and Configuration: As indicated on Drawings.
 4. Basis of Design:

- a. Bobrick Washroom Accessories.
- B. Shower Curtain Rod (SCR): Stainless steel tube, extra heavy duty; 1-1/4 inch outside diameter, 0.05 inch (18 gauge) wall thickness, satin-finished, with satin-finished stainless steel flanges, for concealed mounting.
 - 1. Include shower curtain for each rod; opaque vinyl, 0.008 inch thick minimum, matte finish, with antibacterial treatment; flameproof and stain-resistant; 6 inches wider than rod length.
 - 2. Include shower curtain hooks with each shower rod and curtain; stainless steel Type 304 wire, pear-shaped; sized to fit curtain rod diameter.
 - 3. Basis of Design:
 - a. [Bobrick B-6047 Series](#) (curtain rod).
 - b. [Bobrick 204 Series](#) (curtain).
 - c. [Bobrick 204-1](#) (curtain hooks).
- C. Robe Hook (RH): Stainless steel; single prong; rectangular-shaped hook; satin finish; concealed mounting with vandal resistant escutcheon.
 - 1. Provide one (1) per each shower; locate outside stall on wall 16 inches from stall.
 - 2. Basis of Design:
 - a. [Bobrick B-76717](#).
- D. Shower Seat (SS): Folding type; surface wall-mounted; welded tubular seat frame, structural support members, hinges and mechanical fasteners of Type 304 stainless steel, rectangular seat; supports 500 lbs, minimum.
 - 1. Seat: Phenolic or polymeric composite one-piece seat or seat slats, of color as selected by Architect.
 - 2. Basis of Design:
 - a. [Bobrick B-5191](#).

2.6 UTILITY ROOM ACCESSORIES

- A. Mop and Broom Holder (MH): 0.05 inch thick (18 gage), Type 304 stainless steel.
 - 1. Mop Holders: Four (4) spring-loaded rubber cam holders, holds mops 8 inches from wall.
 - 2. Shelf: 18 gage, 8 inches deep.
 - 3. Rag Hooks: One each, midway between mop holders.
 - 4. Length: 36 inches.
 - 5. Basis of Design:
 - a. [Bobrick B-224 x 36](#).
- B. Mop Sink Wall Splash Guard: 16 gage, Type 304 Stainless steel.
 - 1. Provide wall guard at each mop sink in project.
 - 2. Wall guard height to span from mop sink top rim to 8 inches above water supply pipe wall penetrations, and not less than 36 inches above mop sink top rim.
 - 3. Fabrication: Custom fit to wall configuration; one piece fabrication; configured to protect all wall surfaces adjacent to mop sink rim; all edges to be single hemmed; corners to be ground smooth.
 - 4. Fasteners: Stainless steel, low profile pan head screws with EPDM bonded seal washer.
 - 5. Installation: Ensure that mop sink rim has been fully sealed to wall prior to installation of wall guard. At frame walls, ensure that adequate blocking is behind wall finish to engage with fasteners. Bottom of wall guard to be 1/8 inch above mop sink rim (allowing gap for application of sealant bead). After attaching wall guard to wall, apply sealant around entire perimeter of wall guard.

2.7 FACTORY FINISHING

- A. Stainless Steel: No. 4 satin brushed finish, unless otherwise noted.
- B. Chrome/Nickel Plating: ASTM B456, Type SC 2 polished finish, unless otherwise noted.
- C. Baked Enamel: Pretreat to clean condition, apply one coat primer and minimum two coats epoxy baked enamel.
- D. Powder-Coated Steel: Clean, degrease, and neutralize. Follow immediately with a phosphatizing treatment, prime coat, and two finish coats of powder coat enamel.
- E. Galvanizing for Items Other than Sheet: Comply with ASTM A123/A123M; galvanized ferrous metal and fastening devices; minimum 1.2 oz/sq ft coating thickness; galvanized after fabrication.
- F. Shop Primed Ferrous Metals: Pretreat and clean, spray apply one coat primer and bake.
- G. Back paint components where contact is made with building finishes to prevent electrolysis.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 73 00 - Execution: Verification of existing conditions before starting work.
- B. Verify exact location of accessories for installation.
- C. Verify that internal wall reinforcement and reinforcement of toilet partitions, to receive anchor attachments, is installed and adequate to attach the work securely.
- D. Coordinate electrical requirements with electrical service construction.
- E. Verify field measurements are as indicated on product data instructed by manufacturer.

3.2 PREPARATION

- A. Section 01 73 00 - Execution: Prepare field conditions and existing construction for installation of work of this section.
- B. Prepare materials to be installed and equipment used during installation.
- C. Deliver inserts and rough-in frames to site for timely installation.
- D. Provide templates and rough-in measurements as required.

3.3 INSTALLATION

- A. Section 01 73 00 - Execution: Related to installation of Work.
- B. Install plumb and level, securely and rigidly anchored to substrate.
- C. Mounting Heights and Locations: As required by accessibility regulations and as indicated on Drawings.

3.4 ADJUSTING

- A. Section 01 73 00 - Execution: Starting, testing, adjusting, and balancing.
- B. Adjust and test installed Work for proper functionality.

3.5 CLEANING

- A. Section 01 73 00 - Execution and Section 01 77 00 - Closeout Procedures: Related to cleaning.
- B. Clean installed Work and comply with manufacturer's recommendations.

3.6 PROTECTION OF INSTALLED CONSTRUCTION

- A. Section 01 73 00 - Execution: Protecting installed construction.
- B. Protect installed Work from damage.

END OF SECTION

SECTION 10 44 00
FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fire extinguishers.
 - 2. Fire extinguisher cabinets.
 - 3. Accessories.
- B. Related Requirements:
 - 1. Section 04 20 00 - Unit Masonry: Walls for mounting equipment.
 - 2. Section 09 21 16 - Gypsum Board Assemblies: Walls for mounting equipment.

1.2 REFERENCE STANDARDS

- A. ASTM International (ASTM):
 - 1. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2023a.
- B. Factory Mutual (FM):
 - 1. FM (AG) - FM Approval Guide; Current Edition.
- C. National Fire Protection Association (NFPA):
 - 1. NFPA 10 - Standard for Portable Fire Extinguishers; 2022.
- D. Underwriters Laboratories Inc. (UL):
 - 1. UL (DIR) - Online Certification Directory; Current Edition.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data:
 - 1. Submit extinguisher operational features, full range of colors and finishes, and anchorage details.
 - 2. Submit cabinet product data, operational features, full range of colors and finishes, and anchorage details.
- C. Shop Drawings:
 - 1. Indicate mounting measurements for brackets, locations, and fire ratings.
 - 2. Indicate cabinet physical dimensions, rough-in measurements for recessed cabinets, installation measurements for cabinets. Locations, and fire ratings.
- D. Manufacturer's Installation Instructions: Submit special criteria and wall opening coordination requirements.
- E. Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 78 23 - Operation and Maintenance Data.
- B. Operation and Maintenance Data: Submit test, refill or recharge schedules and recertification requirements.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.
- B. Do not install extinguishers when ambient temperature is capable of freezing extinguisher ingredients.

PART 2 PRODUCTS

2.1 FIRE EXTINGUISHERS

- A. Manufacturers:
 - 1. Activar Construction Products Group Inc. - JL Industries.
 - 2. Ansul, a Tyco Business.
 - 3. Kidde, a unit of United Technologies Corporation.
 - 4. Nystrom, Inc.
 - 5. Potter-Roemer.
 - 6. Pyro-Chem, a Tyco Business.
 - 7. Substitutions: Section 01 60 00 - Product Requirements.
- B. Basis of Design: Activar Construction Products Group Inc. - JL Industries.
- C. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
 - 1. Provide extinguishers labeled by UL (DIR) or FM (AG) for purpose specified and as indicated.
- D. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gauge.
 - 1. Class: A:B:C type.
 - 2. Size: 10 pounds.
 - 3. Finish: Baked polyester powder coat, red color.
 - 4. Temperature range: Minus 40 degrees F to 120 degrees F.
- E. Wet Chemical Type Fire Extinguishers: Stainless steel tank, with pressure gauge.
 - 1. Class: K type.
 - 2. Size: 1.8 gallons.
 - 3. Finish: Polished stainless steel.
 - 4. Temperature range: Minus 20 degrees F to 120 degrees F.

2.2 FIRE EXTINGUISHER CABINETS

- A. Manufacturers:
 - 1. Activar Construction Products Group, Inc. - JL Industries.
 - 2. Kidde, a unit of United Technologies Corp.
 - 3. Larsen's Manufacturing Company.
 - 4. Nystrom Inc.
 - 5. Potter-Roemer.
 - 6. Substitutions: Section 01 60 00 - Product Requirements.
- B. Basis of Design: Activar - JL Industries - Academy Series.
- C. Fire Extinguishers Cabinets: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
 - 1. Fire Rating: Listed and labeled in accordance with ASTM E814 requirements for fire resistance rating of walls where being installed.

2. Provide fire extinguisher cabinets classified and labeled by UL for purpose specified and indicated.
- D. Non-Fire Rated Cabinet Construction:
 1. Formed aluminum; 0.036 inch thick base metal.
- E. Fire Rated Cabinet Construction: Fire rating to be as required by rating of wall construction.
 1. Steel; double wall or outer and inner boxes with minimum 5/8 inch thick fire barrier material.
- F. Cabinet Trim and Installation Configuration:
 1. Semi-Recessed Trim Type:
 - a. 2-1/2 inch projection from wall surface; rolled edge; 1-3/4 inch face width.
- G. Cabinet Tub Size: Provide tube size as needed to accommodate required extinguisher and accessories content.
- H. Door: Minimum 0.036 inch thick base metal formed to 5/8 inch thickness, reinforced for flatness and rigidity with nylon catch. Continuous hinge door for 180 degrees opening. Pull to be surfaced mounted handle type with two through-door bolts.
 1. Glazing: Acrylic plastic, clear, 1/8 inch thick, flat shape and set in resilient channel glazing gasket.
 - a. Full door glazed panel.
 2. Signage:
 - a. Die cut vinyl letters, self adhering; uppercase Helvetica font; vertical descending composition.
 - 1) Application:
 - a) Reverse adhered on inside face of door glazing panel.
 - 2) Letters color to be as selected by Architect from full range of options.
- I. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors; no visible fasteners on exterior of cabinet.
- J. Weld, fill, and grind joinery and components smooth.
- K. Finishes:
 1. Non-Fire Rated Cabinets:
 - a. Cabinet Exterior Trim and Door Finish:
 - 1) Aluminum Construction: Clear anodized finish.
 - b. Cabinet Tub Finish: Match exterior material and finish.
 2. Fire Rated Cabinets:
 - a. Cabinet Exterior Trim, Door, and Tub Finish:
 - 1) Steel Construction: Powder coat finish; color as selected by Architect from manufacturer's full range.

2.3 ACCESSORIES

- A. Extinguisher Brackets:
 1. Formed stainless steel, satin finish.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 73 00 - Execution: Verification of existing conditions before starting work.
- B. Verify locations and mounting heights for each unit.
- C. Verify rough openings for cabinets are correctly sized and located.

3.2 PREPARATION

- A. Section 01 73 00 - Execution: Prepare field conditions and existing construction for installation of work of this Section.
- B. Prepare materials to be installed and equipment to be used during installation.

3.3 INSTALLATION

- A. Section 01 73 00 - Execution: Related to installation of Work.
- B. Install cabinets plumb and level in wall openings and as indicated on Drawings.
- C. Install wall brackets at location indicated on Drawings.
- D. Secure rigidly in place.
- E. Install extinguishers and accessories in cabinets or on wall brackets as indicated on Drawings.

3.4 CLEANING

- A. Section 01 73 00 - Execution and Section 01 77 00 - Closeout Procedures.
- B. Clean installed work in accordance with manufacturer's recommendations including cleaning procedures and materials.

3.5 PROTECTION OF INSTALLED CONSTRUCTION

- A. Section 01 73 00 - Execution: Protecting installed construction.
- B. Protect installed construction from damage.

3.6 SCHEDULES

- A. Fire Extinguisher Cabinet Locations: As indicated on Drawings.
 - 1. In fire rated construction, provide fire rated cabinets in compliance with the requirements for the fire rated construction.
- B. Fire Extinguisher Locations by Type:
 - 1. Type K and Type A:B:C fire extinguishers:
 - a. Kitchens (bracket installed if no cabinet indicated).
 - 2. Type A:B:C fire extinguishers:
 - a. All locations not indicated to be other Type. Areas include, but are not limited to the following:
 - 1) Corridors.
 - 2) Assembly Areas.
 - 3) Work Areas.
 - 4) Mechanical Rooms (bracket installed if no cabinet indicated).
 - 5) Electrical Rooms (bracket installed if no cabinet indicated).
- C. Fire Extinguisher Quantities by Type:
 - 1. Type K: Two (2) each.
 - 2. Type A:B:C: Thirty Five (35) each.

END OF SECTION

SECTION 10 51 13
METAL LOCKERS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes factory manufactured metal lockers and accessories.
 - 1. Kitchen Staff Lockers.
 - 2. Athletic Lockers.
 - 3. Benches.

1.2 REFERENCES

- A. Americans with Disabilities Act (ADA):
 - 1. ADA Standards - ADA Standards for Accessible Design; Current Edition.
- B. ASTM International (ASTM):
 - 1. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
 - 2. ASTM A1008/A1008M - 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; 2023.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate locker plan layout, elevations, filler panels, ADA compliant lockers, numbering plan, and combination lock code.
 - 1. Indicate layout and dimensions for locker benches.
- C. Product Data: Submit data on locker types, sizes, and accessories.
- D. Samples for Initial Selection: Two manufacturer's color charts illustrating the full range of finishes and colors available for products with factory-applied finishes; submit for Architect's initial selections.
- E. Samples for Verification: From the Architect's initial selections, prepare and submit two samples for each selected finish and color; samples on same product material type indicated for final Work; each sample 4 x 4 inches. Where finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.
- F. Manufacturer's Installation Instructions: Submit installation template and attachment devices.

1.4 DELIVERY, STORAGE, AND PROTECTION

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Protect components and accessories from warping, moisture, and other damage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers:
 - 1. Art Metal Products.
 - 2. ASI Storage Solutions.
 - 3. List Industries, Inc.
 - 4. Lyon Workspace Products.
 - 5. Penco Products, Inc.
 - 6. Republic Storage Systems Company.
 - 7. Tennsco Storage.
 - 8. Substitutions: Section 01 60 00 - Product Requirements.

2.2 LOCKER TYPES

- A. Kitchen Staff Lockers (Type LK-KS):
 - 1. Class: Conventional.
 - 2. Configuration: Refer to Drawings for locker configurations.
 - 3. Width:
 - a. 12 inches.
 - 4. Depth:
 - a. 15 inches.
 - 5. Height:
 - a. 72 inches; sloped top.
 - 6. Tiers:
 - a. Double tier.
 - 7. Base Mounting:
 - a. Concrete Base with face finish to match adjacent wall base in room.
 - 8. Base Height: 4 inches, unless indicated otherwise on Drawings.
 - 9. Ventilation Method:
 - a. Door louver vents at upper and lower portion of door.
 - 10. Accessories:
 - a. Two (2) double prong wall hooks.
 - b. Rubber door silencers.
 - c. Metal plate formed shelf.
 - 11. Metal: Steel.
 - a. Sides, Bottom, Top, and Shelf: 16 gauge.
 - b. Back: 18 gauge.
 - c. Doors Face and Frame: 14 gauge.
 - d. Hinges: 0.074 inch thick, 2 inches long or continuous, five-knuckle.
 - e. Base and Trim: 18 gauge.
- B. Athletic Lockers (Type LK-A): Includes Changing Room lockers.
 - 1. Class: Conventional.
 - 2. Configuration: Refer to Drawings for locker configurations.
 - 3. Width:
 - a. 15 inches.
 - 4. Depth:
 - a. 12 inches.
 - 5. Height:
 - a. 72 inches; sloped top.
 - 6. Tiers:
 - a. Double tier.
 - 7. Base Mounting:

- a. Concrete Base with face finish to match adjacent wall base in room.
- 8. Base Height: 6 inches, unless indicated otherwise on Drawings.
- 9. Ventilation Method:
 - a. Diamond shaped perforations on sides and door; 3/4 x 1-1/2 inch perforations.
- 10. Accessories:
 - a. Two (2) double prong wall hooks.
 - b. Rubber door silencers.
 - c. Metal plate formed shelf.
- 11. Metal: Steel.
 - a. Sides, Bottom, Top, and Shelf: 16 gauge.
 - b. Back: 18 gauge.
 - c. Doors Face and Frame: 14 gauge.
 - d. Hinges: 0.074 inch thick, 2 inches long or continuous, five-knuckle.
 - e. Base and Trim: 18 gauge.

2.3 LOCKER FABRICATION

- A. General:
 - 1. Factory Assembled Construction: Made of formed sheet steel; metal edges finished smooth without burrs; finished inside and out.
 - a. Locker Body Components: Formed and flanged from steel sheet of the following type and thicknesses indicated:
 - 1) Commercial Steel (CS), Type B, supplied for exposed applications and complying with ASTM A1008/A1008M and the following:
 - a) Zinc-Coated by the Hot-Dip Process: Comply with ASTM A653/A653M:
 - (1) Coating designation G60/Z180.
 - (2) Coating designation G90/Z275.
 - b) Uncoated.
 - 2. ADA Compliance: Applies to all locker designated as ADA accessible.
 - a. Comply with ICC A117.1 and ADA Standards.
 - b. Decal with international symbol of accessibility on face of locker.
 - c. Shelves: Adjustable type.
 - d. Latches and Locks: ADA compliant.
 - 3. Provide locker units constructed with components capable of being securely anchored to the supporting substrate. Reinforce components as required to anchor units to withstand imposed loads.
 - 4. Provide metal top, end, closure, and filler panels; 16 gauge.
 - 5. Finish edges smooth without burrs.
 - 6. Finish Type: Metal finish to be on all surfaces and components.
 - a. Powder coat; minimum 2 mil dry film thickness.
 - 7. Colors:
 - a. Kitchen Staff Lockers (Type LK-KS): Penco 073 Champagne or manufacturer's equal.
 - b. Athletic Lockers (Type LK-A): Penco 055 Shamrock or manufacturer's equal.
- B. Locker Body:
 - 1. Formed and flanged; with steel stiffener ribs; electric spot welded.
 - 2. Provide finished heavy gauge steel end panel for exposed end lockers.
- C. Frames: Formed channel shape, welded, and ground flush, welded to body, resilient gaskets and latching for quiet operation.

- D. Doors: Hollow channel construction, 1-3/16 inch thick; welded construction, channel reinforced top and bottom with intermediate stiffener ribs, grind, and finish edges smooth. Provide rubber silencers.
- E. Hinges: Welded to door frame and securely fastened to door.
 - 1. Two hinges for doors less than 42 inches high.
 - 2. Three hinges for doors 42 - 60 inches high.
 - 3. Continuous hinge for doors greater than 60 inches high, or 20 inches wide, or lockers located in athletic/changing room locations, or workshop locations.
- F. Door Number Plates: Provide rectangular shaped aluminum plates. Form numbers 3/8 inch high of block font style, in contrasting color. Provide ADA designation for ADA compliant lockers

2.4 LOCKER LATCHES AND LOCKS

- A. Latch Types: Recessed type; formed stainless steel; unless indicated otherwise.
 - 1. Recessed type is always to be ADA compliant, even if locker is not designated to be ADA accessible.
- B. Lock Types:
 - 1. Pad Locks (Type-PL):
 - a. Master combination lock.
 - b. Five preset combination changes.
 - c. Master keyed in front/center of spin-dial.
 - d. Master keys.

2.5 BENCHES

- A. Dimensions: As indicated on Drawings.
- B. Components:
 - 1. Seat: Laminated solid wood strips, birch or maple wood, sealed and varnished.
 - 2. Pedestals:
 - a. Stationary type.
 - 3. Metal Components:
 - a. Stainless steel, satin finish.
 - 4. Fasteners and Anchors: Stainless steel.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 73 00 - Execution: Verification of existing conditions before starting work.
- B. Verify that conditions, finishes, substrates, and anchoring construction are adequate and acceptable to receive Work of this Section.

3.2 PREPARATION

- A. Section 01 73 00 - Execution: Prepare field conditions and existing construction for installation of work of this Section.
- B. Prepare materials to be installed and equipment to be used during installation.

3.3 INSTALLATION

- A. Section 01 73 00 - Execution: Related to installation of Work.

- B. Install lockers plumb and square. Joints between adjacent surfaces to be flush hairline joints.
- C. Secure lockers with anchor devices to suit substrate construction.
 - 1. Minimum Pullout Force: 100 lb.
- D. Bolt adjoining locker units together to provide rigid installation.
- E. Install finished accessories, end panels, filler panels, and bases.
- F. Replace components that are damaged, not fitting properly or not operating smoothly.

3.4 ADJUSTING

- A. Section 01 73 00 - Execution: Starting, testing, adjusting, and balancing.
- B. Adjust doors and latches to operate smoothly and without binding.
- C. Adjust built-in locks (if any) to operate smoothly and without binding of dial or key.
- D. Touch-up with factory-supplied paint and repair or replace damaged products before substantial completion.

3.5 CLEANING

- A. Section 01 73 00 - Execution and Section 01 77 00 - Closeout Procedures: Related to cleaning.
- B. Clean locker interiors and exterior surfaces.

3.6 PROTECTION OF INSTALLED CONSTRUCTION

- A. Section 01 73 00 - Execution: Protecting installed construction.
- B. Protect the Work from damage.

END OF SECTION

SECTION 10 56 13
METAL STORAGE SHELVING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Metal storage shelving units.

1.2 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit data for all components.
- C. Shop Drawings: Indicate shelving unit components, assembly, anchorage, elevations, dimensions, and room plan layout for each location. Include schedule list indicating room locations and quantity of shelving units.
- D. Samples for Initial Selection: Two manufacturer's color charts illustrating the full range of finishes and colors available for products with factory-applied finishes; submit for Architect's initial selections.
- E. Samples for Verification: From the Architect's initial selections, prepare and submit two samples for each selected finish and color; samples on same product material type indicated for final Work; each sample 4 x 4 inches. Where finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.
- F. Manufacturer's Installation Instructions: Indicate special precautions for installation.

1.3 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five (5) years documented experience.
- B. Installer: Company specializing in performing work of this section with minimum three (3) years documented experience.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept components on site in manufacturer's original packaging. Inspect for damage.

PART 2 PRODUCTS

2.1 METAL STORAGE SHELVING

- A. Manufacturers:
 - 1. Lyon Workspace Products.
 - 2. Penco Products.
 - 3. Spacesaver.
 - 4. Tensco Corp.
 - 5. Substitutions: Section 01 60 00 - Product Requirements.

- B. Metal Storage Shelving: Factory-formed, field-assembled, freestanding, upright metal storage shelving system; designed for shelves to span between and be supported by corner posts, with shelves adjustable over the entire height of shelving unit. Shelving units to be engineered to safely support cumulative loaded shelf loads indicated.
- C. Components:
 - 1. Posts: Tubular, L-shaped, and T-shaped, cold-rolled steel, minimum 16 gauge thick, punched on 1-1/2 inch centers. Engineered to safely support loads indicated.
 - 2. Shelves: Box formed edges, minimum 20 gauge thick steel. Engineered to support the following loads:
 - a. Minimum 800 lbs for shelf size of 36W x 18D inches or 36W x 24D inches.
 - b. Minimum 550 lbs for shelf size of 48W x 18D inches or 48W x 24D inches.
- D. Accessories:
 - 1. Shelf Clips: Hot-rolled steel, 12 gauge thick, one-piece construction.
 - 2. Sides and Backs:
 - a. Solid steel panels; 24 gauge thick steel.
- E. Fabrication:
 - 1. Fabricate shelves with turned down box edges with return flange spot welded to bottom of shelf.
 - 2. Fabricate shelves 48 inches long by 24 inches deep, unless indicated otherwise on Drawings.
 - 3. Overall Unit Height: Shelves placed equidistant unless Drawings indicate otherwise.
 - a. 84 inches (5 shelves).
- F. Finish: All metal assemblies and components to be factory powder coated.
 - 1. Colors:
 - a. As selected by Architect from manufacturer's full range.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 73 00 - Execution: Verification of existing conditions before starting work.
- B. Verify dimensions, tolerances, and methods of attachment with other Work.
- C. Verify spaces are ready to receive Work of this Section.

3.2 INSTALLATION

- A. Section 01 73 00 - Execution: Related to installation of Work.
- B. Install components according to manufacturer's written instructions, using fasteners appropriate to substrate indicated and recommended by manufacturer.
- C. Install units level, plumb, and firmly anchored.
- D. Anchor units to back wall to prevent tip-over.

3.3 CLEANING

- A. Section 01 73 00 - Execution and Section 01 77 00 - Closeout Procedures: Related to cleaning.
- B. Replace damaged or defective components.
- C. Remove temporary labels and protective coatings.

- D. Clean exposed surfaces.

3.4 PROTECTION OF INSTALLED CONSTRUCTION

- A. Section 01 73 00 - Execution: Protecting installed construction.
- B. Protect shelving from damage.

END OF SECTION

SECTION 10 71 13
EXTERIOR SUN CONTROL DEVICES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Horizontal, fixed, extruded-aluminum sun control assemblies.
- B. Related Requirements:
 - 1. Division 05 - Metals: Sections related to Structural Steel for supporting structure.

1.2 REFERENCES

- A. American Architectural Manufacturers Association:
 - 1. AAMA 611, AA-M12C22A41 - Clear Anodized Aluminum Surfaces.
 - 2. AAMA 612 - Voluntary Specification, Performance Requirements, and Test Procedures for Combined Coatings of Anodic Oxide and Transparent Organic Coatings on Architectural Aluminum.
 - 3. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2017.
 - 4. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2017.
 - 5. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site.
- B. American Society of Civil Engineers:
 - 1. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.
- C. ASTM International (ASTM):
 - 1. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 2. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy- Coated (Galvannealed) by the Hot-Dip Process; 2017.
 - 3. ASTM A666 2015 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
 - 4. ASTM B26/B26M - Standard Specification for Aluminum-Alloy Sand Castings; 2018.
 - 5. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
 - 6. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
 - 7. ASTM D1187/D1187M - Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal; 1997.
 - 8. ASTM E330 - Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
 - 9. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs; 2017.
- D. American Welding Society, Inc. (AWS):
 - 1. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014.
 - 2. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018.

- E. The Society for Protective Coatings (SSPC):
 - 1. SSPC Paint 20 - Zinc-Rich Primers (Type I - Inorganic and Type II - Organic).

1.3 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate base components and requirements for attachment and anchorage to structure.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Manufacturer's technical and descriptive data on sun control components and assemblies.
- C. Shop Drawings: Include plans; elevations; sections; and details showing profiles, angles, and spacing of blades, frames and supports. Show unit dimensions related to supporting and adjoining structures and construction. Indicate anchorage details and locations for both types of sun screen devices.
- D. Structural Calculations: Submit a comprehensive analysis of design loads, including dead loads, live loads, snow loads, snow drift loads, wind loads and thermal movement. Design calculations shall identify the moment and shear forces transferred to the structure or supports through the installation connections.
- E. Structural Calculations shall be stamped and signed by a professional engineer registered in jurisdiction where Project is located.
- F. Samples for Initial Selection: Two manufacturer's color charts illustrating the full range of finishes and colors available for products with factory-applied color finishes; submit for Architect's initial selection.
- G. Samples for Verification: From the Architect's initial selection, prepare two samples for each selected finish and color; on same product material type indicated for final Work; each 4 x 4 inches. Where finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.

1.5 QUALITY ASSURANCE

- A. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of kind indicated. Engineering services are defined as those performed for installations of sun controls that are similar to those indicated for this Project in material, design, and extent.
- B. Welding Standards: As follows:
 - 1. Comply with AWS D1.2, "Structural Welding Code--Aluminum."
 - 2. Comply with 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.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual supporting and adjoining construction by field measurements before fabrication; and indicate recorded measurements on final Shop Drawings. Verify that supporting construction is as required for support of the Sun Control Devices. Coordinate construction to ensure that sun control assemblies fit properly to supporting and adjoining construction and coordinate schedule with construction progress to avoid delaying the Work.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, coordinate related construction to ensure that Sun Control Devices correspond to established established dimensions and construction.

1.7 DELIVERY, STORAGE, AND PROTECTION

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Comply with AAMA CW-10.
- C. Protect prefinished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather. Provide for adequate ventilation through wrappings.

1.8 WARRANTY

- A. Section 01 77 00 - Closeout Procedures: Product warranties.
- B. Provide five (5) year warranty to correct defective Work.
- C. Provide ten (10) year manufacturer warranty against excessive degradation of metal finishes. Include provision for replacement of units with excessive fading, chalking, peeling, blistering or flaking.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers:
 1. C/S Group - Airfoil. (Basis of Design)
 2. Dittmer Architectural Aluminum.
 3. The Airolite Company, LLC.
 4. All-Lite Architectural Products.
 5. AMETCO Manufacturing Corporation.
 6. ASCA, Inc.
 7. Architectural Grilles & Sunshades, Inc. (AGSINC).
 8. Intertec by Doralco.
 9. Ruskin Company.
 10. Peachtree Protective Covers. (PPC)
 11. Substitutions: Section 01 60 00 - Product Requirements

2.2 MATERIALS

- A. Aluminum Extrusions: ASTM B221, alloy 6063-T5 or T-52.
- B. Aluminum Sheet: ASTM B209, alloy 3003 or 5005 with temper as required for forming.
- C. Aluminum Castings: ASTM B26/B26M, alloy 319.
- D. Galvanized Steel Sheet: ASTM A653/A653M, G90 zinc coating, mill phosphatized.
- E. Stainless-Steel Sheet: ASTM A666, Type 302 or 304.
- F. Fasteners: Of same basic metal and alloy as fastened metal or stainless steel conforming to ASTM F593 requirements, unless otherwise indicated. Do not use metals that are incompatible with joined materials.
 1. Use types and sizes to suit unit installation conditions.
 2. Use hex socket head screws for exposed fasteners, unless otherwise indicated.

- G. Anchors and Inserts: Of type, size, and material required for loading and installation indicated. Use nonferrous metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as needed for corrosion resistance. Use toothed steel or expansion bolt devices for drilled-in-place anchors.
- H. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12 but containing no asbestos fibers, or cold-applied asphalt emulsion complying with ASTM D1187.

2.3 PERFORMANCE REQUIREMENTS

- A. Wind Loads: Design and size components and system to withstand dead loads and live loads caused by positive and negative wind loads acting normal to plane of wall, including increased wind loads at building corners.
 - 1. As calculated in accordance with ASCE 7 - Calculation of Wind Loads, as measured in accordance with ASTM E330.
 - 2. Comply with Design Loads indicated on Drawings and applicable code requirements based on geographical location.
- B. System Assembly: Accommodate the following without damage to system or components.
 - 1. Movement within system.
 - 2. Movement between system, system components and perimeter construction.
 - 3. Dynamic loading and release of loads.
 - 4. Deflection of structural support framing.
 - 5. Tolerance of supporting components.
- C. Expansion / Contraction: System to provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over 12 hour period without causing detrimental effect to system components and anchorage.
- D. System Internal Drainage: Drain water entering joints, condensation, or migrating moisture occurring within system, to exterior by weep drainage network.
- E. Not Permitted: Vibration harmonics, wind whistles, noises caused by thermal movement, thermal movement transmitted to other building elements, loosening, weakening, or fracturing of attachments or components of system.

2.4 HORIZONTAL, FIXED, EXTRUDED-ALUMINUM SUN CONTROLS

- A. Sun Screens: Shop fabricated, shop finished, extruded aluminum outriggers, louvers, and fascia, free of defects impairing strength, durability or appearance.
 - 1. Configuration: As indicated on Drawings.
 - 2. Outrigger Shape:
 - a. As indicated on Drawings.
 - 3. Fascia Shape:
 - a. As indicated on Drawings.
 - 4. Blade Shape:
 - a. Rectangular tube shape.
 - 5. Blade Angle:
 - a. 45 degrees or as indicated on the Drawings
 - 6. Sizes:
 - a. As indicated on drawings.
 - 7. Provide a complete system ready for erection at project site.
 - 8. Shop fabricate to the greatest extent possible; disassemble if necessary for shipping.

2.5 FABRICATION

- A. Assemble sun control assemblies in factory to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- B. Maintain equal sun control blade spacing, including separation between blades and frames to produce uniform appearance.
- C. Include supports, anchorages, and accessories required for complete assembly.
- D. Join frame members to one another and to fixed sun control blades with fillet welds concealed from view, unless size of sun control assembly makes concealed, bolted connections between frame members necessary.

2.6 SHOP FINISHING

- A. Anodized Aluminum Finish:
 - 1. Class I Clear Anodized Finish: AAMA 611, AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.
- B. Extent of Finish:
 - 1. Apply factory coating to surfaces exposed at completed assemblies.
 - 2. Apply finish to surfaces cut during fabrication so no natural aluminum is visible in completed assemblies, including joint edges.
 - 3. Apply touch-up materials recommended by coating manufacturer for field application to cut ends and minor damage to factory applied finish.
- C. Concealed Steel Items: Galvanized to ASTM A123/A123M; minimum 2.0 oz/sq ft coating thickness; galvanize after fabrication.
- D. Apply bituminous paint to concealed aluminum and steel surfaces in contact with cementitious or dissimilar metals.
- E. Touch-Up Primer for Galvanized Steel Surfaces: SSPC Paint 20 zinc rich.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 73 00 - Execution: Verification of existing conditions before starting work.
- B. Verify dimensions, tolerances, and method of attachment with other Work.
- C. Verify that construction to which the Work is to be anchored is complete, structurally sound and adequate to provide the required securement.

3.2 PREPARATION

- A. Section 01 73 00 - Execution: Prepare field conditions and existing construction for installation of work of this section.
- B. Prepare materials to be installed and equipment to be used during installation.
- C. Coordinate Setting Drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

- A. Locate and place sun control assemblies level, plumb, and at indicated alignment with adjacent work.
- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- C. Form closely fitted joints with exposed connections accurately located and secured.
- D. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.
- E. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.

3.4 ERECTION TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Maximum Variation from Level: Plus or minus 1/8 inch in 20 ft.
- C. Maximum Misalignment from Position: Plus or minus 1/8 inch
- D. Maximum Misalignment from Adjoining Members Abutting in Plane: 1/32 inch.

3.5 CLEANING

- A. Section 01 73 00 - Execution and Section 01 77 00 - Closeout Procedures: Related to cleaning.
- B. Clean exposed surfaces with water and a mild soap or detergent not harmful to finishes, or as otherwise recommended by manufacturer. Thoroughly rinse surfaces and dry.
- C. Clean and touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

3.6 PROTECTION OF INSTALLED CONSTRUCTION

- A. Section 01 73 00 - Execution: Protecting installed construction.
- B. Protect sun control assemblies from damage during construction.

END OF SECTION

SECTION 10 73 16

CANOPIES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Factory finished metal canopies suspended from building structure.
- B. Related Requirements:
 - 1. Section 10 73 26 - Walkway Coverings: Walkway coverings supported by columns.
 - 2. Division 05 - Metals: Sections related to structural steel for supporting structure.
 - 3. Division 08 - Openings: Sections related to framed opening infill.

1.2 REFERENCES

- A. American Architectural Manufacturers Association (AAMA):
 - 1. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2020.
 - 2. AAMA 612 - Voluntary Specification, Performance Requirements, and Test Procedures for Combined Coatings of Anodic Oxide and Transparent Organic Coatings on Architectural Aluminum; 2020, with Errata 2022.
 - 3. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
 - 4. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
 - 5. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site; 2015.
- B. American Society of Civil Engineers (ASCE):
 - 1. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- C. ASTM International (ASTM):
 - 1. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
 - 2. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- D. American Welding Society, Inc. (AWS):
 - 1. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata 2020.

1.3 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate base components and requirements for attachment and anchorage to structure.
- C. Coordinate work of other Sections that interface and are related to the work of this Section (drainage, sidewalks, building openings, exterior walls, roofing, soffits, fascia, lighting, etc.).

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

- B. Product Data: Manufacturer's product information, specifications and installation instructions for components and accessories.
- C. Shop Drawings: Indicate system and component profiles, sizes, connection attachments, anchorage, size, and type of fasteners; anticipated deflection under load; affected related work; expansion and contraction joint locations and details; drainage details and flow diagrams; field welding; and accessories.
 - 1. Prepare shop drawings indicating attachment system, framing, transverse cross sections, covering and trim details, and installation details to clearly indicate proper assembly of components.
 - 2. Shop drawings and engineering data indicating compliance with requirements of this Section are to be designed and sealed by a licensed professional Engineer. Include test results of previous testing meeting performance criteria, and other supportive data.
- D. Engineering Certification: Submit written certification prepared and signed by a licensed professional Engineer indicating compliance with applicable codes and Performance Requirements indicated in this Section.
- E. Samples for Initial Selection: Two manufacturer's color charts illustrating the full range of finishes and colors available for products with factory-applied color finishes; submit for Architect's initial selections.
- F. Samples for Verification: From the Architect's initial selections, prepare and submit two samples for each selected finish and color; samples on same product material type indicated for final work; each sample 4 x 4 inches. Where finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.

1.5 QUALITY ASSURANCE

- A. Designer Qualifications: Design of canopy systems included in this Section are to be designed and sealed by a licensed Professional Engineer, experienced in design of work of this type and licensed in the State in which the Project is located. Engineer is to certify that all applicable code requirements have been met. Engineer may be in the employ of the manufacturer of the covering systems, provided Engineer is compliant with the above registration requirement.
- B. Comply with the current provisions of the following unless otherwise indicated:
 - 1. Applicable codes and authorities having jurisdiction (AHJ).
 - 2. AWS (American Welding Society) standards for structural welding.
- C. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five (5) years documented experience.
- D. Installer Qualifications: Company specializing in performing the work specified in this Section with minimum five (5) years documented experience.
- E. Single Source Requirement: If project includes Section 10 73 16 - Canopies and Section 10 73 26 - Walkway Coverings, manufacturer to be same and installer to be same for both Sections.

1.6 DELIVERY, STORAGE, AND PROTECTION

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Comply with AAMA CW-10.
- C. Protect prefinished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather. Provide for adequate ventilation through wrappings.

1.7 WARRANTY

- A. Section 01 77 00 - Closeout Procedures: Product warranties.
- B. Provide five (5) year manufacturer's warranty for finish.
- C. Provide manufacturer's standard one (1) year warranty that includes, but is not limited to, coverage for structural performance, water tightness and finish.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Design system and size components, and anchorage to safely withstand Live Loads, Snow Loads, Wind Loads (+ and -), and Seismic Loads as indicated on Drawings for the Structural Design Criteria and in compliance with ASCE 7 and the State Building Code for the State in which the project is located.
- B. System to provide for expansion and contraction within system components caused by a cycling temperature range of 120 degrees F without causing detrimental effects to system or components.
- C. System to accommodate, without damage to system or components, movement within system, movement between system and perimeter framing components, dynamic loading and release of loads, and deflection of structural support framing.
- D. Conform to applicable code for fire resistance ratings for items.

2.2 MANUFACTURERS

- A. Manufacturers:
 - 1. AVAdek, Inc.
 - 2. Dittmer Architectural Aluminum.
 - 3. Mitchell Metals.
 - 4. Mapes Architectural Products.
 - 5. Peachtree Protective Covers.
 - 6. Perfection Architectural Systems, Inc.
 - 7. Tennessee Valley Metals, Inc., East Coast TVM.
 - 8. Substitutions: Section 01 60 00 - Product Requirements.

2.3 MATERIALS

- A. Extruded Aluminum: ASTM B221; 6063 alloy, T6 temper typical; 6061 alloy, T6 temper for extruded structural members.
- B. Sheet Aluminum: ASTM B209/B209M; 6061 alloy, T6 temper.
- C. Fasteners:
 - 1. Deck Screws (rivets not permitted): Type 18-8 non-magnetic stainless steel sealed with a neoprene "O" ring beneath 5/8 inch outside dimension, conical washer.
 - 2. Rivets: Size 3/16 x 1/2 inch grip range aluminum rivets with aluminum mandrel.
 - 3. Bolts: All bolts, nuts, and washers to be 18-8 non-magnetic stainless steel.
 - 4. Tek Screws: Not permitted.

2.4 COMPONENTS

- A. Decking: Extruded self-flashing aluminum sections; interlocking into a watertight composite unit. Extrusion thickness to be a required to withstand imposed loads.

- B. Soffit Type: Flush bottom, unless indicated otherwise on Drawings.
- C. Fascia: Extruded aluminum.
 - 1. For integral fascia and structural frame extrusion, 0.125 inch thick, minimum.
 - 2. For separate fascia extrusion secured to structural frame, 0.050 inch thick, minimum.
 - 3. Shape and size to be as indicated on Drawings.
- D. Flashing: Extruded aluminum, 0.040 inch thick; same finish as for system components; secured with concealed fastening method.

2.5 FABRICATION

- A. Field Measurements: Verify actual supporting and adjoining construction by field measurements before fabrication; and indicate recorded measurements on final Shop Drawings. Verify that supporting construction is as required for support of the Sun Control Devices. Coordinate construction to ensure that sun control assemblies fit properly to supporting and adjoining construction and coordinate schedule with construction progress to avoid delaying the Work.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, coordinate related construction to ensure that Sun Control Devices correspond to established dimensions and construction.
- B. Fabricate assemblies to comply with design as indicated on Drawings.
- C. Fit and shop assemble components in largest practical sizes, for delivery to site.
- D. Fabricate components with joints tightly fitted and secured. Provide allowance for expansion and contraction of entire system.
- E. Provide drainage pathway without leaks and to point of drainage discharge.
- F. For canopies suspended from building (and without columns for drainage), provide for drainage openings with water diverters along bottom of canopy outer edge member. Drainage openings to be as indicated on Drawings. If drainage openings are not indicated on Drawings, locate drainage openings away from building face and not in direct line of door openings.
- G. Arrange fasteners, attachments and jointing to ensure concealment from view.
- H. Supply components required for anchorage of framing. Fabricate anchors and related components of same material and finish as framing, except where specifically noted otherwise.
- I. Continuously seal joined pieces by continuous welds.
- J. Welding In accordance with ANSI/AWS D1.2/D1.2M.
- K. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, hairline, and waterproof. Ease exposed edges to small uniform radius.
- L. Accurately form components to suit each other and to building structure.
- M. Deck Construction: Deck shall be manufactured of extruded modules that interlock in a self-flashing manner. Interlocking joints shall be positively fastened at not less than 18 inches o.c. creating a monolithic structural unit capable of developing the full strength of the sections. The fastenings must have minimum shear strength of 350 pounds each. Deck shall be assembled with sufficient camber to offset dead load deflection.

2.6 ACCESSORIES

- A. Fittings: Elbows, T-shapes, wall brackets; cast aluminum.

- B. Splice Connectors: Concealed spigot; cast aluminum.
- C. Struts: Manufacturer's standard rod type and material.
- D. Wall Brackets: Manufacturer's standard decorative type for mounting in wall structure, unless shape, profile, or configuration is otherwise indicated on Drawings.
- E. Exposed Fasteners: Flush countersunk stainless steel screws, bolts, and rivets; finish to be same as factory finish indicated.
- F. Protective Coating for dissimilar materials: Clear acrylic; two coats; compatible with materials to be coated.

2.7 FACTORY FINISHING

- A. All surfaces of components, fabrications, and accessories to be factory finished to match colors selected by Architect from full range of colors.
- B. Painted Aluminum Finish: AA-M12C12R1x non-specular as fabricated mechanical finish, chemically cleaned, and prepared for applied coating; with organic coating.
 - 1. High Performance Organic Coating: AAMA 2604, thermally cured polyvinylidene fluoride (PVDF) resin-based coating, fluoropolymer finish containing minimum 70 percent PVDF resins.
 - a. Number of Coats:
 - 1) Two (2) coat system, 1.2 mil minimum total dry-film thickness.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 73 00 - Execution: Verification of existing conditions before starting work.
- B. Verify that substrates and anchor conditions are acceptable and are ready to receive work.
- C. Verify dimensions, tolerances, and method of attachment with other work.

3.2 PREPARATION

- A. Section 01 73 00 - Execution: Prepare field conditions and existing construction for installation of work of this Section.
- B. Prepare materials to be installed and equipment to be used during installation.

3.3 INSTALLATION

- A. Section 01 73 00 - Execution: Related to installation of Work.
- B. Install as indicated on Drawings and in accordance with Engineer's and manufacturer's instructions.
- C. Install components plumb and level, accurately fitted, free from distortion or defects.
- D. Apply two coats of clear acrylic coating to aluminum surfaces in contact with dissimilar materials and cementitious embedment. Application to be concealed from view.
- E. Install anchors required for connecting framing to structure.

3.4 ERECTION TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Maximum Variation from Plumb: 1/4 inch per story, non-cumulative.

- C. Maximum Misalignment from True Position: 1/4 inch.
- D. Maximum Variation from Plane: 1/4 inch every 10 feet, non-cumulative.
- E. Maximum Variation from Plane Alignment of Two Adjoining Members: 0.015 inch.

3.5 CLEANING

- A. Section 01 73 00 - Execution and Section 01 77 00 - Closeout Procedures: Clean installed work and comply with manufacturer's recommendations.
- B. Clean installed work in accordance with manufacturer's recommended materials and procedures.

3.6 PROTECTION OF INSTALLED CONSTRUCTION

- A. Section 01 73 00 - Execution: Protect installed construction.

END OF SECTION

SECTION 10 73 26

WALKWAY COVERINGS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Factory finished metal walkway coverings with columns.
- B. Related Requirements:
 - 1. Section 03 30 00 - Cast-in-Place Concrete: Concrete for column footings.
 - 2. Section 10 73 16 - Canopies: Suspended from building structure.

1.2 REFERENCES

- A. American Architectural Manufacturers Association (AAMA):
 - 1. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2020.
 - 2. AAMA 612 - Voluntary Specification, Performance Requirements, and Test Procedures for Combined Coatings of Anodic Oxide and Transparent Organic Coatings on Architectural Aluminum; 2020, with Errata 2022.
 - 3. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2021.
 - 4. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2020.
 - 5. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site; 2015.
- B. American Society of Civil Engineers (ASCE):
 - 1. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- C. ASTM International (ASTM):
 - 1. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
 - 2. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- D. American Welding Society, Inc. (AWS):
 - 1. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, Errata 2020.

1.3 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate base components and requirements for attachment and anchorage to structure.
- C. Coordinate work of other Sections that interface and are related to the work of this Section (drainage, sidewalks, curbs, building openings, exterior walls, roofing, soffits, fascia, lighting, etc.).

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

- B. Product Data: Manufacturer's product information, specifications and installation instructions for components and accessories.
- C. Shop Drawings: Indicate system and component profiles, sizes, connection attachments, anchorage, footings, size, and type of fasteners; anticipated deflection under load; affected related work; expansion and contraction joint locations and details; drainage details and flow diagrams; field welding; and accessories.
 - 1. Prepare shop drawings indicating attachment system, column and gutter beam framing, transverse cross sections, covering and trim details, and installation details to clearly indicate proper assembly of components.
 - 2. Shop drawings and engineering data indicating compliance with requirements of this Section are to be designed and sealed by a licensed professional Engineer. Include test results of previous testing meeting performance criteria, and other supportive data.
- D. Engineering Certification: Submit written certification prepared and signed by a licensed professional Engineer indicating compliance with applicable codes and Performance Requirements indicated in this Section.
- E. Samples for Initial Selection: Two manufacturer's color charts illustrating the full range of finishes and colors available for products with factory-applied color finishes; submit for Architect's initial selections.
- F. Samples for Verification: From the Architect's initial selections, prepare and submit two samples for each selected finish and color; samples on same product material type indicated for final work; each sample 4 x 4 inches. Where finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.

1.5 QUALITY ASSURANCE

- A. Designer Qualifications: Design of canopy systems included in this Section are to be designed and sealed by a licensed Professional Engineer, experienced in design of work of this type and licensed in the State in which the Project is located. Engineer is to certify that all applicable code requirements have been met. Engineer may be in the employ of the manufacturer of the covering systems, provided Engineer is compliant with the above registration requirement.
- B. Comply with the current provisions of the following unless otherwise indicated:
 - 1. Applicable codes and authorities having jurisdiction (AHJ).
 - 2. AWS (American Welding Society) standards for structural welding.
- C. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five (5) years documented experience.
- D. Installer Qualifications: Company specializing in performing the work specified in this Section with minimum five (5) years documented experience.
- E. Single Source Requirement: If project includes Section 10 73 16 - Canopies and Section 10 73 26 - Walkway Coverings, manufacturer and installer to be same for both Sections.

1.6 DELIVERY, STORAGE, AND PROTECTION

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Comply with AAMA CW-10.
- C. Protect prefinished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather. Provide for adequate ventilation through wrappings.

1.7 WARRANTY

- A. Section 01 77 00 - Closeout Procedures: Product warranties.
- B. Provide five (5) year manufacturer's warranty for finish.
- C. Provide manufacturer's standard one (1) year warranty that includes, but is not limited to, coverage for structural performance, water tightness and finish.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Design system and size components, anchorage, and footings to safely withstand Live Loads, Snow Loads, Wind Loads (+ and -), and Seismic Loads as indicated on Drawings for the Structural Design Criteria and in compliance with ASCE 7 and the State Building Code for the State in which the project is located.
- B. System to provide for expansion and contraction within system components caused by a cycling temperature range of 120 degrees F without causing detrimental effects to system or components.
- C. System to accommodate, without damage to system or components, movement within system, movement between system and perimeter framing components, dynamic loading and release of loads, and deflection of structural support framing.
- D. Conform to applicable code for fire resistance ratings for items.

2.2 MANUFACTURERS

- A. Manufacturers:
 - 1. AVAdek, Inc.
 - 2. Dittmer Architectural Aluminum.
 - 3. Mitchell Metals.
 - 4. Mapes Architectural Products.
 - 5. Peachtree Protective Covers.
 - 6. Perfection Architectural Systems, Inc.
 - 7. Tennessee Valley Metals, Inc., East Coast TVM.
 - 8. Substitutions: Section 01 60 00 - Product Requirements.

2.3 MATERIALS

- A. Extruded Aluminum: ASTM B221; 6063 alloy, T6 temper; 6061 alloy, T6 temper for extruded structural members.
- B. Sheet Aluminum: ASTM B209/B209M; 6061 alloy, T6 temper.
- C. Fasteners:
 - 1. Deck Screws (rivets not permitted): Type 18-8 non-magnetic stainless steel sealed with a neoprene "O" ring beneath 5/8 inch outside dimension, conical washer.
 - 2. Rivets: Size 3/16 x 1/2 inch grip range aluminum rivets with aluminum mandrel.
 - 3. Bolts: All bolts, nuts, and washers to be 18-8 non-magnetic stainless steel.
 - 4. Tek Screws: Not permitted.

2.4 COMPONENTS

- A. Columns: Extruded aluminum tubing with radius corners; size and shape as shown on Drawings; fabricated to allow internal drainage to discharge.

1. Drainage and Discharge: Water shall drain internally from deck to beams to columns, for connection and discharge into below-grade level storm drainage system as indicated on Drawings.
 - a. If no below-grade storm drainage system is indicated for connection and discharge, provide for discharge from column base at grade level in opposite direction of pedestrian walk path. Discharge opening with internal diverter required for drainage discharge. Circular downspout opening in column is not acceptable.
- B. Beams: Open-top tubular extruded aluminum shape as indicated on Drawings; top edges thickened for strength and designed to receive deck members in self-flashing manner. Extrusion thickness to be a required to withstand imposed loads. Structural ties shall be installed in tops of all beams.
- C. Decking: Extruded self-flashing aluminum sections; interlocking into a watertight composite unit. Extrusion thickness to be a required to withstand imposed loads.
- D. Soffit Type: Flush bottom, unless indicated otherwise on Drawings.
- E. Fascia: Extruded aluminum.
 1. For integral fascia and structural frame extrusion, 0.125 inch thick, minimum.
 2. For separate fascia extrusion secured to structural frame, 0.050 inch thick, minimum.
 3. Shape and size to be as indicated on Drawings.
- F. Flashing: Extruded aluminum, 0.040 inch thick; same finish as for system components; secured with concealed fastening method.

2.5 FABRICATION

- A. Field Measurements: Verify actual supporting and adjoining construction by field measurements before fabrication; and indicate recorded measurements on final Shop Drawings. Verify that supporting construction is as required for support of the Sun Control Devices. Coordinate construction to ensure that sun control assemblies fit properly to supporting and adjoining construction and coordinate schedule with construction progress to avoid delaying the Work.
 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, coordinate related construction to ensure that Sun Control Devices correspond to established dimensions and construction.
- B. Fabricate assemblies to comply with design as indicated on Drawings.
- C. Fit and shop assemble components in largest practical sizes, for delivery to site.
- D. Fabricate components with joints tightly fitted and secured. Provide allowance for expansion and contraction of entire system.
- E. Provide drainage pathway without leaks and to point of drainage discharge.
- F. Arrange fasteners, attachments and jointing to ensure concealment from view.
- G. Supply components required for anchorage of framing. Fabricate anchors and related components of same material and finish as framing, except where specifically noted otherwise.
- H. Continuously seal joined pieces by continuous welds.
- I. Welding In accordance with ANSI/AWS D1.2/D1.2M.
- J. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, hairline. and waterproof. Ease exposed edges to small uniform radius.

- K. Accurately form components to suit each other and to building structure.
- L. Deck Construction: Deck shall be manufactured of extruded modules that interlock in a self-flashing manner. Interlocking joints shall be positively fastened at not less than 18 inches o.c. creating a monolithic structural unit capable of developing the full strength of the sections. The fastenings must have minimum shear strength of 350 pounds each. Deck shall be assembled with sufficient camber to offset dead load deflection.

2.6 ACCESSORIES

- A. Fittings: Elbows, T-shapes, wall brackets; cast aluminum.
- B. Splice Connectors: Concealed spigot; cast aluminum.
- C. Struts: Manufacturer's standard rod type and material.
- D. Wall Brackets: Manufacturer's standard decorative type for mounting in wall structure, unless shape, profile, or configuration is otherwise indicated on Drawings.
- E. Exposed Fasteners: Flush countersunk stainless steel screws, bolts, and rivets; finish to be same as factory finish indicated.
- F. Protective Coating for dissimilar materials: Clear acrylic; two coats; compatible with materials to be coated.

2.7 FACTORY FINISHING

- A. All surfaces of components, fabrications, and accessories to be factory finished to match colors selected by Architect from full range of colors.
- B. Painted Aluminum Finish: AA-M12C12R1x non-specular as fabricated mechanical finish, chemically cleaned, and prepared for applied coating; with organic coating.
 - 1. High Performance Organic Coating: AAMA 2604, thermally cured polyvinylidene fluoride (PVDF) resin-based coating, fluoropolymer finish containing minimum 70 percent PVDF resins.
 - a. Number of Coats:
 - 1) Two (2) coat system, 1.2 mil minimum total dry-film thickness.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 73 00 - Execution: Verification of existing conditions before starting work.
- B. Verify that substrates and anchor conditions are acceptable and are ready to receive work.
- C. Verify that adjacent, at-grade and sub-grade construction is ready to receive work of this Section.
- D. Verify dimensions, tolerances, and method of attachment with other work.

3.2 PREPARATION

- A. Section 01 73 00 - Execution: Prepare field conditions and existing construction for installation of work of this Section.
- B. Prepare materials to be installed and equipment to be used during installation.

3.3 INSTALLATION

- A. Section 01 73 00 - Execution: Related to installation of Work.

- B. Install as indicated on Drawings and in accordance with Engineer's and manufacturer's instructions.
- C. Install components plumb and level, accurately fitted, free from distortion or defects.
- D. Apply two coats of clear acrylic coating to aluminum surfaces in contact with dissimilar materials and cementitious embedment. Application to be concealed from view.
- E. Install anchors required for connecting framing to structure and footings.
- F. Rainwater Drainage Through Columns:
 - 1. For downspout columns that are indicated to discharge rainwater into a subgrade storm drainage system, install watertight and as indicated on Drawings.
 - 2. For downspout columns that are indicated to discharge rainwater onto finish grade, fill downspout columns with grout to discharge diverter level to prevent standing water.
- G. Provide weep holes in non-draining columns at top of concrete to remove condensation.

3.4 ERECTION TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Maximum Variation from Plumb: 1/4 inch per story, non-cumulative.
- C. Maximum Misalignment from True Position: 1/4 inch.
- D. Maximum Variation from Plane: 1/4 inch every 10 feet, non-cumulative.
- E. Maximum Variation from Plane Alignment of Two Adjoining Members: 0.015 inch.

3.5 CLEANING

- A. Section 01 73 00 - Execution and Section 01 77 00 - Closeout Procedures: Clean installed work and comply with manufacturer's recommendations.
- B. Clean installed work in accordance with manufacturer's recommended materials and procedures.

3.6 PROTECTION OF INSTALLED CONSTRUCTION

- A. Section 01 73 00 - Execution: Protect installed construction.

END OF SECTION

SECTION 10 75 00

FLAGPOLES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Flagpoles attached to wall structure.
- B. Related Requirements:
 - 1. Section 03 30 00 - Cast-in-Place Concrete: Concrete for base and foundation construction.

1.2 REFERENCES

- A. ASTM International (ASTM):
 - 1. ASTM B241/B241M - Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube; 2022.
- B. National Association of Architectural Metal Manufacturers (NAAMM):
 - 1. NAAMM FP 1001 - Guide Specifications for Design of Metal Flagpoles; 2007.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit data on pole, accessories, and configurations.
- C. Shop Drawings: Indicate detailed dimensions, attachment details, anchor requirements, imposed loads, and foundation details for in-ground installed flagpoles.
 - 1. Shop drawings and engineering data indicating compliance with requirements of this Section and applicable code requirements are to be designed and sealed by a Professional Engineer experienced in design of the work in this Section and licensed to perform structural engineering in the State in which the project is located.
 - 2. Wall Attached Flagpoles: Include wall attachment details.
- D. Flag Designs: Submit drawings indicating design, colors, and fabrication details of flag(s) required.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 78 23 - Operation and Maintenance Data.
- B. Operation and Maintenance Data: Submit Operation and Maintenance Data.

1.5 QUALIFICATIONS

- A. Delegated Designer Requirement: Design flagpole, flagpole foundation, and anchorage under direct supervision of Professional Engineer experienced in design of the work in this Section and licensed in State in which the project is located.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Spiral wrap flagpole with protective covering and pack in protective shipping tubes or containers.

- C. Protect flagpole and accessories from damage or moisture.

1.7 SPARE PARTS AND MAINTENANCE PRODUCTS

- A. Section 01 60 00 - Product Requirements: Extra materials, spare parts, and maintenance products.
1. Four (4) keys to lockable cleat box.
 2. Two (2) specialty adjustment and maintenance tools.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide flagpoles capable of withstanding the effects of wind loads as determined according to NAAMM FP 1001. Design for non-resonant safety factor of 2.5; to resist without permanent deformation at design wind speed as indicated on Drawings; with flag deployed and flag size as indicated in this Section.

2.2 FLAGPOLES - WALL MOUNTED

- A. Manufacturers:
1. American Flagpole.
 2. Concord Industries, Inc.
 3. Ewing.
 4. Morgan-Francis Flagpole.
 5. Pole-Tech Company, Inc.
 6. Substitutions: Section 01 60 00 - Product Requirements.
- B. Aluminum: ASTM B241/B241M, 6063 alloy, T6 temper.

Architect, select flagpoles from following table and remember to set quantity column. Or modify as needed per your design.

- C. Flagpole Quantities Required and Configuration Table: Tapered design.

Quantity Required	Above Ground Height.	Butt Diameter	Wall Thickness	Finial Ball Dia.	Flag Size
1	28 feet	3 inches min**	0.188 inch min**	3.5 inches	6 x 10 feet
0	35 feet	7 inches min**	0.188 inch min**	3.5 inches	6 x 10 feet
0	40 feet	8 inches min**	0.188 inch min**	4 inches	8 x 12 feet
0	45 feet	8 inches min**	0.188 inch min**	4 inches	8 x 12 feet
0	50 feet	10 inches min**	0.188 inch min**	4 inches	10 x 15 feet
** Minimum dimension subject to increase in accordance with Engineer's Design and Performance Requirements.					

- D. Accessories:
1. Flag Types: Flag graphic design is to comply with the referenced entity's official design. Fabrication to be of nylon fabric with hemmed edges and brass grommets. Provide one (1) each of the following flags.
 - a. United States flag. Design in accordance with stars and stripes design.
 2. Halyard: External type; minimum 3/8 inch diameter nylon, braided, with stainless steel or bronze core. Provide non-corrosive hardware required to display (attach/fly) the following quantity of flags per flagpole.
 - a. One (1) flag per flagpole.
 3. Finial Ball: Aluminum; finish to match flagpole.

4. Truck Assembly: Cast aluminum; revolving, stainless steel ball bearings, non-fouling.
 5. Cleats: 9 inch size, aluminum with stainless steel fastenings, two for each halyard.
 6. Cleat Box: Aluminum, with built-in hinge and lockable assembly, attached to pole with tamper proof screws inside box.
 7. Pole Base Attachment: Vertical Wall Mount – bracket.
 8. Lightning Ground Cable: Copper No. 6 AWG, soft drawn.
- E. Factory Finishing:
1. Aluminum: Anodized to clear color.
 2. Finial: Spun finish.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 73 00 - Execution: Verification of existing conditions before starting work.
- B. Verify area is ready to receive work and dimensions are as required.

3.2 PREPARATION

- A. Section 01 73 00 - Execution: Prepare field conditions and existing construction for installation of work of this section.
- B. Prepare materials to be installed and equipment to be used during installation.
- C. Coat metal sleeve surfaces below grade, in contact with cementitious surfaces, and in contact with dissimilar metals with asphaltic paint.

3.3 INSTALLATION

- A. Section 01 73 00 - Execution: Related to installation of Work.
- B. Install work in accordance with Delegated Design by Engineer and manufacturer's requirements.
- C. Provide isolation barrier between dissimilar materials.
- D. Electrically ground flagpole installation.

3.4 ERECTION TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Maximum Variation from Plumb: 1 inch.

3.5 ADJUSTING

- A. Section 01 73 00 - Execution: Adjusting.
- B. Adjust operating devices so halyard and flag function smoothly.

END OF SECTION

SECTION 11 21 73.10

COMMERCIAL LAUNDRY EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Clothes washer.
 - 2. Lint interceptor for clothes washer.
 - 3. Clothes dryer.
- B. Related Requirements:
 - 1. Divisions 22, 23, and 24: Plumbing, venting, and electrical requirements.

1.2 REFERENCES

- A. American Gas Association (AGA).
- B. CSA Group (formerly Canadian Standards Association) (CSA).
 - 1. CSA Certified - Complies with AGA/CSA certification standards.
- C. Electrical Testing Laboratories, a division of Intertek (ETL):
 - 1. ETL Intertek Certified - Complies with ETL certification standards.
- D. National Fire Protection Association (NFPA):
 - 1. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
 - 2. NFPA 54 - National Fuel Gas Code; 2024.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
 - 2. Coordinate electrical requirements with Project's electrical service and connectivity.
 - 3. Coordinate plumbing requirements with Project's gas, water, and waste services and connectivity.
- B. Pre-Installation Meetings:
 - 1. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.
 - 2. Convene minimum one week prior to commencing work of this Section. Review the work requirements, application procedures, quality control, testing and inspection and production schedule.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit product data for product indicated. Data to include, but is not limited to the following:
 - 1. Manufacturer's model number.
 - 2. Accessories and components.
 - 3. Clearance requirements for access and maintenance.
 - 4. Utility service connections for water, drainage, power, and fuel; include roughing-in dimensions.

- C. Shop Drawings: Submit drawings including equipment locations, dimensions of equipment and spacing to adjacent construction, utility connections, and venting details through building construction.
- D. Manufacturer's Installation Instructions: Indicate special installation criteria and interface with adjacent components.
- E. Manufacturer's qualifications statement.
- F. Installer's qualifications statement.
- G. Warranties: Submit sample warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 77 00 - Closeout Procedures.
- B. Operation and Maintenance Data: Provide data for equipment provided.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain equipment from single source and from single manufacturer.

1.7 QUALIFICATIONS

- A. Manufacturer Qualifications: Company specializing in manufacturing Products specified in this Section with minimum ten (10) years documented experience.
- B. Installer Qualifications: Employer of workers trained and approved by equipment manufacturer for installation and maintenance of equipment indicated in this Section.
 - 1. Equipment service staff is to be located within 3 hours drive of Project site.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Deliver products in manufacturer's original packaging. Store materials in a dry, protected, well-vented area. Inspect product upon receipt and report damaged material immediately to delivering carrier and note such damage on the carrier's freight bill of lading.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements: Requirements before, during, and after the work.
- B. Work and installation conditions to comply with equipment manufacturer's recommendations.

1.10 WARRANTY

- A. Section 01 77 00 - Closeout Procedures: Product warranties.
- B. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace equipment or components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion on washer unit frame, wash cylinder, and shaft.
 - 2. Warranty Period: Three years from date of Substantial Completion on washer motor and other parts.
 - 3. Warranty Period: Two years from date of Substantial Completion on dryers.

PART 2 PRODUCTS

2.1 PERFORMANCE / DESIGN REQUIREMENTS

- A. Certification: Provide electric and fuel-burning equipment and components that are evaluated by ETL Intertek or AGA/CSA, as applicable, for fire, electric shock, and casualty hazards according to applicable safety standards, and that are certified for compliance and labeled for intended use.
- B. Regulatory Requirements: Provide and install equipment in compliance with the following:
 - 1. ANSI Z21 Series Standards for gas-burning appliances.
 - 2. NFPA 54 Standards.
 - 3. NFPA 70 Standards.

2.2 MANUFACTURERS

- A. Manufacturers:
 - 1. Belco Athletic Laundry Equipment Co., Inc.
 - 2. Girbau, North America.
 - 3. Maytag Commercial.
 - 4. Substitutions: Section 01 60 00 - Product Requirements.

2.3 CLOTHES WASHER

- A. Basis of Design: Girbau, North America .
- B. Extractor type and front-loading unit; ETL Intertek certified.
- C. Unit Size:
 - 1. Not greater than 39W x 46D x 62H inches.
 - a. Drum Capacity: 55 lb to 60 lb.
- D. Drum: Perforated stainless steel.
- E. Controls: Rotary dial controls for water-fill levels, wash/rinse water temperatures, and variable-speed and fabric selectors.
 - 1. Wash Cycles: Five.
 - a. Soak, extended wash, and advance.
 - b. Three deep rinses, three intermediate extractions, and one final extraction.
 - c. Normally closed drain valve operation to enable extended soak.
 - 2. Extraction: Maximum force 90 G.
 - 3. Wash Temperatures: Three settings.
 - 4. Speed Combinations: Four.
- F. Electrical Power: 208 - 240 V, 60 Hz, single phase, inverter driven.
- G. Motor: Manufacturer's standard with built-in overload protector, permanently lubricated main drive and motor bearings, and self-adjusting drive belt tensioning.
- H. Features:
 - 1. Self-cleaning lint filter.
 - 2. Self-cleaning water inlet valves.
 - 3. Unbalanced-load compensator.
 - 4. Inlet Hoses: Minimum length 60 inches.
 - 5. Drain Hoses: Minimum length 48 inches.
 - 6. Automatic dispenser for bleach, fabric softener, and detergent.
 - 7. Spin-cycle safety switch.
 - 8. End-of-cycle signal.

- I. Finish:
 - 1. Unit Cabinet: Polyester powder coat or stainless steel.
 - 2. Unit Front Panel: Stainless steel.
- J. Temporary Finish Protection: Apply strippable temporary protective covering before shipping.

2.4 LINT INTERCEPTOR FOR CLOTHES WASHER

- A. Basis of Design: H-M Company - Lint Interceptor.
- B. Provide lint interceptor acceptable to authorities having jurisdiction, sized for discharge capacity of clothes washer, fabricated from corrosion-resistant material, accessible for routine maintenance.

2.5 CLOTHES DRYER

- A. Basis of Design: Belco Athletic Laundry Equipment.
- B. Front-Loading Unit:
 - 1. Electric unit and to be CSA certified.
- C. Unit Size:
 - 1. Match clothes washer in unit size and drum capacity.
- D. Drum: Perforated stainless steel.
- E. Controls: Rotary dial controls for drying cycle, temperatures, and fabric selectors.
 - 1. Drying Temperatures: Preset controls with the following marked settings for automated controls adjusting to uniform makers' temperature setting directions:
 - a. Game uniforms.
 - b. Practice uniforms.
 - c. Towels.
 - 2. Timer: 60-minute, with 5-minute cool down.
- F. Electrical Power:
 - 1. Electric Dryer:
 - a. As indicated on Drawings.
- G. Dryer Fan: 3/4 HP motor, 750 CFM, fully enclosed, fan-cooled.
- H. Features:
 - 1. Preheating chamber for make-up air.
 - 2. Drying compartment for athletic gear.
 - 3. Removable lint filter.
 - 4. End-of-cycle signal.
 - 5. Interior drum light.
- I. Finish:
 - 1. Unit Cabinet:
 - a. Match clothes washer.
 - 2. Unit Front Panel:
 - a. Match clothes washer.
 - 3. Temporary Finish Protection: Apply strippable temporary protective covering before shipping.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 73 00 - Execution: Verification of existing conditions before starting work.
- B. Verify that field measurements are as required.
- C. Examine substrates and conditions for compliance with requirements for installation tolerances, utility connections, and other conditions affecting installation and performance of equipment.
- D. Examine walls, ceilings, and roofs for suitable conditions where dryer vent outlets will be installed.
- E. Examine products to be installed for damage and other conditions detrimental to completion of the Work.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Section 01 73 00 - Execution: Prepare field conditions and existing construction for installation of Work of this Section.
- B. Prepare materials to be installed and equipment to be used during installation.

3.3 INSTALLATION

- A. Section 01 73 00 - Execution: Related to installation of Work.
- B. Install the Work in compliance with the design requirements, applicable codes, manufacturer's recommendations, and the Contract Documents.
- C. Install dryer venting complying with applicable codes and manufacturer's recommendations.
- D. Built-in Equipment: Securely anchor units to supporting structure with manufacturer-approved fasteners. Verify that clearances are adequate for proper functioning and that rough openings are completely concealed.
- E. Utilities: Refer to Divisions 22, 23, and 26 for plumbing, venting, and electrical requirements.

3.4 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Monitor quality of installation, inspection, and testing.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
 - 1. Perform visual, mechanical, and electrical inspection and testing for each appliance according to manufacturers' written recommendations. Certify compliance with each manufacturer's appliance-performance parameters.
 - 2. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After installation, start units to confirm proper operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and components.

- D. Equipment will be considered defective if it does not pass tests and inspections.
- E. Prepare and report results of tests and inspections.

3.5 ADJUSTING

- A. Section 01 73 00 - Execution: Starting, testing, adjusting, and balancing.
- B. Adjust operating components to smooth operation without binding.

3.6 CLEANING

- A. Section 01 73 00 - Execution and Section 01 77 00 - Closeout Procedures.
- B. Clean installed Work in accordance with manufacturer's recommendations including cleaning procedures and materials.

3.7 PROTECTION OF INSTALLED CONSTRUCTION

- A. Section 01 73 00 - Execution: Protecting installed construction.
- B. Protect installed construction from damage and unauthorized tampering.

3.8 DEMONSTRATION AND TRAINING

- A. Section 01 79 00 - Demonstration and Training.
- B. Engage a factory-authorized service representative to provide demonstration and training to Owner regarding adjusting, operation, and maintenance of the Work of this Section.

END OF SECTION

SECTION 11 30 13
RESIDENTIAL APPLIANCES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes residential appliances with installation including connections to utilities.
- B. Related Requirements:
 - 1. Division 22 - Plumbing: Coordinate equipment plumbing requirements.
 - 2. Division 23 - HVAC: Coordinate equipment venting requirements.
 - 3. Division 26 - Electrical: Coordinate equipment electrical requirements.

1.2 REFERENCES

- A. American Gas Association (AGA):
 - 1. AGA Certification Seal.
- B. National Electrical Manufacturers Association (NEMA):
 - 1. NEMA Standards; Current.
- C. Underwriters Laboratories Inc. (UL):
 - 1. UL (DIR) - Online Certification Directory; Current Edition.
- D. U.S. Environmental Protection Agency (EPA):
 - 1. Energy Star - Label Indicating Compliance With Certification Standards for EPA Energy Star Voluntary Labeling Program.

1.3 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate plumbing, venting, and electrical work with requirements of appliances.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit data on appliances; indicate configuration, sizes, materials, finishes, locations, and utility connections and locations.
- C. Shop Drawings:
 - 1. Indicate in large scale detail, fabricated equipment showing construction methods, types and gages of metal, hardware and fittings, plan, front elevation, minimum of one cross-section. Indicate verification that the projects planned provisions for utilities, ventilation and connectivity are compliant with the requirements of the appliance and/or device, to include types, sizes, locations, and accessibility.
 - 2. Illustrate complicated parts of typical items in cut-away perspective.
 - 3. For control systems, indicate service connections, characteristics, and wiring diagrams.
- D. Samples: Submit samples illustrating manufacturer's full range of color and finish options for selection by Architect.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- F. Manufacturer's Installation Instructions: Submit special procedures for built-in items and perimeter conditions requiring special attention.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 77 00 - Closeout Procedures.
- B. Operation and Maintenance Data: Submit manufacturer's operating instructions for specified equipment and care and maintenance of finished surfaces.

1.6 QUALITY ASSURANCE

- A. Electric Appliances: Listed and labeled by UL (DIR) and complying with NEMA Standards.
- B. Gas Appliances: Bearing design certification seal of American Gas Association (AGA).

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Store products clear of floor in manner to prevent damage.
- C. Coordinate size of access and route to place of installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers:
 - 1. Frigidaire Products.
 - 2. GE Appliances.
 - 3. LG Electronics.
 - 4. Whirlpool Corporation.
 - 5. Substitutions: Section 01 60 00 - Product Requirements.
- B. Basis of Design: Refer to appliance types indicated.

2.2 KITCHEN APPLIANCES

- A. Refrigerator/Freezer:
 - 1. Quantity: 5 units each.
 - 2. GE - Model [GIE18GTNRWW](#) (17.5 cu. ft. top-freezer refrigerator, icemaker, Energy Star, white).
- B. Dishwasher:
 - 1. Provided by Owner and installed by Contractor.
 - 2. Locations:
 - 3. Quantity: 3 unit each.
 - 4. GE - Model [GDF550PGRWW](#) (built-In dishwasher, tall tub, SS tub/door liner, Energy Star, white).
- C. Microwave Oven (countertop type):
 - 1. Locations: 1 unit in Mail Room 1 unit in Concessions.
 - 2. Quantity: 2 units each.
 - 3. GE - Model [PES7227DLWW](#) (2.2 cu. ft. countertop microwave oven, glass turntable, white).

2.3 LAUNDRY APPLIANCES

- A. Washer/Dryer:

1. Locations: As indicated on drawings.
2. Quantity: 2 unit each.
3. GE - Washer Model [GTW465ASNWW](#) (4.5 cu. ft. capacity, top load, SS basket, white).
4. GE - Dryer Model [GTD42EASJWW](#) (7.2 cu. ft. capacity, aluminized alloy drum, electric dryer, white).

2.4 ACCESSORIES

- A. Provide rough-in hardware, supports and connections, attachment devices, closure trim, and accessories.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 73 00 - Execution: Verification of existing conditions before starting work.
- B. Verify plumbing, electrical, and venting service connection requirements.
- C. Verify supports and anchorage construction is correct and in required locations.

3.2 PREPARATION

- A. Section 01 73 00 - Execution: Prepare field conditions and existing construction for installation of work of this section.
- B. Prepare materials to be installed and equipment to be used during installation.

3.3 INSTALLATION

- A. Section 01 73 00 - Execution: Related to installation of Work.
- B. Installation is to comply with manufacturer's recommendations and building code requirements.
- C. Insulate to prevent electrolysis between dissimilar metals.
- D. Use anchoring devices appropriate for equipment and expected usage.

3.4 ADJUSTING

- A. Section 01 73 00 - Execution: Starting, testing, adjusting, and balancing.
- B. Adjust equipment and apparatus to ensure proper working order and conditions.
- C. Remove and replace equipment creating excessive noise or vibration.

3.5 CLEANING

- A. Section 01 73 00 - Execution and Section 01 77 00 - Closeout Procedures: Related to cleaning.
- B. Remove masking or protective covering from stainless steel and other finished surfaces.
- C. Wash and clean equipment.
- D. Polish glass, plastic, hardware, accessories, fixtures, and fittings.

3.6 PROTECTION OF INSTALLED CONSTRUCTION

- A. Section 01 73 00 - Execution: Protecting installed construction.

- B. Protect installed Work from damage.

END OF SECTION

SECTION 11 40 00
FOOD SERVICE EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The general provisions of the contract including general and supplementary conditions and general requirements apply to the work specified in this section.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Plumbing: Refer to Division 22, including:
 - 1. Rough-in piping for gas and water supply and waste lines.
 - 2. Piping for supply and waste lines.
 - 3. Traps, grease traps, line strainers, tail pieces, valves, stops, shut offs and miscellaneous fittings required for complete installation.
 - 4. Final connections.
 - 5. Indirect drains for sink compartments.
 - 6. Disconnect existing equipment.
- B. Mechanical: Refer to Division 23, including:
 - 1. Roof mounted fans and connecting ductwork not shown as part of the kitchen equipment.
 - 2. Final connections, including approved welded duct connections to hoods.
 - 3. Disconnect existing equipment.
- C. Electrical: Refer to Division 26, including:
 - 1. Rough-in conduit, wiring, line and disconnect switches, safety cut-offs and fittings, control panels, fuses, boxes, and fittings required for complete installation.
 - 2. Final connections, including mounting and wiring of switches furnished as part of the food service equipment (unless otherwise indicated on the drawings).
 - 3. Disconnect existing equipment.
- D. Mechanical Work:
 - 1. Provide exhaust hoods with connection collars ready for final connection by HVAC Section.
 - 2. Provide stainless steel exposed ducts to ceiling for dishmachine.

1.3 WORK INCLUDED THIS SECTION:

- A. Furnish and install all food service equipment as specified herein, including that which is reasonably inferred, with all related items necessary to complete work shown on contract drawings and/or required by these specifications.
- B. Electrical Work:
 - 1. Interwiring of food service equipment between components within equipment, such as heating elements, switches, thermostats, motors, etc., complete with junction box as is applicable, ready for final connection.
 - 2. Voltages shall be as indicated on contract drawings. Any differences in electrical characteristics at job site from those shown on contract documents must be submitted to Architect for consideration prior to ordering equipment.

- C. Plumbing Work:
 - 1. Furnish all equipment with faucets, sink waste assemblies, and trim as specified in this section.
 - 2. Other than sink compartments, extend all indirect waste lines to nearest floor receptor. All such drain lines to be properly sized. Drain shall terminate with proper air gap above flood rim of floor receptor. Drain lines to be copper with silver paint unless specified otherwise. Drain lines in public areas to be chrome plated where exposed to public view.
- D. Mechanical Work:
 - 1. Provide exhaust hoods with connection collars ready for final connection by Division 23.
- E. Existing Equipment:
 - 1. Contractor shall remove and store existing equipment at his expense in a controlled environment storage facility until such time as job site is ready for reinstallation.
 - 2. Relocate those items of existing equipment noted as being reset to new positions shown on plan drawings. Coordinate resetting to minimize disruptions of operation of kitchen operations.
 - 3. Remove remaining existing equipment from premises.
 - 4. All piping, traps, etc. for reset equipment shall be new.

1.4 QUALITY ASSURANCE

- A. It is required that all custom fabricated equipment such as food serving units, tables, sinks, counter tops, etc., be manufactured by a food service equipment fabricator who has the plant, personnel and engineering equipment required. Such manufacturer shall be subject to approval of Architect. All work in above category shall be manufactured by one manufacturer and shall be of uniform design and finish.
- B. Manufacturer of this equipment must be able to show that they are now and for the past five years have been engaged in manufacture or distribution of equipment, as required under this contract, as their principal product.
- C. Manufacturer of equipment herein specified shall be a recognized distributor for items of equipment specified herein which are of other manufacture than their own.
- D. Only manufacturers who can meet the foregoing qualifications will be acceptable.
- E. All work shall be done in an approved professional manner, to the complete satisfaction of the Owner.

1.5 SUBMITTALS

- A. Submit shop drawings as required by General Conditions. All shop drawings and rough-in drawings shall be CAD drafted and must be submitted in .DWF or .PDF electronic format. Multiple hard copies are not acceptable.
- B. Shop drawings and bound brochures covering manufactured or "buy-out" items covering all work and equipment included in this contract shall be submitted to Architect as soon as possible after award of contract. After approval, Food Service Equipment Contractor shall furnish to Architect electronic files of shop drawings and brochures, corrected as required by virtue of review comments, for distribution to various interested trades on project. All costs of reproduction and submission shall be part of contract. Bound brochure and cut sheet submittals must be copied to Owner for review and comment.

- C. Provide fully dimensioned rough-in plans at 1/4" scale, consisting of a separate drawing for each discipline. Each drawing shall show equipment shaded down 50%. Rough-in set shall include all required mechanical, electrical, plumbing, services for equipment and dimensioned rough-in location for same. Rough-in locations shown shall make allowances for required traps, switches, etc., thereby not requiring interpretation or adjustment on the part of other Contractors.
Food Service Equipment Contractor shall visit site to verify all rough-in and sleeve locations prior to installation of finished floors and shall cooperate with other Contractors involved in proper location of same. Food Service Equipment Contractor shall be responsible for any required relocations of rough-in due to errors or inaccuracies on those rough-in plans which they prepare.
- D. Rough-in plans shall include all required services which relate to equipment, but which may not directly connect thereto, such as convenience outlets at walls, hose stations, floor drains, etc.
- E. Rough-in plans shall also include all required outlet services for equipment which is designated on drawing schedule, even though such equipment may not be included in this contract. Drawings shall indicate dimensions for floor depressions, wall openings, etc., for equipment.
- F. Fully dimensioned and detailed shop drawings of custom fabricated equipment items shall be submitted, drawn at 3/4" and 1 - 1/2" scale for plans, elevations, and sections respectively.
Drawings shall show all details of construction, installation, and relation to adjoining and related work where cutting or close fitting is required. Drawings shall show all reinforcements, anchorage, and other work required for complete installation of all fixtures.
- G. Do not begin fabrication of custom manufactured equipment until approvals of shop drawings have been received and until field measurements have been taken by Food Service Equipment Contractor, where such measurements are necessary to assure proper conformance with intent of contract drawings and specifications.
- H. Make field measurements, giving due consideration to any architectural, mechanical, or structural discrepancies which may occur during construction of building. No extra compensation will be allowed for any difference between actual measurements secured at job site and dimensions indicated on contract drawings. Any differences which may be found at job site during field measurements shall be submitted to Architect for consideration before proceeding with fabrication of equipment.
- I. Submit illustrative brochures for manufactured or "buy-out" equipment items, complete with illustrations, specifications, line drawings, rough-in requirements, and list of accessories or other specified additional requirements. Brochures shall be bound and shall include data on all equipment which is to be provided, arranged in numerical sequence which conforms to item numbers of specifications. Omission of data does not reduce obligation to provide items as specified.
- J. Approval of shop schedules and brochures will be in general and shall be understood to mean that Architect has no objection to use of materials or processes shown. Approval does not relieve Food Service Equipment Contractor from responsibility for errors, omissions, or deviations from their contract requirements.

1.6 SUBSTITUTIONS - STANDARDS

- A. Refer to Instructions to Bidders and Division 01 for requirements.
- B. All unspecified substitutions after bid must be submitted to Owner for written approval prior to acceptance.

1.7 DRAWINGS

- A. Drawings which constitute part of contract documents indicate general arrangement of piping and location of equipment. Should it be necessary to deviate from arrangement indicated to meet structural conditions, make such deviations without expense to Owner.
- B. Specifications and drawings are reasonably exact, but their extreme accuracy is not guaranteed. Drawings and specifications are for assistance and guidance of Contractor, and exact locations, distances and levels shall be governed by the building.

1.8 MANUFACTURER'S DIRECTIONS

- A. Follow manufacturer's directions in all cases where manufacturers of articles used in this contract furnish directions or prints covering points not shown on drawings or specifications.

1.9 INDUSTRY STANDARDS

- A. Electric operated and/or heated equipment, fabricated or otherwise, shall conform to latest standards of National Electric Manufacturers Association and of Underwriters Laboratories, Inc., and shall bear the U.L. label.
- B. Cooking and hot food holding equipment shall meet minimum construction standards as noted by NSF #4.
- C. Refrigeration equipment shall meet minimum construction standards as noted by NSF #7.
- D. Items of food service equipment furnished shall bear the N.S.F. seal.
- E. Food service equipment shall be installed in accord with N.S.F. standards.
- F. Work and materials shall comply with requirements of applicable codes, ordinances, and regulations, including but not limited to those of Occupational Safety and Health Act (OSHA), National Fire Protection Association, State Fire Marshal, State Accident Commission, U.S. Public Health Service, State Board of Health, local health codes, etc.
- G. No extra charge will be paid for furnishing items required by regulations, even though such may not be shown on drawings or called for in these specifications.
- H. Rulings and interpretations of enforcing agencies shall be considered part of regulations.

PART 2 - PRODUCTS

2.1 MANUFACTURED EQUIPMENT

- A. All like types of equipment such as all refrigerated and heated cabinets, all ovens, and all mixers shall be by the same manufacturer.
- B. Except as may be specified otherwise under individual item specifications in "Equipment Schedule", all items of standard manufactured equipment shall be complete in accord with

manufacturer's standard specification for specific unit or model called for, including finishes, components, attachments, appurtenances, etc., except as follows:

1. All items of standard equipment shall be that manufacturer's latest model at time of delivery.
2. Substitutions for manufactured equipment specified will be accorded consideration under terms set forth in "Substitutions - Standards".

2.2 FABRICATED EQUIPMENT

- A. Stainless steel shall be U.S. standard gauges as called for, 18-8, Type 302, Type 304, No. 4 finish.
- B. Galvanized iron shall be Armco or equal. Framework of galvanized iron shall be welded construction, having welds smooth, and where galvanizing has been burned off, touched up with high grade aluminum bronze.
- C. Legs and crossrails shall be continuously welded, unless otherwise noted, and ground smooth.
- D. Bottom of legs at floor shall be fitted with sanitary stainless-steel bullet type foot, with not less than 2" adjustment.
- E. Legs shall be fastened to equipment as follows:
 1. To sinks by means of closed gussets. Gussets shall be stainless steel, reinforced with bushing, having set screws for securing legs.
 2. To tables and drainboards with closed gussets which shall be welded to stainless steel hat sections or channels, 14 gauge or heavier, exposed hat sections having closed ends. Bracing shall be welded to underside of tops.
- F. Closed gussets shall be a 3" minimum diameter at top, continuously welded to frame members or to sink bottom.
- G. Sinks, unless otherwise specified, shall be furnished with rotary type waste outlets, without connected overflows: Atlantic Brass Works Model 772-RB; Fisher Brass Foundry Model 250A; T&S; or approved equal. Where exposed, furnish wastes chromium plated.
- H. Rolls shall be 1 1/2" diameter, except as detailed contrary, with corners bullnosed, ground and polished.
- I. Seams and joints shall be shop welded. Welds to be ground smooth and polished to match original finish. Materials 18 gauge or heavier shall be welded.
- J. Metal tops shall be one-piece welded construction, unless specified otherwise, reinforced on underside with stainless steel hat sections or channels welded in place. Crossbracing to be not more than 30" on centers.
- K. Drawers to be 18-gauge stainless steel channel type housing and drawer cradle, both housing and cradle being reinforced and welded at corners, housing being secured to underside of table top, and both housing and cradle being sized for and fitted with 18-gauge 20" x 20" x 5" deep stainless-steel drawer insert having coved corners. Drawer insert shall be easily removable from cradle without tools or having to remove entire drawer. Drawers to have stainless steel fronts. Provide with recessed flush type stainless steel pulls.

- L. Support drawer on fabricated 14-gauge stainless steel interlocking channel solid delrin ball bearing wheels. Support slides shall be load rated at 200 lb. per pair. Slides to be Component Hardware S52 Series.
- M. Enclosed cabinet type bases shall be made of formed steel sheets reinforced with formed steel sections to create a rigid structure. Steel shall be 18-gauge or heavier. Base shall be welded construction throughout with front rails, mullions, etc., welded to appear as one-piece construction. All exposed sections of interior and exterior shall be stainless steel, and unexposed sections shall be galvanized steel, unless specified contrary.
- N. Hardware shall be solid materials and except where unexposed or specified contrary, of cast brass, chrome plated. Stampings are not acceptable. Identify all hardware with manufacturer's name and number so that broken or worn parts may be ordered and replaced.
- O. Fabricate sink compartments with fully coved vertical and horizontal corners. Multiple compartment partition to be double thickness, continuously welded where sheets join at top. Front of multiple compartment sinks to be continuous on exterior. Bottoms shall be creased to drain.
- P. Ends of all fixtures, splashbacks, shelves, etc., shall be finished flush to walls or adjoining fixtures.
- Q. Fabricate sink compartments with fully coved vertical and horizontal corners. Multiple compartment partition to be double thickness, continuously welded where sheets join at top. Front of multiple compartment sinks to be continuous on exterior. Bottoms shall be creased to drain.
- R. Ends of all fixtures, splashbacks, shelves, etc., shall be finished flush to walls or adjoining fixtures.
- S. Dishtables, draintables, splashbacks and turned-up edges shall have radius bends in all horizontal and vertical corners, coved at intersections.
- T. Rounded and coved corners or radius bends shall be 1/2" radius or longer.
- U. Shelves in fixtures with enclosed bases shall be turned up on back and sides and feathered slightly to insure tight fit to enclosure panels. Bottom shelves shall be made for easy removal unless otherwise noted.
- V. Undersides of tops to be coated with heavy-bodied resinous material compounded for permanent, non-flaking adhesion to metal, 1/8" thick, applied after reinforcing members have been installed, drying without dirt-catching crevices.
- W. Metal components, unless specified or noted otherwise, to be the following gauges:

Counter and table tops	14 ga. Stainless Steel
Wall shelves	16 ga. Stainless Steel
Pipe leg undershelves	16 ga. Stainless Steel
Drawer fronts	16 ga. Stainless Steel
Enclosed cabinet bases	18 ga. Stainless Steel
Sinks and drainboards	14 ga. Stainless Steel
Exhaust hoods	18 ga. Stainless Steel
Legs 1 - 5/8" diameter	16 ga. Stainless Steel
Doors (outer pan)	18 ga. Stainless Steel
Doors (inner pan)	20 ga. Stainless Steel

- X. Products fabricated by Savannah Industrial Solutions, John Boos, Premier Stainless, Eagle Group, Advance Tabco, or approved equal, modified to comply with specifications, are acceptable.

2.3 HEATING EQUIPMENT

- A. Wherever electric heating equipment or thermostat control for such equipment is specified, it shall be complete, and of the materials, size and rating specified within equipment item or details.
All such equipment shall be designed and installed to be easily cleaned or to be easily removed for cleaning.
- B. Electrical appliances or heating element circuits of 120 volts shall not exceed 1650 watts, unless specifically shown contrary.

2.4 SWITCHES AND CONTROLS

- A. Food Service Equipment Contractor shall supply on each motor driven appliance or electrical heating unit suitable control switch of proper type in accord with Underwriter's Code.
- B. All internal wiring for fabricated equipment items included, all electrical devices, wiring, controls, switches, etc., built into or forming an integral part of these items shall be furnished and installed by Food Service Equipment Contractor in their factory or building site with all items complete to junction box for final connection to building lines by Electrical Contractor.
- C. Provide standard 3-prong plugs to fit "U" slot grounding type receptacles, similar to No. 5262, for all equipment items powered by plugging into 110-120 volts, single phase AC. Also, provide suitable length 3-wire cord for equipment.

2.5 CONNECTION TERMINALS

- A. All equipment shall be complete with connection terminals as standardized by equipment manufacturers, except where specified otherwise.

2.6 LOCKS

- A. Fit all doors for reach-in refrigerated compartments with locking type latches. Provide master keys.

2.7 GAS EQUIPMENT

- A. Equipment to be suitable for use with gas available at site, and to be furnished by F.S.E.C. with pressure regulators designed to work with incoming pressure.

2.8 GAS QUICK DISCONNECTS

- A. Where specified, gas quick disconnects shall be furnished complete with gas valve, gas connector hose, quick disconnect fitting elbows, and restraining cable, all AGA approved. Gas hose shall be flexible, braided or corrugated stainless steel with smooth plastic exterior coating or sleeve of heat shrink tubing (provide on all caster mounted gas equipment).

- B. All mobile cooking equipment requiring surface protection by fire suppression nozzles shall be secured in place by stainless steel cradle type wheel stops as manufactured by the Eagle Group or Select Stainless products. Plastic wheel stops are not acceptable.

2.9 LAMINATED PLASTIC

- A. Wherever laminated plastic materials are specified, they shall be Formica, Wilson-Art, Micarta, or approved equal. Veneer all materials using urea base cement, waterproof and heatproof. Rubber base adhesives are not acceptable. Apply materials directly over close-grained plywood such as mahogany or birch. Standard fir plywood is not acceptable. Face exposed surfaces and edges with 1/16" material and corresponding back faces with 1/32" reject material. Place top sheet on and over finished edge.

PART 3 - EXECUTION

3.1 GENERAL

- A. Work under this contract and covered under this section of specifications includes but is not limited to:
 - 1. Cutting of holes and/or ferrules on equipment for piping, drains, electrical outlets, conduits, etc. as required to coordinate installation of food service equipment with work of other Contractors on project.
 - 2. Field checking of building and rough-in requirements, and submission of brochures and shop drawings, all as required hereinbefore under "Submittals".
 - 3. Repair of all damage to premises as result of this installation, and removal of all debris left by those engaged in this installation.
 - 4. Having all food service equipment fixtures completely cleaned and ready for operation when building is turned over to Owner.

3.2 INSTALLATION PROCEDURES

- A. Food Service Equipment Contractor shall arrange for receiving their custom fabricated and "buy out" equipment and shall make delivery into building as requisitioned by their installation superintendent. They shall not consign any of their equipment to Owner or to any other Contractor unless they have written acceptance from them and have made satisfactory arrangements for the payment of all freight and handling charges.
- B. Food Service Equipment Contractor shall deliver all their custom fabricated and "buy out" equipment temporarily in its final location, permitting Trades to make necessary arrangements for connection of service lines; they shall then move equipment sufficiently to permit installation of service lines, after which they shall realign their equipment level and plumb, making final erection as shown on contract drawings.
- C. All portable or counter mounted equipment weighing more than 25 pounds shall be mounted on 4" stainless steel adjustable legs.
- D. This Contractor shall coordinate their work and cooperate with other trades working at site toward the orderly progress of the project.
- E. Architect or Owner's Agent shall always have access to plant or shop in which custom fabricated equipment is being manufactured, from time contract is let until equipment is shipped, in order that progress of work can be checked, as well as any technical problem which may arise in coordination of equipment with building. Any approval given at this

point of manufacture shall be tentative, subject to final inspection and test after complete installation.

- F. Food Service Equipment Contractor shall assist Architect, Owner, and/or Owner's Agent in making any desired tests during or prior to final inspection of equipment; they shall remove immediately any work or equipment rejected by Architect, Owner, and/or Owner's Agent, replacing same with work conforming with contract requirements, and shall reimburse mechanical and/or other contractors involved for extra work made necessary by such replacement.
- G. This Contractor shall keep premises free from accumulation of their waste material and rubbish, and at completion of their work shall remove their rubbish and implements, leaving areas of their work broom clean.
- H. This Contractor shall provide and maintain coverings or other approved protection for finished surfaces and other parts of their equipment subject to damage during and after erection. After removal of protective coverings, all field joints shall be grounded, polished and entire work shall be thoroughly cleaned and polished.

3.3 TRIMMING AND SEALING EQUIPMENT

- A. Seal completely spaces between all units to walls, ceilings, floors, and adjoining (not portable) units with enclosed bodies against entrance of food particles or vermin by means of trim strips, welding, soldering, or commercial joint material best suited to nature of equipment and adjoining surface material.
- B. Close ends of all hollow sections.
- C. Equipment butting against walls, ceilings, floor surfaces and corners to fit tightly against same; backsplashes or risers which fit against wall to be neatly scribed and sealed to wall with Dow Corning # 732 RTV or General Electric clear silicone sealant, wiping excess sealant out of joint to fillet radius. Where required to prevent shifting of equipment and breaking wall seal, anchor item to floor or wall.
- D. Treat enclosed spaces (inaccessible after equipment installation) for vermin prevention in accord with industry practice.

3.4 TESTING AND DEMONSTRATION OF EQUIPMENT

- A. After completion of installation, all equipment using water, gas, and electricity shall be performance inspected and tested by factory certified service agent, including wet test of hood fire suppression systems, if so required. Food Service Equipment Contractor shall document that these inspections have been performed prior to scheduling demonstrations and Owner acceptance of equipment.
- B. Food Service Equipment Contractor shall arrange to have all manufactured, mechanically operated equipment furnished under this contract demonstrated by authorized representatives of equipment manufacturers, these representatives to instruct Owner's designated personnel in use, care, and maintenance of all items of equipment after same are in working order. Demonstration and instruction shall be held on dates designated by Owner.

- C. Food Service Equipment Contractor shall provide a competent service representative to be present when installation is put into operation.

3.5 EQUIPMENT HANDLING AND STORAGE

- A. Deliver equipment to site, properly crated and protected, and store in safe place, protected from damage until time for installation.

3.6 GUARANTEE

- A. Special Project Warranty: Provide written warranty, signed by manufacturer, agreeing to replace/repair, within warranty period, with inadequate and defective materials and workmanship, including leakage, breakage, improper assembly, or failure to perform as required, provided manufacturer's instructions for handling, installing, protecting, and maintaining units have been adhered to during warranty period. This warranty shall be in addition to, and not limitation of, the rights the Owner may have against the Contractor under the Contract Documents.
- B. Warranty Period:
 - 1 year minimum from date of Substantial Completion, all new equipment furnished.
 - 5-year warranty period on refrigeration compressors.
 - 10-year warranty period on walk-in panels.

3.7 OPERATING AND MAINTENANCE MANUALS

- A. After completion of installation, Food Service Equipment Contractor shall present to Owner three sets of all operating and maintenance manuals, covering all mechanically operated equipment furnished under this contract, each set being neatly bound in loose-leaf binder having durable cover.
- B. Include in each binder a list of names, addresses and telephone numbers of local servicing agencies authorized to make necessary repairs and/or adjustments of equipment furnished under this contract.

PART 4 – FOOD SERVICE EQUIPMENT

ITEM 01 COLD STORAGE ASSEMBLY

QUANTITY AS SCHEDULED

Provide prefabricated cold storage room assembly of size and shape shown on plan and detail drawings. Exact overall size to be field verified prior to fabrication.

- A. Insulation:

Panels shall be insulated with 4" thick urethane, foamed or poured in place using HCPC (no CFC) blowing agent. Foam shall be 2.25 lb. density, 95% closed cell. Panels shall meet STME-84 (UL-723) and be listed by Underwriters laboratories. Panels shall have a maximum flame spread of 25, maximum smoke developed of 450 minimum. Flash ignition of 600 degrees and minimum self-ignition of 800 degrees F.
- B. Coved corners:

Assembly shall be constructed so that all interior wall, floor, and ceiling intersections shall comply with N.S.F. requirements.
- C. Cam lock fasteners:

All panel intersections and wall, floor and ceiling intersections shall be secured by cam-lock fasteners connected with 2" wide metal straps set in and surrounded by insulation.
- D. Finishes:

- Exterior and interior finishes shall be as shown on drawings.
- E. Doors:
Door size and finish shall be as shown on drawings, and shall be furnished complete with sill wiper gasket, and a minimum of 3 spring loaded lift type hinges. Doors to be Super doors with a reinforced 14 ga. U-Channel steel frame, backed with additional 1/8" steel plate drilled and tapped where all hardware is mounted. 3/16" backing on all doors larger than 42" wide. Exterior door to be equipped with automatic door closer. Cooler and Freezer doors to be equipped with perimeter heat. All doors to be equipped with heavy duty padlocking pull-handle lever, with inside safety release.
- F. Thermometers:
Each compartment to be provided with exterior flush mounted thermometer mounted at eye level to each door. Provide remote read-out for freezer compartment at exterior cooler door.
- G. Lights:
Each compartment to be furnished complete with manufacturer's standard light fixtures, having protective cover, mounted and pre-wired to switch with pilot light in door section. Extra light fixtures as needed to provide 30-foot candles 30" above floor. Lights to be furnished and installed by this section.
- H. Ceiling panels to be one piece, self-supporting and span full width of assembly when available.
- I. Floor:
Recessed insulated floor by Food Service Equipment Contractor with .100 diamond tread aluminum.
Reinforced floor panels to support minimum 1200 pounds per square foot.
The floor and ceiling shall have maximum length panels to span full length of box, if possible, otherwise stagger joints so there are no common "four corner" intersections and no joints occurring in doorways.
- J. Refrigeration System:
Shall be furnished by manufacturer as part of cold storage room assembly, provide each compartment with complete refrigeration system sized to maintain appropriate temperature.
Provide temperature alarm system with remote read-out and recording capability.
Condensing units to be air-cooled, remote. Units to have performance and wiring characteristics as scheduled on drawings.
Refrigeration systems to be designed for use with R448 refrigerant. Condensing units to be provided with painted galvanized steel all-weather housing, controls, and crankcase heaters, all suitable for outdoor conditions, and located as shown on drawings. Evaporators to be low-silhouette type with adaptive defrost control equal to a Bally SmartVap+controller.
Evaporators to be equipped with 2speed EC motors, running full speed while refrigeration is engaged, and running at 1/3 speed while system is pumped down; mounted at locations shown on drawings. Performance and wiring characteristics to be as scheduled on drawings. Condensing units shall be provided with 2 speed EC fan motors, running full speed while refrigeration is engaged and 1/2" speed while ambient temp is below 60 degrees Fahrenheit. Also, the crank case heater will be turned off at an ambient above 60 degrees Fahrenheit.
The evaporator drain lines are to be provided by this section and extended to floor receptors outside assembly.
Freezer drain lines to be wrapped with heater cable and insulated with pre-molded foamed plastic insulation suitable for the application. Thickness as recommended by manufacturer.
Refrigerant piping to be ACR copper tubing, hard temper, with wrought fittings and silver solder joints. Insulate suction lines with pre-molded foamed plastic insulation, thickness as recommended by manufacturer for temperature and application.
Refrigeration systems to be provided with all required refrigerant piping, insulation, sight glass vibration eliminator, solenoid(s), dryer, suction line filter, expansion valve(s),

thermostat(s), heat exchangers, and defrost timers, etc. as necessary for complete installation. Provide pump control circuit consisting of thermostat and solenoid valve. All components including piping and insulation to be installed using accepted industry standards, manufacturer's instructions, and first-class workmanship.

K. Miscellaneous:

Assembly to be installed on depressed building slab. See detail drawing.

Provide 1/8" diamond tread wainscot along exposed front exterior of assembly mounted from floor to 48" A.F.F.

Provide trim strips, closure panels, etc., as necessary to trim assembly to adjacent building surfaces.

Provide removable top closure panels with "C" channel rails. Lift-out panel sections to have turn-down edges for strength and are not to exceed 4'-0" in length.

Provide plastic strip curtains at door locations, transparent vinyl overlapping strips, aluminum bar hanging rod and bracket, suitable for low temperature application, as manufactured by Curtron, Flexstrip Products, Inc., or equal. Size to suit openings.

Provide heated pressure relief port in freezer.

Provide sleeves properly located for utility entrance, drain lines, and refrigeration lines, and after lines are installed, fill sleeves with spray foam compound, suitable for use in refrigerated spaces. Trim excess foam away and cover with stainless steel escutcheon. Cold storage room shall be erected by factory trained, or factory approved installers or shall be supervised by factory personnel. Shop drawing submittal shall indicate who the installer is, and a letter of approval shall accompany the submittal indicating the manufacturer's acceptance of the installers.

Refrigeration systems shall be furnished by cold storage room manufacturer and installed by factory approved personnel.

This specification does not constitute a complete description of cold storage assembly, also see plan and detail drawings.

Cold storage room assembly to be as manufactured by Bally, Arctic, Norlake, American Panel, Imperial/Brown, or Masterbilt complying with specifications and drawings.

ITEM 02A SHELIVING UNIT QUANTITY AS SCHEDULED

Provide wire shelving unit with the following features:

- A. 60"W x 21"D x 67-5/16"H
- B. (4) Open grid shelves with epoxy coated steel frames & removable polymer shelf mats
- C. (4) Polymer posts
- D. Antimicrobial product protection
- E. (4) Swivel 5" casters with polyurethane treads

Shelving unit to be as manufactured by Metro, Model No. Q466EG3, Quantum, or Cambro.

ITEM 02B SHELIVING UNIT QUANTITY AS SCHEDULED

Provide wire shelving unit with the following features:

- A. 48"W x 21"D x 67-5/16"H
- B. (4) Open grid shelves with epoxy coated steel frames & removable polymer shelf mats
- C. (4) Polymer posts
- D. Antimicrobial product protection
- E. (4) Swivel 5" casters with polyurethane treads

Shelving unit to be as manufactured by Metro, Model No. Q456EG3, Quantum, or Cambro.

ITEM 02C SHELIVING UNIT QUANTITY AS SCHEDULED

Provide wire shelving unit with the following features:

- A. 36"W x 21"D x 67-5/16"H
- B. (4) Open grid shelves with epoxy coated steel frames & removable polymer shelf mats
- C. (4) Polymer posts
- D. Antimicrobial product protection
- E. (4) Swivel 5" casters with polyurethane treads

Shelving unit to be as manufactured by Metro, Model No. Q436EG3, Quantum, or Cambro.

ITEM 03A DUNNAGE RACK

QUANTITY AS SCHEDULED

Provide dunnage rack having the following features:

- A. 22" x 36" x 12"H
- B. Slotted, with separate polymer tie for joining racks
- C. Corrosion proof polymer construction

Dunnage rack to be as manufactured by Metro, Model HP2236PD, Quantum, or Cambro.

ITEM 03B DUNNAGE RACK

QUANTITY AS SCHEDULED

Provide dunnage rack having the following features:

- A. 22" x 48" x 12"H
- B. Slotted, with separate polymer tie for joining racks
- C. Corrosion proof polymer construction

Dunnage rack to be as manufactured by Metro, Model HP2248PD, Quantum, or Cambro.

ITEM 04A SHELVING UNIT

QUANTITY AS SCHEDULED

Provide wire shelving unit with the following features:

- A. 60"W x 24"D x 80"H
- B. (4) Open grid shelves with epoxy coated steel frames & removable polymer shelf mats
- C. (1) Solid shelf, (4) polymer posts
- D. Antimicrobial product protection
- E. Caster mounted

Shelving unit to be as manufactured by Metro, Model No.5Q567EG3, Quantum, or Cambro.

ITEM 04B SHELVING UNIT

QUANTITY AS SCHEDULED

Provide wire shelving unit with the following features:

- A. 48"W x 24"D x 80"H
- B. (4) Open grid shelves with epoxy coated steel frames & removable polymer shelf mats
- C. (1) Solid shelf, (4) polymer posts
- D. Antimicrobial product protection
- E. Caster mounted

Shelving unit to be as manufactured by Metro, Model No.5Q557EG3, Quantum, or Cambro.

ITEM 05 AIR CURTAIN

QUANTITY AS SCHEDULED

Provide air curtain with the following features:

- A. For 42" wide door
- B. Unheated
- C. Galvanized steel cabinet
- D. Obsidian black powder coat finish
- E. Microswitch at door
- F. Voltage as scheduled, direct connection

Air curtain to be as manufactured by Mars Air Systems, Model No. LPN242-1UA-OB, Curtron, or Berner.

ITEM 06 NOT USED

ITEM 07 WORK TABLE QUANTITY AS SCHEDULED

Provide worktable with the following features:

- A. 96"W x 30"D, 10"H backsplash
- B. 14 Gauge 304 stainless steel top with countertop non drip edge
- C. Galvanized legs with side & rear cross rails
- D. Flanged feet
- E. Drawer assembly

Worktable to be as manufactured by Advanced Tabco, Model TVKG-308, Eagle, or Titan Stainless.

ITEM 07A WELD-IN SINK, SINGLE BOWL QUANTITY AS SCHEDULED

Provide single weld-in sink bowl for Item 10 with the following features:

- A. 24"W x 24"D x 14" single bowl
- B. Includes faucet
- C. (1) Stainless steel sink cover
- D. (1) Disposer provision

Weld-in single sink to be as manufactured by Advanced Tabco, Model TA-11D, Eagle, or Titan Stainless.

ITEM 08 FOOD PROCESSOR, BENCHTOP QUANTITY AS SCHEDULED

Provide food processor with the following features:

- A. Includes: vegetable prep attachment with kidney shaped & cylindrical hopper (no bowl)
- B. (1) 3MM grating disc
- C. (1) 3MM slicing disc
- D. Stainless steel base
- E. Single speed 425 RPM
- F. Voltage as scheduled, cord and plug

Food processor to be as manufactured by Robot Coupe, Model No. CL50EULTRA, Hobart, or Sammic.

ITEM 09 WORK TABLE QUANTITY AS SCHEDULED

Provide worktable with the following features:

- A. 108"W x 30"D, 10"H backsplash
- B. 14 Gauge 304 stainless steel top with countertop non drip edge
- C. Stainless steel legs with side & rear cross rails
- D. Flanged feet
- E. Drawer assembly

Worktable to be as manufactured by Advanced Tabco, Model TVKG-309, Eagle, or Titan Stainless.

ITEM 09A WELD-IN SINK, DOUBLE BOWL QUANTITY AS SCHEDULED

Provide double weld-in sink bowl for Item 07 with the following features:

- A. 20"W x 20"D x 12" double bowls
- B. (1) Lever drain, (1) disposer provision
- C. (2) Stainless steel sink covers
- D. Includes faucet

Weld-in double sink to be as manufactured by Advanced Tabco, Model TA-11D-2, Eagle, or Titan Stainless.

ITEM 10 WORK TABLE, S/S TOP QUANTITY AS SCHEDULED

Provide work table with the following features:

- A. 48"W x 30"D, 10" backsplash
- B. 14 Gauge 304 stainless steel top with non-drip edge
- C. Stainless steel adjustable undershelf
- D. Stainless steel legs with stainless steel bullet feet
- E. HD Drawer

Work table to be as manufactured by Advance Tabco, Model VKS-304, Eagle, or Titan Stainless.

ITEM 11 EQUIPMENT STAND QUANTITY AS SCHEDULED

Provide countertop cooking stand for Item 12 with the following features:

- A. 30"W x 30"D x 28"H (overall)
- B. Aluminum pan rack with 2" spacing
- C. 16-Gauge stainless steel top with 1"H up-turn on sides & rear
- D. 18-Gauge adjustable 430 stainless steel undershelf
- E. Stainless steel legs with 5" casters (2 braked)
- F. Accommodates (6) 18" x 26" pans

Equipment stand to be as manufactured by Advance Tabco, Model No. MT-MS-300, Eagle, or Titan Stainless.

ITEM 12 FOOD SLICER, ELECTRIC QUANTITY AS SCHEDULED

Provide food slicer with the following features:

- A. Automatic, single speed
- B. Anodized aluminum finish, carriage & knife cover
- C. Medium duty, angled feed
- D. 13" Chrome plated knife
- E. Carriage & gauge interlocks, no volt release
- F. Poly-v belt drive system
- G. Top mounted sharpener
- H. Voltage as scheduled, cord and plug

Food slicer to be as manufactured by Hobart, Model EDGE13A-11, Globe, or Univex.

ITEM 13 DISPOSER QUANTITY AS SCHEDULED

Provide disposer with the following features:

- A. Basic unit
- B. 3 HP motor
- C. Stainless steel construction
- D. Includes mounting gasket
- E. Adjustable leg kit
- F. Control panel mounted to table
- G. Voltage as scheduled, direct connection

Disposer to be as manufactured by InSinkErator, Model No. SS-300, Salvajor, or Hobart.

ITEM 14 WORK TABLE, S/S TOP QUANTITY AS SCHEDULED

Provide work table with the following features:

- A. 72"W x 30"D
- B. 14 Gauge 304 stainless steel top with non-drip edge
- C. Adjustable galvanized undershelf
- D. Caster mounted

Work table to be as manufactured by Advance Tabco, Model VLG-306, Eagle, or Titan Stainless.

ITEM 15 UNIVERSAL PAN RACK

QUANTITY AS SCHEDULED

Provide pan rack with the following features:

- A. Full height, open sides
- B. Universal stepped angle slides, slides on 5" centers
- C. Holds 12 pans
- D. All-welded aluminum construction
- E. Front & rear loading
- F. 5" Stem bolted casters

Pan rack to be as manufactured by Advance Tabco, Model No. UR12, Channel, or Piper.

ITEM 16 REACH-IN REFRIGERATOR

QUANTITY AS SCHEDULED

Provide reach-in refrigerator with the following features:

- A. Reach-in
- B. Two-sections
- C. 46.15 Cu. ft. capacity
- D. (2) Solid hinged doors (lockable)
- E. (6) Adjustable shelves
- F. Electronic control
- G. LED interior lighting
- H. Digital display
- I. Adaptive defrost
- J. Stainless steel interior & exterior
- K. Bottom mounted self-contained refrigeration
- L. R290 Hydrocarbon refrigerant
- M. 6" Heavy duty casters
- N. Voltage as scheduled, cord and plug

Reach-in refrigerator to be as manufactured by Beverage Air, Model No. HBR49HC-1, Continental, or True.

ITEM 17 CAN OPENER

QUANTITY AS SCHEDULED

Provide can opener with the following features:

- A. Manual
- B. 16" Bar length
- C. Dishwasher safe
- D. Rust proof
- E. Stainless steel, with cast stainless steel base
- F. NFS certified

Can opener to be as manufactured by Edlund, Model No S-11, or approved equal.

ITEM 18

NOT USED

ITEM 19 UTILITY DISTRIBUTION SYSTEM

QUANTITY AS SCHEDULED

Provide island utility chase to serve items under exhaust hood, having the following features:

- A. Type 18-guage 330 stainless steel construction.
 - B. Unit(s) shall be UL/ETL listed.
 - C. Breaker panel factory installed in end riser for single point field connection.
 - D. Designed to include electrical wireway system. Each appliance to be fed from the individual breakers which are wired to each receptacle located along the raceway.
 - E. All outlets shall provide moisture resistant covers and have been sized per NEMA standards. Each is supplied with a matching cord and plug set if these are not already supplied by the equipment manufacturer.
 - F. The plumbing riser shall house manual shut-off valves for each incoming main supply line located in the UDS. The plumbing manifolds shall be provided with stub-outs along the raceway for the individual plumbing connections. Each stub-out shall be equipped with a manual shut-off valve.
 - G. The plumbing compartment shall be completely isolated from the electrical with all piping labeled. Hot and cold water and steam supply and return manifolds shall be insulated.
 - H. Gas and water quick-disconnects to be provided for connection to equipment.
 - I. Gas shut-off valve to come installed in UDS.
 - J. Length as shown on drawings, with utilities coming from above.
 - K. Lift out doors shall provide easy access to risers. Removeable panels provided along the length of the raceway shall allow access to either plumbing or electrical compartments.
 - L. Note: Cord and plugs must not interfere with placement of equipment.
 - M. UDS must comply with all national and local code standards.
- Utility chase to be as manufactured by Captive-Aire, Model UDI, Gaylord, or Avtec.

ITEM 20 EXHAUST HOOD

QUANTITY AS SCHEDULED

Provide island mount exhaust hood of size, shape and content as shown on detail drawings, having the following features:

- A. All exposed surfaces of 430 Series, stainless steel construction.
- B. N.F.P.A. 96 construction, including all joints and seams welded externally, continuous, and liquid tight.
- C. 5/8" diameter hanger rods to structural ceiling, approximately 96" on center.
- D. Stainless steel high-efficiency baffle type U.L. classified grease extracting filters, with handles.
- E. Integral grease gutter sloped to drain to grease receptacle.
- F. Vapor-proof U.L. listed recessed LED light fixtures.
- G. Coordinated installation of fire suppression system as specified for Item 21.
- H. Integral make-up air plenum along front as shown
- I. Provide spacer frame to allow passage of utility chase between hood sections and stainless-steel trim on bottom and ends.
- J. Removable stainless steel perimeter trim and/or closure panels from top of hood to ceiling.
- K. Food Service Equipment Contractor shall provide and install any secondary supporting members required to suspend exhaust hoods. Hood supports shall include seismic bracing, if required, installed in accord with SMACNA guidelines.
- L. Fire suppression cabinet with pre-wire control package and switches with variable speed control fan.

Exhaust hood to be as manufactured by Captive-Aire, Model ND2-PSP, Gaylord, or Avtec.

ITEM 21 FIRE SUPPRESSION SYSTEM

QUANTITY AS SCHEDULED

Provide automatic wet chemical fire suppression system as required to protect exhaust hood, Item 20, and the cooking equipment located under this hood, and having the following features:

- A. All tanks, control heads, piping, relays, cable, fusible links, nozzles, elbows, etc., as required for complete system
- B. Brass nozzles and chrome plated or sleeved exposed piping

- C. Manual strike mechanism in accessible location
 - D. Installation in accord with N.F.P.A. 17A code requirements and coordinate with exhaust hood construction and installation
 - E. Four contacts for use by E.C., one contact for alarm, one for supply fan shut-off, one for shunt trip actuation, and one spare
 - F. Provide mechanical gas solenoid valve loose for installation by plumber
- Fire suppression system to be as manufactured by Ansul, Model R-102, Pyro-chem, or Range Guard.

ITEM 22 MOBILE HEATED CABINET

QUANTITY AS SCHEDULED

Provide holding cabinet with the following features:

- A. Mobile
- B. Full-size, insulated
- C. Convection holding
- D. Accommodates (14) 18" x 26" sheet pans or (28) 13" x 18" sheet pans or (28) 12" x 20" hotel pans
- E. Load limit 65 lbs. (29.25 kg) per rack
- F. (2) Field reversible hinged solid Dutch doors
- G. Magnetic door handle
- H. Touch control with processor
- I. HACCP temperature downloads
- J. Caster mounted
- K. USB audio & audio port
- L. Manual water fill
- M. Stainless steel interior & exterior
- N. Voltage as scheduled, cord and plug

Proofer cabinet to be as manufactured by Winston Foodservice, Model No. HOV5-14UV, Alto-Shaam, or Metro.

ITEM 23 CONVECTION STEAMER, ELECTRIC

QUANTITY AS SCHEDULED

Provide convection steamer having the following features:

- A. Electric, boilerless
- B. Double stacked, with stacking kit
- C. (6) Full size pan capacity
- D. Sure cook controls
- E. 60-Minute electro-mechanical timer & manual (continuous steaming) bypass switch
- F. Left-hand hinged door, controls on right
- G. Automatic drain & water level controls
- H. Clean shield interior
- I. Standard treated & tap water connection
- J. Stainless steel exterior
- K. 4" Adjustable legs
- L. Voltage as scheduled, (2) direct connection
- M. Water filter, with backflow preventer
- N. Drain cooling kit with 1-1/2" drain

Convection steamer to be as manufactured by Cleveland, Model No. (2) 22CET66.1, Accu-Temp, or Groen.

ITEM 24 CONVECTION OVEN, ELECTRIC

QUANTITY AS SCHEDULED

Provide convection oven with the following features:

- A. Electric

- B. Double-deck, standard depth
 - C. Capacity (5) 18" x 26" pans per compartment
 - D. Solid state infinite controls with 60 min. manual timer
 - E. Two speed fan
 - F. Vent connector
 - G. Dependent glass doors
 - H. Interior light
 - I. Stainless steel front, sides & top
 - J. Low profile casters
 - K. Voltage as scheduled, (2) direct connection
- Convection oven to be as manufactured by Blodgett, Model No. ZEPH-100-E DBL, Southbend, or Garland.

ITEM 25 COUNTERTOP KETTLE, ELECTRIC QUANTITY AS SCHEDULED

Provide electric twin unit tilting kettle with the following features:

- A. Countertop, twin unit
 - B. 12 gallon capacity each
 - C. 2/3 Steam jacket design
 - D. Self-contained
 - E. Lever style-tilting
 - F. Anti-drip pour spout
 - G. Water protection controls
 - H. Self-locking latch, reinforced rolled rim
 - I. Center support console
 - J. Stainless steel construction with 316 series stainless steel liner
 - K. Double pantry faucet with spout & spray hose combination
 - L. Equipment stand, open base with sliding drain drawer & splash screen
 - M. Retractable splash guard/pan shelves for drain drawer
 - N. Voltage as scheduled, (2) direct connection
- Twin countertop kettle to be as manufactured by Cleveland Range Model No. TKET12T, Groen, or Crown.

ITEM 26 BRAISING PAN, ELECTRIC QUANTITY AS SCHEDULED

Provide tilting skillet braising pan with the following features:

- A. Electric
 - B. 30-gallon capacity
 - C. Bead blasted cooking surface
 - D. 10° tilt cooking feature, with power tilt with hand tilt override
 - E. Spring-assisted cover with vent
 - F. Gallon & liter markings
 - G. Stainless steel construction with open leg frame, flanged feet
 - H. Voltage as scheduled, direct connection
 - I. Single Pantry Skillet Filler, with 60" hose
- Tilted skillet braising pan to be as manufactured by Cleveland Range, Model No. SEL30T1, Accutemp, or Groen.

ITEM 27 FLOOR TROUGH QUANTITY AS SCHEDULED

Provide floor trough with the following features:

- A. 36"W x 18"D, 6" deep receptacle
- B. (1) 4" OD tailpiece

- C. Stainless steel beehive strainer
- D. 14/304 Stainless steel
- E. Brushed satin finish
- F. Pultruded fiberglass grating

Floor trough to be as manufactured by IMC/Teddy, Model ASFT-1836-PFG, Eagle Group, or SPG.

ITEMS 28-29

NOT USED

ITEM 30 HAND SINK

QUANTITY AS SCHEDULED

Provide hand sink with the following features:

- A. Wall Mounted
- B. Side splashes, left and right
- C. 14"x10" front-to-back x 5" deep bowl
- D. 20 gauge S/S
- E. HD Faucet
- F. Side splash where required

Hand sink to be as manufactured by Advanced Tabco, Model No. 7-PS-40, Eagle Group, or Titan Stainless.

ITEM 31 ICE MAKER, CUBE-STYLE

QUANTITY AS SCHEDULED

Provide ice maker with the following features:

- A. 36"W
- B. Dual exhaust top/side air discharge
- C. Air-cooled
- D. Self-contained condenser
- E. Approximately 465 lb./24 hours at 70°/50° (350 lb. at 90°/70°)
- F. Built-in antimicrobial protection
- G. Full-size cube
- H. LED status display
- I. One touch sanitize/descaling controls
- J. Dishwasher safe food zone components
- K. Water filter manifold, with backflow preventer
- L. Voltage as scheduled, direct connection

Ice maker to be as manufactured by Ice-O-Matic, Model No. CIM0436FA, Scotsman, or Manitowoc.

ITEM 31.1 ICE BIN

QUANTITY AS SCHEDULED

Provide ice bin with the following features:

- A. 510 Lb. Storage Capacity
- B. 30"W x 31"D x 50"H
- C. Top-hinged
- D. Slope front door
- E. For top-mounted ice maker
- F. Polyethylene interior, durable aluminum exterior
- G. 6" legs

Ice bin to be as manufactured by Ice-O-Matic, Model No. CB55PS, Scotsman, or Manitowoc.

ITEM 32 PASS-THRU REFRIGERATOR

QUANTITY AS SCHEDULED

Provide pass-thru refrigerator with the following features:

- A. Pass-thru

- B. One-section, standard depth cabinet
- C. Self-contained refrigeration
- D. Stainless steel exterior, aluminum interior
- E. Half-height solid doors, hinged on right
- F. Cylinder locks
- G. Electronic control with digital display
- H. Hi-low alarm
- I. Unit comes standard with expansion valve
- J. Caster mounted
- K. R290 Hydrocarbon Refrigerant
- L. Voltage as scheduled, cord and plug

Pass-thru refrigerator to be as manufactured by Continental Refrigerator, Model No. 1RNSAPTHD, Beverage Air, or True.

ITEM 33 PASS-THRU HEATED CABINET
SCHEDULED

QUANTITY AS

Provide pass-thru cabinet with the following features:

- A. One-section, standard depth cabinet
- B. 21 Cu. ft. capacity
- C. (3) Shelves
- D. Stainless steel exterior, aluminum interior
- E. Half-height doors, hinged on right
- F. Electronic control with digital display
- G. Caster mounted
- H. Voltage as scheduled, cord and plug

Pass-thru heated cabinet to be as manufactured by Continental Refrigerator, Model No. DL1W-SA-PT-HD, Beverage Air, or True.

ITEM 34 MILK COOLER
SCHEDULED

QUANTITY AS

Provide milk cooler with the following features:

- A. Forced air, single access
- B. Nom. 34"W x 34"D x 47"H
- C. 13.59 Cu. ft.
- D. Exterior digital thermometer
- E. (8) 13" x 13" x 11" or (4) 19" x 13" x 11" Case capacity
- F. Self-latching doors/lids with safety bumpers
- G. R290 Hydrocarbon refrigerant
- H. Cylinder lock
- I. Wire floor rack
- J. Floor drain
- K. Electronic control, auto defrost
- L. Stainless steel interior & exterior
- M. 6" Heavy duty casters
- N. Voltage as scheduled, cord and plug

Milk cooler to be as manufactured by Beverage Air, Model No. SMF34HC-1-S, Continental, or True.

ITEM 35

NOT USED

ITEM 36 SERVING COUNTER, COLD FOOD

EXISTING, RESET

This item is to be reset from Owner's existing facility by Food Service Equipment Contractor.

ITEM 37 NOT USED

ITEM 38 CASH REGISTER STAND EXISTING, RESET

This item is to be reset from Owner's existing facility by Food Service Equipment Contractor.

ITEM 39 SERVING COUNTER, QUICK SWITCH EXISTING, RESET

This item is to be reset from Owner's existing facility by Food Service Equipment Contractor.

ITEM 40 THREE (3) COMPARTMENT SINK QUANTITY AS SCHEDULED

Provide three compartment sink with the following features:

- A. 24" Left & right-hand drainboards
- B. 28" Front-to-back x 20"W sink compartments, 14" deep, with 11"H backsplash
- C. Stainless steel legs with adjustable left-to-right and front cross rail
- D. Adjustable bullet feet
- E. 14 Gauge 304 stainless steel construction
- F. HD splash mount faucet, 12" swing
- G. (3) Lever drains
- H. HD pre-rinse unit with add-on faucet, 12" swing
- I. (2) Wall mounted shelves

Three compartment sink to be as manufactured by Advance Tabco, Model 94-83-60-24RL, Eagle Group, or Titan Stainless.

ITEM 41 DISHWASHER, CONVEYOR TYPE QUANTITY AS SCHEDULED

Provide energy recovery single tank dishmachine having the following features:

- A. (202) Racks/Hour
- B. Insulated hinged doors
- C. .62 Gallon/rack
- D. Stainless steel enclosure panels
- E. Microprocessor controls with low temperature & dirty water indicators
- F. NSF Pot & Pan mode
- G. Programable de-lime notification
- H. Standard height
- I. Electric tank heat 15kW, 30 kW Electric booster
- J. Automatic soil removal
- K. Drain water tempering kit
- L. Left-to-right operation
- M. Table limit switch
- N. Voltage as scheduled, (2) direct connection

Dishmachine to be as manufactured by Hobart, Model CLPS44EN-BAS+BUILDUP, Champion, or CMA Dishmachines.

ITEM 42 PANT LEG HOOD & VENT DUCT QUANTITY AS SCHEDULED

Provide pantleg duct with the following features:

- A. 56"W x 16"D x 52"H
- B. Fits 44" conveyor dish machines that include vent cowls (4" x 16")

C. Includes: stainless steel pantleg duct & ceiling trim ring (10" x 10")
 Pantleg duct to be as manufactured by Avtec, Model No. SSA-PANTLEG44, Eagle Group, or Titan Stainless.

ITEM 43 SOILED DISHTABLE CUSTOM

This item is to be custom fabricated per General Requirements of specifications and with plan and detailed drawings.

ITEM 44 CLEAN DISHTABLE QUANTITY AS SCHEDULED

Provide clean dishtable with the following features:

- A. Straight design
- B. Attaches to left of dish machine operator
- C. 10-1/2"H backsplash, 3" rolled front & side rims
- D. Stainless steel legs & crossrails
- E. 107"W x 30"D x 34"H
- F. 14/304 Stainless steel construction
- G. Dishtable sorting shelf
- H. Table limit switch provision

Clean dishtable to be as manufactured by Advance Tabco, Model DTC-S30-108L, Eagle Group, or Titan Stainless.

ITEM 45 POT&PAN SHELVING RACK QUANTITY AS SCHEDULED

Provide drying rack unit with the following features:

- A. 48"W x 24"D x 74"H
- B. 4-Tier
- C. Includes (2) shelves, (2) open shelf frames, (4) 74" posts, (2) drop-ins, & (1) cutting board
- C. Built-in antimicrobial protection

Drying rack unit to be as manufactured by Metro, Model No. PR48X3, or approved equal.

ITEM 46 SHELVING UNIT QUANTITY AS
 SCHEDULED

Provide wire shelving unit with the following features:

- A. 48"W x 24"D x 80"H
- B. (4) Open grid shelves with epoxy coated steel frames & removable polymer shelf mats
- C. (1) Solid shelf, (4) polymer posts
- D. Antimicrobial product protection
- E. Caster mounted

Shelving unit to be as manufactured by Metro, Model No.5Q556EG3, Quantum, or Cambro.

ITEM 47 UTILITY CART QUANTITY AS SCHEDULED

Provide utility caddy with the following features:

- A. Open base, (2) U-shaped handles
- B. Nom. 38"W x 22"D x 35"H
- C. (2) Shelves with notched corners
- D. Shelf size approximately 36" x 24", 18-1/4" shelf clearance
- E. Stainless steel construction
- F. 4" Polyurethane swivel casters

Bussing utility cart to be as manufactured by Caddy, Model No. T-202-B, Lakeside, or Carlisle.

END OF SECTION 11 40 00

SECTION 11 53 00

LABORATORY EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Corrosives and acids storage cabinets.
 - 2. Flammables storage cabinets.
 - 3. Laboratory refrigeration units.
 - 4. Accessories.

1.2 REFERENCES

- A. Environmental Protection Agency (EPA).
- B. Factory Mutual (FM).
- C. International Code Council (ICC) - International Fire Code (IFC):
 - 1. ICC I-CODE IFC - International Fire Code; 2021.
- D. National Fire Protection Association (NFPA):
 - 1. NFPA 1 - Fire Code; 2021, Errata 2022.
 - 2. NFPA 30 - Flammable and Combustible Liquids Code; 2024.
- E. Underwriters Laboratories Inc. (UL):
 - 1. UL (Dir) - Online Certification Directory; Current Edition.
- F. US Department of Labor - Occupational Safety and Health Act (OSHA).

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
 - 2. Coordinate requirements of this Section with any utilities, alarms, or grounding connection requirements that may be required.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit data and drawings indicating compliance with product specifications Regulatory Requirements indicated in this Section.
- C. Manufacturer's Installation Instructions: Indicate special installation criteria and interface with adjacent components.

1.5 QUALIFICATIONS

- A. Manufacturer Qualifications: Company specializing in manufacturing Products specified in this Section with minimum five (5) years documented experience.
- B. Installer Qualifications: Company specializing in performing work of this Section and with minimum three (3) years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Deliver products in manufacturer's original packaging. Store materials in a dry, protected, well-vented area. Inspect product upon receipt and report damaged material immediately to delivering carrier and note such damage on the carrier's freight bill of lading.

1.7 WARRANTY

- A. Section 01 77 00 - Closeout Procedures: Product warranties.
- B. Manufacturer's Warranty: Provide manufacturer's standard ten (10) year warranty for materials and workmanship to be free of defects. Warranty duration to begin with the date of Substantial Completion.

PART 2 PRODUCTS

2.1 CORROSIVES AND ACIDS STORAGE CABINETS

- A. Regulatory Requirements:
 - 1. Comply with approvals and requirements of FM, UL, OSHA, NFPA 1, NFPA 30, ICC I-CODE IFC, EPA, and authorities having jurisdiction.
- B. Manufacturers:
 - 1. Durham Manufacturing.
 - 2. Global Industrial.
 - 3. Justrite.
 - 4. Labconco.
 - 5. Substitutions: Section 01 60 00 - Product Requirements.
- C. Basis of Design: Justrite - Sure-Grip EX Safety Storage Cabinet.
- D. Storage Cabinet Types:
 - 1. Acid Storage Cabinet:
 - a. Size and Capacity:
 - 1) 65 H x 24 W x 18 D inches. 22 gallons (83 L) capacity.
 - b. Color: As selected by Architect from manufacturer's full range.
 - 2. Base Storage Cabinet:
 - a. Size and Capacity:
 - 1) 65 H x 24 W x 18 D inches. 22 gallons (83 L) capacity.
 - b. Color: As selected by Architect from manufacturer's full range.
- E. Cabinet:
 - 1. Double wall construction; 18 gauge steel.
 - 2. Leakproof seals.
 - 3. Comply with EPA requirements for leakproof spills sump, and not less than 2 inches.
 - 4. Dual vents.
 - 5. Grounding wire connection.
 - 6. Leveling feet.
- F. Cabinet Doors:
 - 1. Double wall construction; 18 gauge steel.
 - 2. Single door for cabinet width of 24 inches or less. Double doors for cabinet width greater than 24 inches.
 - 3. Door hinges to be secured to frame at cabinet side panels.

4. Self-closing doors shut and latch automatically when a fusible link melts at 165° F (74° C) under fire conditions. Self-closing mechanism is to allow obstruction-free access to contents. Coordinated self-closing for double doors.
 5. Three-point self-latching doors.
 6. Door Latch: Recessed with perimeter flange; paddle type pull latch release; lockable cylinder with keys; secondary security lock feature for padlock use.
 7. Factory apply warning labels indicating type of contents and labels as may be required in compliance with Regulatory Requirements.
- G. Shelves: Adjustable locations with adjustable mount brackets.
1. One adjustable shelf for each 18 inches of cabinet overall height.
 2. Shelves designed with slight slope to rear allowing minor spills to drain from rear of shelf to bottom spills sump.
 3. Polyethylene trays attached to galvanized steel shelves and a separate polyethylene liner for the bottom sump, resistant to aggressive chemicals. Liner is to be easily removed for cleaning of drips and leaks.
 4. Provide extra polyethylene work tray that can be secured to cabinet top for a handy work surface.
- H. Fabrication:
1. Fabricate components free of distortion and defects.
 2. Corners and joints to be fully welded and finished prior to application of finish.
- I. Finishes:
1. Epoxy powder coat finish on interior and exterior cabinet surfaces.

2.2 FLAMMABLES STORAGE CABINETS

- A. Regulatory Requirements:
1. Comply with approvals and requirements of FM, UL, OSHA, NFPA 1, NFPA 30, ICC I-CODE IFC, EPA, and authorities having jurisdiction.
- B. Manufacturers:
1. Durham Manufacturing.
 2. Global Industrial.
 3. Justrite.
 4. Labconco.
 5. Substitutions: Section 01 60 00 - Product Requirements.
- C. Basis of Design: Justrite - Sure-Grip EX Safety Storage Cabinet.
- D. Flammable Storage Cabinet:
1. Size and Capacity:
 - a. 65 H x 24 W x 18 D inches. 22 gallons (83 L) capacity.
 2. Color: Yellow.
 3. Double wall construction; 18 gauge steel.
 4. Leakproof seals.
 5. Comply with EPA requirements for leakproof spills sump, and not less than 2 inches.
 6. Dual vents with flame arresters.
 7. Grounding wire connection.
 8. Leveling feet.
- E. Cabinet Doors:
1. Double wall construction; 18 gauge steel.
 2. Single door for cabinet width of 24 inches or less. Double doors for cabinet width greater than 24 inches.
 3. Door hinges to be secured to frame at cabinet side panels.

4. Self-closing doors shut and latch automatically when a fusible link melts at 165° F (74° C) under fire conditions. Self-closing mechanism is to allow obstruction-free access to contents. Coordinated self-closing for double doors.
 5. Three-point self-latching doors.
 6. Door Latch: Recessed with perimeter flange; paddle type pull latch release; lockable cylinder with keys; secondary security lock feature for padlock use.
 7. Factory apply warning labels indicating type of contents and labels as may be required in compliance with Regulatory Requirements.
- F. Shelves: Adjustable locations with adjustable mount brackets.
1. One adjustable shelf for each 18 inches of cabinet overall height.
 2. Shelves designed with slight slope to rear allowing minor spills to drain from rear of shelf to bottom spills sump.
 3. Galvanized steel shelves.
- G. Fabrication:
1. Fabricate components free of distortion and defects.
 2. Corners and joints to be fully welded and finished prior to application of finish.
- H. Finishes:
1. Epoxy powder coat finish on interior and exterior cabinet surfaces.

2.3 LABORATORY REFRIGERATION UNITS

- A. Manufacturers:
1. Labcold.
 2. Liebherr.
 3. Thermo Scientific.
 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Refrigerator/Freezer Units.
1. Basis of Design:
 - a. Liebherr - LCexv 4010.
 2. Vertical standing unit with lockable self-closing doors to each refrigerator and freezer compartments.
 3. Spark-free interior compartments.
 4. Volume Capacity:
 - a. Refrigerator Capacity: Minimum 200 L (7.0 cu ft).
 - b. Freezer Capacity: Minimum 50 L (1.76 cu ft).
 5. Locations: As indicated on Drawings.

2.4 ACCESSORIES

- A. Goggles Storage Cabinet:
1. Basis of Design: Sellstrom - S90494 Germicidal Cabinet.
 2. Germicidal goggles and safety glasses sanitizing cabinet.
 3. Temperature Range: 0 to 40 degrees C. Maximum relative humidity 80 percent for temperatures up to 31 degrees C, decreasing linearly to 50 percent relative humidity at 40 degrees C.
 4. Listed UL (DIR).
 5. Electrical: 120V, 60hz; integrated 10 amp fuse protection against electrical overload.
 6. Controller: Automatic 5 minute timer control.
 7. Cabinet: 22 gauge steel; surface mounted type; white baked enamel.
 8. Goggle Racks: 8 shelf racks; 0.187 steel wire; white baked enamel.
 9. Capacity: 40 goggles.
 10. Lock: Stainless steel; vandal-resistant; keyed to laboratory casework master key.

- B. Fire Blanket and Cabinet:
 - 1. Basis of Design:
 - a. Larsen - FB 1016 Series, standard cabinet (16W x 10H x 8D inches).
 - 2. Cabinet: 22 gauge steel; surface mounted type; red baked enamel.
 - 3. Blanket: 62 x 80 inches; wool and complying with 16 CFR 1610.
- C. Wall Hooks: Wall mounted upper and lower pronged hook for lab coats and other articles.
 - 1. Basis of Design: Spectrum Plastics, Ltd. - Toughook.
 - 2. Coordination: Provide concealed solid blocking at wall locations for mounting hooks.
 - 3. Material: Molded nylon-plastic; vandal resistant; unbreakable.
 - 4. Size and Shape: Curved design with hook at top and at bottom.
 - a. 16W x 120H x 32D millimeters (0.63W x 4.73H x 1.25D inches).
 - 5. Mounting: Each hook to be wall mounted with 2 screws through screw holes formed during manufacturing process. Holes to be countersunk for recessing screw heads. Provide stainless steel screws of length required to securely anchor hoods through substrate and into structure or blocking behind substrate.
 - 6. Color: To be selected by Architect from manufacturer's full range.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 73 00 - Execution: Verification of existing conditions before starting work.
- B. Verify that field measurements are as required.
- C. Verify that surfaces and conditions are ready to accept the Work of this Section.
- D. Examine products to be installed for damage and other conditions detrimental to completion of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Section 01 73 00 - Execution: Prepare field conditions and existing construction for installation of Work of this Section.
- B. Prepare materials to be installed and equipment to be used during installation.

3.3 INSTALLATION

- A. Section 01 73 00 - Execution: Related to installation of Work.
- B. Install equipment in compliance with the design requirements, regulatory requirements, and manufacturer's recommendations.
- C. Install equipment plumb and level.
- D. Anchor equipment securely in place.
- E. For equipment requires utilities, alarms, or grounding connections, apply connections securely.

3.4 ADJUSTING

- A. Section 01 73 00 - Execution: Starting, testing, adjusting, and balancing.
- B. Adjust operating components to smooth operation without binding.

3.5 CLEANING

- A. Section 01 73 00 - Execution and Section 01 77 00 - Closeout Procedures.
- B. Clean installed Work in accordance with manufacturer's recommendations including cleaning procedures and materials.

3.6 PROTECTION OF INSTALLED CONSTRUCTION

- A. Section 01 73 00 - Execution: Protecting installed construction.
- B. Protect installed construction from damage and unauthorized tampering.

3.7 DEMONSTRATION AND TRAINING

- A. Section 01 79 00 - Demonstration and Training: Provide demonstration and training to Owner regarding operation and maintenance of the Work of this Section.

END OF SECTION

SECTION 11 61 43

STAGE CURTAINS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes fire retardant stage curtains and rigging.
 - 1. The term “curtains” refers to all hanging fabric items indicated in this Section and includes, but is not limited to, curtains, travelers, valances, masking borders, masking legs, cyclorama hangings, etc.
- B. Related Requirements:
- C. Refer to paragraph 1.6 (J). for requirements under the Theatrical Integrator responsibilities included in Section 26 55 61.10 - Auditorium Theatrical Lighting System.

1.2 REFERENCE STANDARDS

- A. Aerospace Industries Association (AIA) - National Aerospace Standard (Metric) (NASM):
 - 1. NASM 16491 - Grommet, Metallic, General Specification For; 2016, Stabilization Notice 2023.
- B. FM Global (FM):
 - 1. FM (AG) - FM Approval Guide; Current Edition.
- C. Intertek Testing Services (ITS):
 - 1. ITS (DIR) - Directory of Listed Products; Current Edition.
- D. National Fire Protection Association (NFPA):
 - 1. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2023.
- E. Military and Government Specs & Standards (Naval Publications and Form Center) (NPFC):
 - 1. NPFC - RR-C-271 - Chains And Attachments, Carbon And Alloy Steel; 2021 - Revision H, Amendment 2022.
- F. Underwriters Laboratories (UL):
 - 1. UL (DIR) - Online Certification Directory; Current Edition.

1.3 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate structural and other requirements of this Section with other related construction elements.
- C. Coordinate support and anchorage requirements with building construction elements required to provide adequate support and anchorage locations.

1.4 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this Section. Review the work requirements, project conditions, sequencing, application procedures, quality control, testing and inspection and production schedule.

1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Provide for each type of product as follows:
 - 1. Stage Curtains: Provide information on type of curtain, weight, location for use on project, and type of flame retardancy.
 - 2. Tracks: Provide capacity of each curtain track to support curtain weight and control curtain operation.
 - 3. Electric Curtain Operators: Provide rated capacities, operating characteristics, and electrical characteristics.
- C. Shop Drawings: Indicate installation information for components not dimensioned or detailed in product data.
 - 1. Submit floor plans, elevations, detail sections of typical rigging elements, locations in plan and section views, and attachment details of curtains and operating clearances. Show anchors, hardware, operating equipment, and other components not included in manufacturer's standard product data. Coordinate stage curtains and battens with theatrical lighting plan and equipment.
 - 2. Submit fabric assembly and support details.
 - 3. Submit documentation indicating load capacity of each batten, track, attachment, and rigging components.
 - 4. Submit curtain attachment locations and corresponding loads imposed on structure.
 - 5. Delegated Design Data: Indicate stage curtain system structural attachments, including analysis data signed and sealed by Professional Engineer responsible for the design.
- D. Samples for Initial Selection: Two manufacturer's color charts for each type of stage curtain material indicated that includes full range of colors, textures, and patterns available, along with 12-inch (305 mm) square fabric sample, in any color, of each fabric type and seam; Submit for Architect's initial selections.
- E. Samples for Verification: From the Architect's initial selections, prepare and submit two samples of each material; 12 inch square samples of each selected fabric from dye lot to be used for this work, with specified treatments applied and showing repeat of patterns; mark top and face of fabric.
- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- G. Manufacturer's Qualification Statement.
- H. Installer's Qualification Statement.
- I. Delegated Designer's Qualification Statement.

1.6 CLOSEOUT SUBMITTALS

- A. Section 01 78 23 - Operation and Maintenance Data.
- B. Project Record Documents: Record actual locations of installed items.
- C. Operation and Maintenance Data: Submit data for stage curtains and rigging to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five (5) years documented experience.
- B. Installer: Company specializing in performing work of this Section with minimum five (5) years documented experience approved by manufacturer.

- C. Delegated Designer Qualifications: Perform design of track and support systems under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.
- D. All equipment in this Section and Section 26 55 61.10 - Auditorium Theatrical Lighting System shall be furnished, coordinated, and installed by the theatrical systems integrator. The stage rigging, lighting and drapery systems shall be furnished and installed through an experienced theatrical systems integrator with a minimum of 10 years experience in projects of this scope. The theatrical systems integrator will supervise and act as a source of information to the installing contractor throughout the installation period. The theatrical systems integrator must have been in the business of designing and integrating systems for a period of no less than 10 years, and must provide, as part of their bid package, a listing of three rigging jobs in similar scope in North and/or South Carolina within the last two years. Bidders who do not provide project lists shall be considered nonresponsive.
 - 1. Theatrical Lighting System Contractor/Integrator Qualifications: The Theatrical Lighting Contractor must:
 - a. Be qualified with at least 10 years experience in the installation of systems of similar scope.
 - b. Have suitable financial status to meet the obligations of the work.
 - c. Have adequate staff trained in the installation of this type of equipment and regularly provide maintenance on this type of equipment.
 - d. Provide one person to oversee the project throughout the installation.
 - e. Approved System Integrators are listed below. All other interested systems integrators must submit and receive prior approval 7 days before the advertised bid date.
 - 1) Barbizon Charlotte, 1016 McClelland Court, Charlotte, NC 28206
Contact: Jeff Montgomerie, (704) 372-2122.
 - 2) Bandit Lites, 5100 Reagan Drive, Suite 14, Charlotte, NC 28206
Contact: Andrew Fisher, (704) 266-2113.
 - 3) Productions Unlimited, 870 Anderson Ridge Road, Greer, SC 29651
Contact: Brian Phillips, (864) 675-6146.
 - 4) Alternative manufacturers must submit a full pre-approval package 10 days prior to the bid date. Acceptance or refusal of alternate manufacturers is the responsibility of the architect and his consultant.
 - 5) Texas Scenic Company, 8053 Potranco Rd, San Antonio, TX 78251, (210) 684-0091
 - 6) Janson Industries, 1200 Garfield ae SW Canton, OH 44706, (330) 455-7029

1.8 WARRANTY

- A. Section 01 77 00 - Closeout Procedures: Product warranties.
- B. Special Warranty:
 - 1. Warrant systems and equipment to be free of defective components, faulty workmanship, or improper adjustment for a period of one year from the date of Owner's acceptance. Replace items showing evidence of defective materials or workmanship (including installation workmanship) within thirty (30) days after notification. Make replacements without cost to the Owner. Rectify conditions that might present a hazard to human life, well-being and or property within 48 hours of notification.
 - 2. Designate warranties on manufactured equipment to the Owner on the date of system acceptance.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Stage Curtain Systems Design: Engage qualified designer to develop design of stage curtain system, including comprehensive project specific analysis of necessary structural system attachments in compliance with performance requirements.
- B. Structural Performance: Ensure attachment of stage curtain system to structure withstands material weight and operational loads applicable for this project and in compliance with local building codes and authorities having jurisdiction.
 - 1. Design Loads: Weight of stage curtains and track system.
- C. Fire-Test Characteristics: Stage curtain fabrics in compliance with NFPA 701 flame propagation fire test requirements conducted by authorized testing agency, listed by UL (DIR), ITS (DIR), or FM (AG) and acceptable to authorities having jurisdiction.
 - 1. Permanently attach label to fabric of each curtain assembly indicating fabric treatment as follows:
 - a. Inherently Flame Retardant (IFR), fibers/yarns that are non-combustible for life of fabric.
 - b. Durable Flame Retardant (DFR), fibers/yarns that are non-combustible for life of fabric.
 - c. Flame Retardant (FR), fabric has been topically treated in an immersion process with chemical fire retardant.
 - d. Indicate retreatment requirements after cleaning or after designated time period.
 - 2. Permanently attach swatch of matching fabric from same dye lot, at least 12 inches square, to backside of curtain assembly for use as fire-resistance test strip.
- D. Electrical Components: Devices that are listed and labeled in compliance with NFPA 70, by a qualified testing agency, and marked for designated application.

2.2 STAGE CURTAINS

- A. Manufacturers:
 - 1. Basis of Design: KM Fabrics, Inc.
 - 2. Frankel Associates, Inc.
 - 3. JB Martin Ltd.
 - 4. Valley Forge Fabrics, Inc.
 - 5. Substitutions: Section 01 60 00 - Product Requirements.
- B. Basis of Design: Refer to CURTAIN SCHEDULE article at end of this Section.

2.3 COMPONENTS

- A. Curtain Fabric: Woven Cotton Velour with napped fabric of 100 percent cotton; 54-inch minimum width; not less than 40 backing ends per inch, 40 pile ends per inch, and 32 picks per inch; 640 pile tufts per square inch; 60 percent fullness, and other characteristics as follows:
 - 1. Heavy Weight: Fabric weighing not less than 25 oz. per linear yard before flameproofing, with pile height of approximately 135 mils.
 - a. Exception: Fabric weighing less than 25 oz. per linear yard is acceptable only for specific items as indicated in this Section.
 - 2. Color: As indicated in Curtain Schedule at end of this Section.
- B. Lining: Yarn-dyed denim cloth of 100 percent cotton, woven in warp-faced twill; 54-inch minimum width.

2.4 CURTAIN TRACKS AND PIPE BATTENS

- A. Main Curtain Track: H&H Specialties 400 Series or equivalent.
- B. Rear Curtain Track: H&H Specialties 200 Series or equivalent.
- C. Pipe Battens: 1-1/2 inch diameter, Schedule 40, Plain-End Tested Pipe. Internal Bolt-Thru Pipe splices shall be used as needed; threaded couplers shall not be accepted. Pipe battens shall be supported at not less than 10 feet OC and dead hung from structure above.
- D. Hanging Hardware: JR Clancy #698 Beam Clamp with two 3/8 x 1 inch, Grade 5 hex bolts, with lock nuts, and a 1/4 inch round pin anchor shackle or as required.
- E. Chains and Trim Chains: Grade 30 Proof coil chain for dead hanging; zinc plated; manufactured to Federal Specification NPFC - RR-C-271-E, 1/4 inch Proof Coil Chain.

2.5 ACCESSORIES

- A. Jack Chain: No. 8 weighing not less than 9 oz per yard for the bottom hems of draperies.
- B. Tie Lines: Solid braided black "venetian blind" or mason cord No .4-1/2 (9/64 inch diameter).
- C. Grommets: Comply with NASM 16491. For black curtains, grommets to be black anodic finished.

2.6 FABRICATION

- A. Confirm field measurements before fabrication.
- B. Sewing and Fabrication:
 - 1. Table drapery, as removed from bolts, across an inspection window for detecting weaving flaws and imperfections. Remove and do not incorporate detected flaws. Sew all black draperies nap up; color velour nap down. Construct fabrics and draperies as specified herein, unless otherwise noted.
 - 2. Unless specified otherwise herein, sew fabrics with a locked filament polyester core thread in a running interlock stitch and not more than nine stitches per inch. Monofilament thread is not acceptable.
 - 3. Fabricate the fabric panels to run the height of the various sections without horizontal seams. Box pleat at the top in the fullness listed, exclusive of turn-back facing. Sew pleats on the face side of the drapery and reinforce across the top with jute webbing. Sew the webbing to the top of the drapery with two runs of stitching using a double needle machine with 2.75 inch needle spacing and heavy industrial thread. Locate brass grommets in the center of the webbing width so no horizontal stitching is cut or severed. Locate grommets on each pleat at 12 inches OC for flat sewn and pleated panels. Employ matching thread throughout.
 - 4. Provide full length drapery items operating from traveler tracks with nickel plated oblong spring harness or carabineer type clips fastened in place by means of heavy nylon or polyester strap double stitched to webbing. Provide other drapery installed in grommets with tie lines for attachment to rigging. Employ black cotton solid braided "venetian blind" or mason cord No. 4-1/2 (9/64 inch diameter), 36 inch long, double knotted and tied as tie lines.
 - 5. Sew bottom hems 6 inches deep with full length items containing No. 8 jack chain in a separate pocket inside the bottom hem with chain being held 2 inches above extreme bottom of curtain (except where pipe batten weights are called out).
 - 6. Fabricate so that the bottom edge of the face fabric and lining is within 0.25 inch parallel with the top edge of the drapery, for true hanging across full width.

7. Sew lining in the same fullness as the face fabric with side hems 1 inch wide. Fabricate so the lining is sewn inside the bottom hem of the face fabric to prevent catching air when the curtain descends. Lace the sides of the lining to the inside of the side hems of the face fabric with 1 inch wide webbing. 1 inch webbing loops are sewn to both the face fabric and lining at 9 inches OC and the lacing webbing runs through the loops loosely connecting the face fabric to the lining. Provide two 6 inch tucks in lining no more than 36 inches from the bottom of the curtain to allow for a total adjustment of 12 inches in the lining height due to shrinkage. For curtain less than 10 feet high, provide one shrinkage tuck.
- C. Construction: Refer to materials specified in this Section and include materials indicated in Curtain Schedule at end of this Section.
1. Main Curtain Travelers (Grand Drape) and Main Valance (Valance):
 - a. Fabricate in two lined panels to provide for bi-parting action. Finish each panel to the dimensions and fullness indicated in Curtain Schedules.
 - b. Provide lining (if indicated in Curtain Schedule) as indicated in "Sewing and Fabrication" paragraphs above.
 - c. Face back the center edges of each panel with a 1/2 width of fabric. Stop the lining (if indicated in Curtain Schedule) at the edge of this turnback as indicated in "Sewing and Fabrication" paragraphs above.
 - d. Face back the offstage edges of each panel with at least 2 inches of fabric.
 - e. Fabricate the top of each panel with face material pleats 12 inches OC. Reinforce tops with jute webbing with brass grommets 12 inches OC.
 - f. Fabricate the bottom of each panel with a 6 inch double-turned hem with No. 8 jack chain inserted in a separate pocket 2 inches above the finish floor and placed inside the hem.
- D. Signage:
1. Signage to be legible both in construction and grammar utilizing the English Language.
 2. Mark the centerline of the jute webbing with indelible marker. Use a white tie line on the centerline grommet.
 3. Sew a white fabric label on the upper right and left corners of the jute webbing of the drape with the following information:
 - a. Item Name.
 - b. Item Number.
 - c. Dimensions.
 - d. Fullness.
 - e. Date of Manufacture.
 - f. Manufacturer.
- E. Steel Tracks - General: Fabricate of not less than 0.075-inch (14-gage) nominal thickness galvanized roll-formed steel, with continuous bottom slot, and with each half of track in one continuous piece.
1. Provide curtain carriers for track spaced at 12 inches OC.
- F. Heavy-Duty Track: Equip track with heavy-duty live-end double pulley and heavy-duty dead-end single pulley, with 5 inch cast-iron or nylon wheels on ball bearings, enclosed in steel housings. Provide curtain carriers of molded nylon with a pair of neoprene- or nylon-tired ball-bearing wheels riveted parallel to body. Equip carriers with neoprene or rubber bumper, heavy-duty swivel eye, and trim chain for attaching curtain snap or S hook. Provide end stops for track and adjustable floor block designed to maintain proper tension on 3/8-inch stretch-resistant operating line of braided polypropylene or fiber-glass center cord.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 73 00 - Execution: Verification of existing conditions before starting work.
- B. Verify that inserts, clips, blocking, and other supports are installed and ready to receive work of this Section.

3.2 PREPARATION

- A. Section 01 73 00 - Execution: Prepare field conditions and existing construction for installation of work of this Section.
- B. Theatrical integrator to provide theatrical masking plan and lighting fixtures layout for approval by Architect before installing stage curtains and lighting fixtures.
- C. Prepare materials to be installed and equipment to be used during installation.
- D. Furnish layouts for inserts, clips, or other supports required to be installed by other trades to support tracks and battens.

3.3 INSTALLATION

- A. Section 01 73 00 - Execution: Related to installation of Work.
- B. All curtains and accessories require dead-hung installation. Provide hanging schedule for approval by Architect prior to installation.
- C. Install track for center-parting curtains with not less than 24-inch overlap of track sections at center, supported by special lap clamps.
- D. Secure curtains to track carriers with track manufacturer's special heavy-duty S-hooks or snap hooks.

3.4 ADJUSTING

- A. Section 01 73 00 - Execution: Starting, testing, adjusting, and balancing.
- B. Adjust track and carriers to provide smooth operation of curtains.

3.5 CLEANING

- A. Section 01 73 00 - Execution and Section 01 77 00 - Closeout Procedures: Clean installed work and comply with manufacturer's recommendations.

3.6 PROTECTION OF INSTALLED CONSTRUCTION

- A. Section 01 73 00 - Execution: Protecting installed construction.

3.7 DEMONSTRATION AND TRAINING

- A. Section 01 79 00 - Demonstration and Training: Provide demonstration and training to the Owner regarding operation and maintenance of component of the installed Work.

3.8 CURTAIN SCHEDULE

3.9 CURTAIN SCHEDULE

- A. Main Curtain Travelers (Grand Drape):
 - 1. Basis of Design:
 - a. KM Fabrics - Memorable

2. Color:
 - a. KM Fabrics - As selected by Architect.
 3. 100 % cotton velour.
 4. 25 oz. per lineal yard.
 5. Flame retardant treated.
 6. 60% fullness.
 7. Lining: None
 8. Quantity and Size:
 - a. Two (2) each; 14 feet wide x 9 feet high; field verify all dimensions.
- B. Main Valance (Valance):
1. Basis of Design:
 - a. KM Fabrics - Memorable.
 2. Color:
 - a. KM Fabrics - As selected by Architect.
 3. 100 % cotton velour.
 4. 25 oz. per lineal yard.
 5. Flame retardant treated.
 6. 60% fullness.
 7. Lining: None
 8. Quantity and Size:
 - a. One (1) each; 28 feet wide x 3 feet high; field verify all dimensions.

END OF SECTION

SECTION 11 66 23
GYMNASIUM EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Scorer's Table.
 - 2. Gymnasium Floor Cover.
 - 3. Ball Storage Cage.
 - 4. Team Chairs.

1.2 REFERENCES

- A. ASTM International (ASTM):
 - 1. ASTM D2261 - Standard Test Method for Tearing Strength of Fabrics by the Tongue (Single Rip) Procedure (Constant-Rate-of-Extension Tensile Testing Machine); 2013, Editorial Changes 2017.
 - 2. ASTM D5034 - Standard Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test):2021.
- B. National Electric Code (NEC):
 - 1. NEC Article 600 - Electric Signs and Outline Lighting; 2021.
- C. National Fire Protection Association (NFPA):
 - 1. NFPA 701 - Standard Methods Of Fire Tests For Flame Propagation Of Textiles And Films; 2023.
- D. Underwriters Laboratories Inc. (UL):
 - 1. UL (DIR) - Online Certification Directory; Current Edition.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit data describing product construction, sizes, configurations, jointing methods and locations, and functional components.
- C. Shop Drawings: Submit shop drawings including profiles, components, materials, accessories, joint/seam fabrication and locations, and installed use location/layout.
 - 1. Scorer's Table: Include details for folding/locking mechanism, caster type/sizes/quantities/locations, front signage panel attachment to table assembly, electrical requirements.
 - 2. Gymnasium Floor Protective Cover: Include plan indicating cover layout and fabric edge overlap locations. Include details of roller storage racks and quantities required for storage of all fabric rolls.
- D. Samples for Initial Selection: Two manufacturer's color charts illustrating the full range of finishes and colors available for products with factory-applied color finishes; submit for Architect's initial selections.
- E. Samples for Verification: From the Architect's initial selections, prepare and submit two samples for each selected finish and color; samples on same product material type indicated for final Work; each sample 4 x 4 inches. Where finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 77 00 - Closeout Procedures.
- B. Operation Data: Include description of equipment operation and required adjusting and testing.
- C. Maintenance Data: Identify system maintenance requirements, parts list, servicing cycles, lubrication types required and local spare part sources.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this Section with minimum five (5) years documented experience.
- B. Installer Qualifications: Company specializing in performing work of this Section and with minimum five (5) years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Deliver products in manufacturer's original packaging. Store materials in a dry, protected, well-vented area. Inspect product upon receipt and report damaged material immediately to delivering carrier and note such damage on the carrier's freight bill of lading.

1.7 WARRANTY

- A. Section 01 77 00 - Closeout Procedures: Product warranties.
- B. Warranty durations are to begin on the date of Substantial Completion.
- C. Scorer's Table:
 - 1. Manufacturer's Warranty: Provide manufacturer's five (5) year warranty for materials and workmanship to be free of defects. Should a component or material fail to perform its function in normal use within this period, manufacturer is to provide matching repair or new replacement at no charge.
- D. Gym Floor Protective Cover and Storage Rack:
 - 1. Manufacturer's Warranty: Provide manufacturer's warranty for materials and workmanship to be free of defects. Should a component or material fail to perform its function in normal use within this period, manufacturer is to provide matching repair or new replacement at no charge.
 - a. Floor Covers: Warranty duration to be as follows.
 - 1) Weight of 18 - 21 oz/sq yd: Eight (8) years warranty duration.
 - b. Floor Cover Storage Racks: Twenty (20) years warranty duration.
- E. Ball Storage Cage: Provide manufacturer's standard warranty for materials and workmanship to be free of defects.
- F. Team Chairs: Provide manufacturer's standard warranty for materials and workmanship to be free of defects.
 - 1. Team Chairs: Manufacturer's standard duration but not less than one (1) year.
 - 2. Team Chair Storage Carts: Manufacturer's standard duration but not less than one (1) year.

1.8 SPARE PARTS AND MAINTENANCE PRODUCTS

- A. Section 01 60 00 - Product Requirements: Extra materials, spare parts, and maintenance products.

- B. Scorer's Table: Furnish 3 spare lamps for the back-lit front panel sign.
- C. Gymnasium Floor Cover.
 - 1. Floor Cover Fabric: Provide 10 percent spare.
 - 2. Floor Cover Storage Racks:
 - a. Hand Cranks: Provide 2 spares.
 - b. Electric Power Winder: Provide 1 spare.
 - c. Roller Tube: Provide 1 spare (include 4 cover attachment clips).

PART 2 PRODUCTS

2.1 SCORER'S TABLE

- A. Manufacturers:
 - 1. Sideline Interactive, LLC.
 - 2. Substitutions: Section 01 60 00 - Product Requirements.
- B. Basis of Design: Sideline Interactive, LLC - Backlit Static Table.
- C. Scorer's Table: Designed for interior use and as follows:
 - 1. Electrical components to be certified, listed, and labeled by the following standards organization(s) as suitable for the purpose indicated and installed conditions:
 - a. UL (DIR).
 - b. NECA 600.
 - 2. Electrical components to include electrical surge protection.
 - 3. Capable of withstanding strikes by balls and players.
 - 4. Free-standing unit, transportable, and with heavy-duty locking non-marring swivel casters.
 - a. Capable of folding for transport.
 - 5. Protective padding to be heavy-duty vinyl covered and secured to unit.
 - a. Color to be selected by Architect from manufacturer's full range.
 - 6. Table Length:
 - a. 10 feet.
 - 7. Front Panel Signage: Sign to be factory printed with custom graphics.
 - a. Single panel; full panel static graphics with electric back light illumination.
 - 1) Sized to length and height of table.
 - 2) Custom graphics design to be provided by the Architect.
 - 3) Shatterproof polycarbonate sheet protective cover.
 - 4) Maintenance access panel.
 - 8. Finishes and Colors:
 - a. To be selected by the Architect from manufacturer's full range.
 - b. Metal components to be powder coat finish.
 - 9. Electrical Power Strip: Integral power strip and media wire tray.

2.2 GYMNASIUM FLOOR COVER

- A. Manufacturers:
 - 1. CoverSports, a division of Humphrys.
 - 2. CoverMaster.
 - 3. Greatmats.
 - 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Basis of Design:
 - 1. CoverSports - GymGuard Gym Floor Cover.
- C. Gymnasium Floor Cover: Protective floor cover designed for interior use and as follows:

1. Physical Characteristics: Minimum requirements; comply with indicated standard.
 - a. Weight: 18 oz/sq yd, minimum.
 - 1) 4 oz woven polyester fabric coated with 14 oz PVC (7 oz each side).
 - 2) Tensile Strength: 280 lbs x 270 lbs (ASTM D5034).
 - 3) Tear Strength: 90 lbs x 65 lbs (ASTM D2261).
 - 4) Surface Finish: Smooth surface.
 2. Waterproof, rot and mildew resistant, anti-fungal, and anti-bacterial.
 3. Color to be selected by Architect from manufacturer's full range.
 4. Fire Resistance: Comply with NFPA 701 (large scale), and requirements of local authorities having jurisdiction.
 5. Slip Resistant Surface: Comply with ADA and OSHA requirements.
 6. Seams to be heat weld sealed, minimum 1 inch wide, and are to lay smooth and flat.
 7. Roll Widths:
 - a. 10 feet wide minimum.
 8. Locations: Provide floor cover quantity for floor areas indicated.
 - a. Gymnasium.
 - 1) Entire floor area, less area under extended bleachers.
- D. Floor Cover Storage Racks: Engineered and designed to store multiple fully loaded floor cover rolls; mobile and stable base to deploy and load floor covers; allows for safe cover deployment by 2 persons.
 1. Quantity: Provide quantity of storage rack units as required to store required floor cover quantity.
 2. Storage Rollers:
 - a. 8 rollers per each storage rack unit.
 3. Size: Not to exceed 35 inches wide x 68 inches long x 79 inches high.
 4. Frame: Steel framing and stabilizing members with powder coat finish.
 5. Outriggers: Designed to stabilize storage rack during operational use; retractable with adjustable casters to prevent tipping; safety orange color.
 6. Brakes: Floor locking brakes to be at each end of storage rack.
 7. Casters: Lockable heavy-duty swivel casters; non-maintenance bearings for swivel and wheels; non-marring 3/4 inch tread thickness; 3 casters at each end.
 8. Roller Collars: Bright yellow collar on each end of every roller to eliminate finger pinching.
 9. Roller Brackets: Made of polycarbonate with delrin bearings. Mounted with 1/8 inch thick shock absorbing rubber pads.
 10. Roller Safety: Safety bolt on each bracket to prevent roller "pop-ups".
 11. Rollers: Non-corrosive tube; protective coated for clean handling.
 12. Fastening Clips: 4 push-on clips for each roller to secure floor cover sheet to roller.
 13. Hand Cranks: 2 cranks designed to engage both roller ends for loading floor covers.
 14. Accessories:
 - a. Electric Power Winder: Provide one (1) hand-held electric power winder designed to engage roller end for loading floor covers; include reverse rotation switch.
 - b. Floor Cover Brush Cleaner: Provide for each floor cover storage rack. Full width brush system designed to attach to the floor cover storage rack, Sweeps and cleans the floor cover on both sides simultaneously as each floor cover is cranked back (loaded) onto the rack rollers. Designed with two opposing sets of brush heads, each with a row of soft bristles of styrene fiber for fine particles and a row of stiffer polystyrene bristles for heavier debris.
 - c. Storage Rack Cover: Provide one (1) for each floor cover storage rack. Designed to fully cover loaded and stored storage rack; material to be not less than 18 oz vinyl.

- d. Seaming Tape: Provide quantity required for Owner to deploy full coverage of floor cover for six (6) separate events. Extra strength, clear, 3 inches wide, and formulated for easy removal and leaving no glue residue on floor or floor cover.
- e. Seaming Tape Dispensers:
 - 1) Walk-Behind Tape Dispenser: Provide one (1), designed to apply 3 inch wide floor cover seaming tape by user walking behind dispenser in fully erect walking posture. Unit to include tape roll dispenser cradle designed for easy tape roll changeover, flat roller for compressing dispensed tape to application surface, and in-line secondary guide wheel. Handle to be adjustable to user's height. Constructed of heavy gauge steel and enameled or powder coated finished.
 - 2) Hand-Held Tape Dispenser: Provide two (2), designed to apply 3 inch wide floor cover seaming tape by user. Heavy-duty components; heavy gauge steel frame; ergonomically designed handle that won't twist under pressure during use.

2.3 BALL STORAGE CAGES

- A. Manufacturers:
 - 1. Gared Holding, LLC.
 - 2. Substitutions: Section 01 60 00 - Product Requirements.
- B. Basis of Design:
 - 1. Gared - DBC Deluxe Ball Gage.
- C. Ball Storage Cage: Provide two (2) storage cage units of the following minimum requirements.
 - 1. Size: Overall unit to be 42 inches long x 24 inches wide x 42 inches high (from floor to top of frame's push handle).
 - a. Ball cage shape to be 42 inches long x 24 inches wide x 28 inches high.
 - 2. Construction: Frame to be 1 inch steel tube framing. Ball cage to be 3/16 inch steel wire welded to form 3 inch square grid sections. Cage top to be hinged and lockable.
 - 3. Finish and Color: Factory applied.
 - a. Powder coat; black color.
 - 4. Casters: Provide four (4) swivel casters; each caster with single 3 inch diameter wheel and non-marring tread of 1/2 inch thickness.

2.4 TEAM CHAIRS

- A. Team Chairs: Folding type with cushioned seat and backrest.
 - 1. Quantity: Provide thirty-three (33) chairs.
 - 2. Manufacturers:
 - a. Spec Seats.
 - b. Substitutions: Section 01 60 00 - Product Requirements.
 - 3. Basis of Design:
 - a. Spec Seats - Model DS100 Logo Series.
 - 4. Physical Characteristics:
 - a. Metal Frame: 18ga Galvanized Steel (DTC X-Frame)
 - b. Seat: Upholstered with 2.5 to 3 inch cushion thickness.
 - c. Backrest: Upholstered with 1 inch cushion thickness.
 - d. Front Leg: "K" brace with cross-brace.
 - e. Linking Bracket: 11 gauge steel.
 - f. Leg Foot: Non-marring molded metal foot inserts.
 - g. Chair Weight: 20 lbs (9.1 kgs).
 - h. Frame Height: 33 inches, open; 40 inches, closed.

- i. Frame Width: 18.25 inches, includes ganging.
 - j. Seat Height: 19.25 inches, from floor to top of seat.
 - k. Depth: 22 inches, front to back.
 - l. Folded Thickness: 4.5 inches.
- 5. Finishes:
 - a. Metal surfaces to be factory applied powder coat finish.
 - b. Seat and backrest to be factory applied upholstery.
- 6. Colors: To be selected by Architect from manufacturer's full range.
- 7. Graphics: Custom graphics, factory applied to each chair.
 - a. Separate graphics for seat cushion and seat backrest.
 - b. Graphics design to be provided by Architect.
- 8. Accessories:
 - a. Team Chair Storage Carts: Platform type storage cart.
 - 1) Quantity: Provide quantity of storage carts required to store quantity of chairs indicated.
 - 2) Basis of Design:
 - a) Spec Seats - Model TSC106 (6 feet long, 4 casters).
 - 3) Size: 70 inches long x 36 inches wide x 82.5 inches high (88 inches high when loaded with folded chairs).
 - 4) Construction: Steel members designed and assembled to withstand loads imposed when cart is fully loaded and mobile. Cart structure to remain rigid and without racking during mobile use.
 - a) Provide each end of cart with rigid U-shaped handle tubing for pushing and pulling cart from either end.
 - b) Provide intermediate U-shaped tubing with adjustable location along length of cart. This member is to function as an adjustable "bookend" stop for chairs when cart is partially loaded.
 - 5) Casters: Lockable heavy-duty swivel casters; non-maintenance bearings for swivel and wheels; non-marring 3/4 inch tread thickness.
 - a) Minimum 4 casters for carts of length 8 feet or less.
 - b) Minimum 6 casters for carts longer than 8 feet and up to 10 feet.
 - (1) 2 of the 6 casters are to be located at carts mid-length.
 - 6) Finish and Color: Factory applied powder coat; black color.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 73 00 - Execution: Verification of existing conditions before starting work.
- B. Verify that field measurements are as required.
- C. Verify that surfaces and conditions are ready to accept the Work of this Section.
- D. Examine products to be installed for damage and other conditions detrimental to completion of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Section 01 73 00 - Execution: Prepare field conditions and existing construction for installation of Work of this Section.
- B. Prepare materials to be installed and equipment to be used during installation.

3.3 INSTALLATION

- A. Section 01 73 00 - Execution: Related to installation of Work.
- B. Products Requiring Installation: Install system components and accessories in accordance with manufacturer's printed instructions.
- C. Products Normally Stored Until Use: Assemble system components and verify functionality prior to demonstration to Owner.

3.4 ADJUSTING

- A. Section 01 73 00 - Execution: Starting, testing, adjusting, and balancing.
- B. Adjust operating components to smooth operation without binding.

3.5 CLEANING

- A. Section 01 73 00 - Execution and Section 01 77 00 - Closeout Procedures.
- B. Clean installed Work in accordance with manufacturer's recommendations including cleaning procedures and materials.

3.6 PROTECTION OF INSTALLED CONSTRUCTION

- A. Section 01 73 00 - Execution: Protecting installed construction.
- B. Protect installed construction from damage and unauthorized tampering.

3.7 DEMONSTRATION AND TRAINING

- A. Section 01 79 00 - Demonstration and Training.
- B. Provide demonstration and training to Owner regarding operation and maintenance of the Work of this Section.

END OF SECTION

SECTION 11 66 23.16
BASKETBALL BACKSTOPS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Indoor suspended backstops.
- B. Related Requirements:
 - 1. Section - 05 12 00 - Structural Steel.
 - 2. Section - 05 21 00 - Steel Joists.
 - 3. Section - 05 50 00 - Metal Fabrications: Supplementary framing.
 - 4. Division 26 - Electrical: Electrical service for winch operations and Work requirement for electrical work.

1.2 REFERENCES

- A. American Society of Civil Engineers (ASCE):
 - 1. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- B. ASTM International (ASTM):
 - 1. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- C. American Welding Society (AWS):
 - 1. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020; Errata 2023.
- D. Athletic Associates: Comply with current requirements.
 - 1. National Association of Intercollegiate Athletics (NAIA).
 - 2. National Basketball Association (NBA).
 - 3. National Collegiate Athletic Association (NCAA).
 - 4. National Federation of State High School Associations (NFHS):
 - a. NFHS - Basketball Rules Book.
 - 5. International Basketball Federation (FIBA).
 - 6. International Olympic Committee (IOC).
- E. National Electrical Manufacturers Association (NEMA):
 - 1. NEMA MG 1 - Motors and Generators; 2021.

1.3 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate backstops with structural system building framing as indicated in Specifications and Drawings to distribute loads to building framing without overloading building framing.
- C. Coordinate backstops and support framing layout to avoid interferences with the following:
 - 1. HVAC equipment, ductwork, outlets, and inlets.
 - 2. Fire suppression system piping and sprinkler heads.
 - 3. Lighting.
- D. Coordinate electrical requirements for the work in this Section with electrical service and connection points provided.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data:
 - 1. Submit data indicating loads, and materials of construction and thicknesses.
 - a. Indicate data for components and accessories.
 - b. Include manufacturer's full range of the following for selection by Architect:
 - 1) Colors and finishes.
 - 2) Graphics.
 - c. Include operational instructions.
- C. Suspended Backstops.
 - 1. Shop Drawings: Signed and sealed by licensed Professional Engineer.
 - a. Indicate size and location of backstops, mounting details, accessory anchoring members.
 - b. Indicate magnitude and location of loads imposed on building framing.
 - c. Show operable backstops in fully extended and retracted positions.
 - d. Indicate operator locations and mounting details. Include wiring diagrams for electric operators and controls.
 - 2. Design Data: Signed and sealed by licensed Professional Engineer.
 - a. Submit calculations for system, mounting, anchor, and structure design.
 - 1) Include foundation design for in-ground mounted units.
 - b. Submit calculations for supplementary framing required to attach backstops to building framing.
 - c. Indicate location and magnitude of loads imposed on building framing.
 - d. Seismic Design: Provide sealed calculations indicating that design of suspension systems provide compliance with seismic structural requirements indicated in the Performance and Design Requirements in this Section.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 77 00 - Closeout Procedures.
- B. Operation and Maintenance Data: Include the following.
 - 1. Instructions for operational control systems, adjustments, and safety features.
 - 2. Parts catalog with complete list of replacement parts.
 - 3. Schematic wiring diagrams for electrical components.

1.6 QUALITY ASSURANCE

- A. Products Requiring Electrical Connection: Listed and classified by UL or other testing firm acceptable to authority having jurisdiction.
- B. Perform welding in accordance with AWS D1.1/D1.1M.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three (3) years documented experience.
- B. Installer: Company specializing in performing work of this section with minimum three (3) years documented experience and approved by manufacturer.
- C. Welders and Welding Procedures: AWS qualified within previous twelve (12) months.

- D. Design backstops and support framing under direct supervision of licensed Professional Engineer experienced in design of this Work and licensed in the State in which the project is located.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept backstops on site in manufacturer's original packaging. Inspect for damage.
- C. Store backstops indoors, protected from weather and contamination until installed.

1.9 WARRANTY

- A. Section 01 77 00 - Closeout Procedures: Product warranties.
- B. Indoor Suspended Backstops: Furnish lifetime manufacturer's warranty for masts and backboards.

1.10 SPARE PARTS AND MAINTENANCE PRODUCTS

- A. Section 01 60 00 - Product Requirements: Extra materials, spare parts, and maintenance products.
 - 1. Furnish six (6) of each net type.
 - 2. Furnish four (4) manual crank tools and other tools required for backstop adjustments including adjusting height of backboard for play.

PART 2 PRODUCTS

2.1 INDOOR SUSPENDED BACKSTOPS

- A. Performance And Design Requirements:
 - 1. Design backstops including masts, backboards, and goals to meet requirements of NFHS and the following:
 - a. Withstand loads without damaging backstop.
 - b. Transfer loads to building structural frame to prevent overloading and damage to building.
 - c. Seismic Loads: Design and size components to withstand seismic loads and sway displacement as calculated in accordance with ASCE 7 and applicable codes.
 - 1) Seismic Design is to comply with requirements for the Seismic Design Category as indicated on the Structural Drawings and Section 00 31 00 - Available Project Information.
- B. Manufacturers:
 - 1. American Athletic, Inc.
 - 2. Draper, Inc.
 - 3. Performance Sports Systems.
 - 4. Porter Athletic Equipment Company.
 - 5. Progressive Sports Construction Group.
 - 6. Substitutions: Section 01 60 00 - Product Requirements.
- C. Basis of Design: Porter Athletic Equipment Company - Style 909xxxxx Series.
- D. Backstop systems suspended from building structure above:
 - 1. Suspended and forward folding retraction:
 - a. Operation:

- 1) Electric motorized winch.
 - b. Locations and Quantities:
 - 1) Main Court; two (2) backstop systems.
 - 2) Side Court: four (4) backstop systems.
- E. Masts:
 - 1. Center Post Masts: Single post at center of backboard with side sway bracing to eliminate sway and vibration during play.
 - 2. Tubular steel, welded construction.
 - 3. Overhead Mounting: Mast assembly extending vertically from overhead building structural frame to support backboard at position and height indicated on Drawings.
 - a. Design and provide supplemental steel framing as needed to span between and anchor to building structural frame and support mast at position indicated on Drawings.
 - 4. For retractable folding backstop systems, provide winches and safety straps with retractor reel.
 - 5. Furnish manufacturer's standard hardware for mast operation as specified.
- F. Winches - Motorized Operation:
 - 1. Electric motorized winch; sized to suit application with adjustable upper and lower limit switches.
 - 2. Geared drive and cables designed to hold backstop at any position.
 - 3. Motor: NEMA MG 1; 1/2 hp; 115 volts, single phase, 60 Hz; continuous duty rated.
 - 4. Controls: Provide remote, flush, wall mounted control station three position key switch.
 - a. Gang Control Switch: Provide winch operation control switches as follows.
 - 1) Main Court Backstops:
 - a) Individual switches for each main court backstop.
 - 2) Side Court Backstops:
 - a) Individual switches for each side court backstop.
 - 5. Disconnect Switch: Factory mount disconnect switch on equipment.
- G. Backboards:
 - 1. Glass Backboards: 1/2 inch thick clear shatter proof tempered glass, resiliently mounted in painted welded steel frame; target and border markings fired onto glass.
 - 2. Rectangular shape; 72 x 42 inches with manufacturer's standard mounting to suit mast; drilled for goal mounting.
 - 3. Molded safety padding installed along lower edge and corners.
 - 4. Adjustable Vertical Movement Mounting: Variable height with rim height ranging from 8 to 10 feet above finished floor.
 - a. Manual crank tool operated from floor beneath backboard.
- H. Goals and Nets:
 - 1. Goals: Steel, removable type; fabricated from 5/8 Inches rod; 18 Inches inside clear diameter; with no-tie style net hooks; painted finish; mounted directly to main mast.
 - a. Breakaway type; single rim, breakaway type; rigid play up to 230 lbs, flexible for forces greater than 230 lbs.
 - 2. Net: Woven chord, size, and style to fit goal; 15 to 18 inches long.
 - a. Competition Net: Anti-whip nylon.
- I. Shop Finishing:
 - 1. All metal components, parts, fasteners, and accessories to be powder coat finished.
 - 2. Color: As selected by Architect from manufacturer's full range.

2.2 ACCESSORIES

- A. Mounting Hardware: As designed and recommended by manufacturer.

2.3 FABRICATION

- A. Verify field measurements prior to fabrication.
- B. Fabricate components in largest practical sizes for delivery.
- C. Grind exposed welded joints flush and smooth with adjacent finish surface.
- D. Provide fittings and hardware to accommodate site assembly and installation.
- E. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 73 00 - Execution: Verification of existing conditions before starting work.
- B. Verify building structural frame is ready to receive backstops.
- C. Verify that finishing work, including painting, is complete before installing backstops.
- D. For work requiring electrical power connections, verify electrical power, with correct electrical characteristics, is installed at required locations and available.

3.2 PREPARATION

- A. Section 01 73 00 - Execution: Prepare field conditions and existing construction for installation of work of this Section.
- B. Prepare materials to be installed and equipment to be used during installation.

3.3 INSTALLATION

- A. Section 01 73 00 - Execution: Related to installation of Work.
- B. Install backstops in accordance with NFHS requirements.
- C. Assemble components furnished loose for field assembly.
- D. Install masts plumb and rigid at location indicated on Drawings.
- E. Install backboards plumb, level, and parallel to basketball court end line.
- F. Install goals level and adjust rim height to 10 feet above finish floor.
- G. Install safety padding on backboards.
- H. For winch operated backstops, install winches with cables connected to backstops.
- I. For motorized and control components, make electrical connections as required for operation.
- J. Touch up damaged finishes to match shop finish.

3.4 ADJUSTING

- A. Section 01 73 00 - Execution: Requirements for starting and adjusting.

- B. Adjust moving components and controls for smooth and proper operation over full range of movement.
- C. For motorized components, adjust limit switches to prevent damage to equipment.

3.5 CLEANING

- A. Section 01 73 00 - Execution and Section 01 77 00 - Closeout Procedures: Clean installed work and comply with manufacturer's recommendations.
- B. Clean installed work in accordance with manufacturer's recommended materials and procedures.

3.6 PROTECTION OF INSTALLED CONSTRUCTION

- A. Section 01 73 00 - Execution: Requirements for protecting finished Work.
- B. Fully retract retractable backstops and disable operators until Substantial Completion.
- C. Protect install Work from damage.

3.7 DEMONSTRATION

- A. Section 01 79 00 - Demonstration and Training: Requirements for demonstration and training.
- B. Demonstrate to Owner representatives, operation and maintenance of operating components, and safety features.

END OF SECTION

SECTION 11 66 23.23
VOLLEYBALL EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Volleyball vertical net standards (pair of posts for volleyball net).
 - 2. Volleyball floor sleeves (pair of floor receptors for pair of vertical standards).
- B. Related Requirements:
 - 1. Section 03 30 00 - Cast-In-Place Concrete: Placing of volleyball sleeves.
 - 2. Division 09 - Finishes: Flooring finishes surrounding floor sleeves.

1.2 REFERENCES

- A. National Federation of State High School Associations:
 - 1. NFHS - Volleyball Rules Book; Current Edition.

1.3 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate floor sleeves with requirements of volleyball vertical standards.
- C. Coordinate installation of floor sleeves with placing of concrete slab and installation of finish flooring system.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Provide data indicating characteristics of materials, construction and fabrication of products and assemblies, sleeve cap locking options, and manufacturer's full range of colors and finishes available.
- C. Shop Drawings: Indicate sizes, dimensions, locations, and construction details for installing the Work. Include details for concrete anchor of floor sleeves and flush cap finish at finish floor.
- D. Certification of Coordination with Owner: In such case that volleyball net vertical standards are being provided by the Owner and Contractor is providing floor receptor sleeves for the Owner's standards, Contractor is to provide written certification indicating that all floor sleeve components and installation have been coordinated with Owner to be fully compatible with Owner's volleyball equipment. Indicate in the certificate the manufacturer and model number of the Owner's volleyball standards for which the floor sleeves are designed to receive.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 77 00 - Closeout Procedures.
- B. Submit Operation and Maintenance Data.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five (5) years documented experience.

- B. Installer: Company specializing in performing work of this section with minimum three (3) years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept volleyball equipment on site in manufacturer's original packaging. Inspect for damage.
- C. Store volleyball equipment indoors, protected from weather and contamination until installed.

1.8 SPARE PARTS AND MAINTENANCE PRODUCTS

- A. Section 01 60 00 - Product Requirements: Extra materials, spare parts, and maintenance products.
 - 1. Furnish four (4) keys for volleyball floor sleeve cover caps.

PART 2 PRODUCTS

2.1 DESIGN REQUIREMENTS

- A. Design standards, sleeves, and net to meet requirements of NFHS and the following:
 - 1. Volleyball equipment to be competition grade.

2.2 VOLLEYBALL EQUIPMENT

- A. Manufacturers:
 - 1. American Athletic, Inc.
 - 2. Draper, Inc.
 - 3. Gared Holding, LLC.
 - 4. Performance Sports Systems.
 - 5. Porter Athletic Equipment Company.
 - 6. Progressive Sports Construction Group.
 - 7. Substitutions: Section 01 60 00 - Product Requirements.

2.3 VOLLEYBALL EQUIPMENT SYSTEM

- A. Quantities: Provide quantity of Volleyball Equipment System products equal to the number of pairs of Volleyball Vertical Net Standards indicated, unless indicated otherwise.
- B. Volleyball Floor Sleeves: Steel; manufactured for use with volleyball vertical net standards; and each with key operated chrome or stainless steel cover plate.
 - 1. Quantity:
 - a. Four (4) pair unless indicated otherwise on Drawings.
- C. Volleyball Vertical Net Standards: Pair; extruded aluminum; 3-1/2 O.D.; telescoping type; protective padding.
 - 1. Basis of Design:
 - a. Gared - Rallyline 6100 Series.
 - 2. Quantity:
 - a. Four (4) pair unless indicated otherwise on Drawings.
 - 3. Finish:
 - a. As selected by Architect from manufacturer's full range.
- D. Net: Nylon competition type.

1. Basis of Design:
 - a. Gared - Competition Volleyball Net.
- E. Protective Padding: Polyester reinforced vinyl covers over 1-1/2 inch thick foam padding.
 1. Basis of Design:
 - a. Gared - Official Upright Pads.
- F. Referee Stand: Fitted type; steel frame with nominal two (2) foot square platform; non-marking feet and 3 inch diameter wheels; protective padding.
 1. Basis of Design:
 - a. Gared - Volleyball Collapsible Referee Stand - 6448.
- G. Storage and Transport Equipment:
 1. Vertical Net Standard Storage Bracket: Stores pair of vertical net standards vertically; wall mounted brackets.
 - a. Basis of Design:
 - 1) Gared - Vertical Volleyball Upright Storage Bracket - 6291.
 2. Vertical Net Standard Transporter Cup: Steel cup with two (2) non-marring casters; sized to fit vertical net-standards.
 - a. Basis of Design:
 - 1) Gared Volleyball 3-1/2" Upright Transporter - 6294.
 3. Net Storage Rack: Transporter trolley with lockable non-marring swivel casters; capacity for rolling and storing two (2) volleyball nets.
 - a. Basis of Design:
 - 1) Gared Store-It Double Net Storage Rack - 9940.

2.4 FINISHES

- A. Colors to be as selected by Architect from full range unless indicated otherwise on Drawings.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 73 00 - Execution: Verification of existing conditions before starting work.
- B. Verify that field measurements are as required.
- C. Verify that surfaces and conditions are ready to accept the work of this Section.
- D. Examine products to be installed for damage and other conditions detrimental to completion of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Section 01 73 00 - Execution: Prepare field conditions and existing construction for installation of work of this section.
- B. Prepare materials to be installed and equipment to be used during installation.

3.3 INSTALLATION

- A. Section 01 73 00 - Execution: Related to installation of Work.
- B. Install sleeves without damaging vapor barrier under slab-on-grade.
- C. Set up all equipment and tension volleyball net to ensure sleeves are installed properly.

1. Make adjustments required to bring entire volleyball assembly in conformance with NFHS.
2. In such case that the volleyball net vertical standards are being provided by Owner and Contractor is providing floor receptor sleeves for Owner's standards, Contractor is to coordinate this set up, assembly and adjustment procedure with Owner staff present to ensure that Contractor provided floor sleeves are appropriate and installed in a manner that allows for proper assembly of Owner's vertical standards and net system. Contractor is to make corrections to the work of floor sleeves as required to provide for proper assembly of Owner's vertical standards and net system.

3.4 CLEANING

- A. Section 01 73 00 - Execution and Section 01 77 00 - Closeout Procedures.
- B. Clean installed work and work area and comply with manufacturer's recommendations.

3.5 PROTECTION OF INSTALLED CONSTRUCTION

- A. Section 01 73 00 - Execution: Protecting installed construction.
- B. Protect work from damage.

END OF SECTION

SECTION 11 66 23.53

WALL PADDING

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes wall padding and accessories.
- B. Related Requirements:
 - 1. Section 04 20 00 - Unit Masonry: Substrate.

1.2 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Provide physical characteristics of wall pads and mounting accessories.
- C. Shop Drawings: Indicate dimensioned elevations layout (include cutouts at wall devices), unit sizes and thickness, describe finish method around cutouts at wall devices, mounting details and hardware.
- D. Samples for Initial Selection: Two manufacturer's complete sets of color samples illustrating the full range of finishes and colors available. Submit for Architect's initial selections.
- E. Samples for Verification: From the Architect's initial selections, prepare and submit two samples for each selected finish and color; samples to be same product material type indicated for final Work; each sample 4 x 4 inches. Where finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.

1.3 CLOSEOUT SUBMITTALS

- A. Section 01 77 00 - Closeout Procedures.
- B. Submit Operation and Maintenance Data.

PART 2 PRODUCTS

2.1 WALL PADDING

- A. Manufacturers:
 - 1. American Athletic, Inc.
 - 2. Draper, Inc.
 - 3. Performance Sports Systems.
 - 4. Porter Athletic Equipment Company.
 - 5. Progressive Sports Construction Group.
 - 6. Substitutions: Section 01 60 00 - Product Requirements.

2.2 COMPONENTS

- A. Wall Pads: Urethane foam, 3.7 lb. density, 2 inches thick; over 3/8 inch OSB wood panel; flame retardant vinyl coated polyester covering; compliant with state and local codes.

2.3 ACCESSORIES

- A. Wall Attachment Clip: Extruded aluminum.
- B. Z-Channels: Extruded aluminum.

- C. Floor Mounting Channel: Extruded aluminum, if Drawings indicate wall pads layout to extend to the floor.
- D. Molded Cutout Inserts: Factory molded and flame retardant rubber inserts for pad cutouts for accessing electrical outlets, switches, and wall devices. Color to be selected by Architect from manufacturer's full range.
- E. Fasteners to be non-corrosive and compatible with components and substrates.

2.4 FABRICATION

- A. Wall Pads: Adhere foam to backing board. Wrap finish covering to back of backing board and fasten securely. Provide a one inch fastener margin at top and bottom of backing board covered by finish covering. Fabricate in 2 feet wide by 6 feet tall panels, unless indicated otherwise on Drawings.

2.5 FINISHES

- A. Vinyl Coated Polyester Covering: Color as selected by Architect from manufacturer's full range.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 73 00 - Execution: Verification of existing conditions before starting work.
- B. Verify adequacy of support framing and blocking.

3.2 PREPARATION

- A. Section 01 73 00 - Execution: Prepare field conditions and existing construction for installation of work of this section.
- B. Prepare materials to be installed and equipment to be used during installation.

3.3 INSTALLATION

- A. Install wall pads in accordance with manufacturer's instructions and as indicated on Drawings.
- B. Use anchoring devices to suit conditions and substrate materials encountered.
- C. Set wall pads plumb, square, aligned at top and bottom with adjacent pads, and securely anchored to building structure.
- D. Provide anchorage to prevent wall pads from sliding laterally on z-clip mounting.
- E. Provide protected and finished cutouts for wall devices such as outlets and switches. Provide reinforced edge support at cutouts.

3.4 CLEANING

- A. Section 01 73 00 - Execution and Section 01 77 00 - Closeout Procedures: Related to cleaning.
- B. Clean wall pad covering and exposed mounting accessories.

3.5 PROTECTION OF INSTALLED CONSTRUCTION

- A. Section 01 73 00 - Execution: Protecting installed construction.

END OF SECTION

SECTION 11 66 43
INTERIOR SCOREBOARDS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Interior type electronic scoreboards including control center and other accessories for complete functional installation. Equipment to be designed for managing and displaying information for the following sports:
 - 1. Basketball.
 - 2. Volleyball.
 - 3. Wrestling.
- B. Related Requirements:
 - 1. Division 26 - Electrical, for electrical related work.

1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- B. Federal Communications Commission (FCC):
 - 1. Part 15 of FCC Rules and Regulations.
- C. National Electrical Code (NEC).
- D. Underwriters Laboratories Inc. (UL):
 - 1. UL and C-UL Standard for Electric Signs.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Data for scoreboards, controls, and accessories shall include descriptions of control functions.
- C. Shop Drawings: Installation drawings, face layout, dimensions, construction, electrical wiring diagrams, and method of anchorage.
- D. Samples: For each component requiring color selection, provide to the Architect samples indicating the manufacturer's full range of colors, textures, and finishes for selection.
- E. Warranty(s) sample.
- F. Manufacturer's installation instructions.

1.4 QUALITY ASSURANCE

- A. Source Limitation: All components including scoreboard, control center, control cable, and other accessories and installation hardware shall be products of a single manufacturer.
- B. Manufacturer Qualifications: Company specializing in manufacturing electronic scoreboards with minimum ten (10) years successful world-wide experience.
- C. Scoreboards and other electrical components shall be certified for use in United States and Canada by Underwriter Laboratories, (UL), Inc. and shall bear either UL or C-UL label.

- D. Scoreboards and other electrical components shall be electrically grounded in accordance with National Electrical Code (NEC), Article 600.

1.5 WARRANTY

- A. Section 01 77 00 - Closeout Procedures: Product warranties.
- B. Provide manufacturer's warranty covering defects in materials and workmanship.
 - 1. Scoreboards, scoring tables, marquees, message centers, video boards** and Stadium Pro loudspeaker enclosures are guaranteed for a period of five (5) years from the date of invoice against defects in workmanship or materials. (**Excluded: Video Boards 8815, 8825, 8835, and 8845.)
 - 2. Wireless components, portable scoreboards and solar power kit carry a two (2) year guarantee from date of invoice. Hand-held controls and switches carry a one (1) year guarantee from date of invoice. The Stadium Pro loudspeaker front printed scrim is guaranteed for one (1) year from the date of invoice. Video Board Models 8815, 8825, 8835, and 8845 are guaranteed for one (1) year from date of invoice, unless additional years of warranty is purchased. For products supplied by third-party suppliers (i.e. cameras, computers, computer monitors, radar guns, loudspeakers, amplifiers, and associated electronics), Purchaser agrees to accept the third-party manufacturer's warranty, if any, in lieu of any warranty from Nevco.
 - 3. Lifetime telephone support.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers:
 - 1. Nevco Inc, 301 East Harris Avenue, Greenville, Illinois 62246; Phone (800) 851-4040; Website www.nevco.com.
- B. Basis of Design: Nevco, Inc. - Model 2700 Series.

2.2 SCOREBOARDS

- A. Type: Interior, multi-purpose basketball/volleyball/wrestling electronic scoreboard with two integral horns, changeable captions, LED displays for time, scores, period, number of player fouling with personal fouls, team fouls, bonus and double bonus indicators, and next possession arrows; Model 2700-NL (base) as manufactured by Nevco Inc. Rear-lit (RL) caption plates or Electronic Team Names (ETN) are optional and scoreboard shall be capable of in-the-field retrofit. Only LED lighting shall be used for rear-lit captions, incandescent lighting excluded. No captions shall be applied directly to the face of the scoreboard. All caption plates will be changeable and made of polyvinylchloride with vinyl lettering applied.
 - 1. Size: 8 feet long x 3 feet high x 8 inches deep
 - 2. Approximate hanging weight: 71 pounds .
 - 3. Captions:
 - a. 6 inches high:
 - 1) Basic: "Home", "Guests", and "Period".
 - 2) Basketball: "Fouls" and "Player".
 - 3) Volleyball: "Won" and "Game".
 - 4) Wrestling: "Match" and "Weight".
 - 4. LED displays:
 - a. Timing: Super Bright Red 13 inches high digits with lit colon.
 - b. Team scores: Super Bright Amber 13 inches high digits.

- c. Period: Super Bright Amber 9 inches high digits.
 - d. Player number with personal fouls, game, and weight: Super Bright Red 9 inches high digits.
 - e. Team fouls, games won, and match: Super Bright Amber 9 inches high digits.
 - f. Next possession: Super Bright Amber arrow for each team.
 - g. Include bonus and double bonus in the form of a 4 inch Super Bright Red LED "B".
- 5. Rear-lit captions (when specified) shall require zero maintenance.
 - 6. Provide Advertising /Team logo area 3 each, 12 x 12 inches minimum.
 - 7. Suspension mounting attachments will be included.
 - 8. Power Requirement: All options included: 126 Watts, MAX, 100-240 Volts AC w/Power Factor Correction.

2.3 ACCESSORIES/OPTIONS

- A. Provide each scoreboard or accessory with control cable of length required. Electrical junction boxes, conduits, mounting hardware, and other accessories as required for installation are to be provided by others.
- B. Additional accessories include but are not limited to the following:
 - 1. Nevco Inc Shot Clocks / End of Period (EOP) system. (TWO REQUIRED)

2.4 CONTROL CENTER

- A. MPCX - Wireless, battery operated control center with receiver unit mounted at scoreboard.
- B. Type: Handheld wireless, basic, AA battery operated, sport specific, control center with receiver unit mounted at scoreboard; Model MPCW as manufactured by Nevco Inc. Control will have operability with earlier scoreboards from Nevco Inc. (PROVIDE TWO UNITS)
 - 1. Unit shall comply with Part 15 of FCC Rules and Regulations.
 - 2. Control unit: High impact, break-resistant black ABS plastic Size: 3-1/4 x 5-1/2 x 7/8 inches.
 - 3. Features:
 - a. Wireless operation within 1000 feet.
 - b. Operate multiple scoreboards simultaneously.
 - c. System allows multiple controllers to link to individual scoreboards.
 - d. High visibility LCD display with a sealed keyboard.
 - e. Long battery life with indicator; include two AA batteries.
 - f. Single hand operation with a no slip grip.
 - g. Built-in belt clip.
 - h. Wireless signal strength meter and internal antenna.
 - 4. Receiver: Injection molded case, 5-1/2 by 3-3/4 by 2 inches mounted at scoreboard.
 - 5. Maximum range: 1,000 feet from control center to receiver.
 - 6. Receiver shall require no additional source of power or separate control cable.
 - 7. Power adapters: Provide for each scoreboard receiver.
 - a. Input: 120 volts, 0.4 amps, 50/60 Hz.
 - b. Output: 9 volts, 1.67 amps, 15 watts.
 - 8. Provide carrying case for up to two control centers, Model CC-4 as manufactured by Nevco Inc.
 - a. Size: 18-1/2 x 14-1/2 x 6 inches.
 - b. Construction: Double wall, high density black polyethylene with padded interior, mechanical latches, and hinges.

2.5 MATERIALS

- A. Aluminum face and perimeter frame: Fabricated from 0.050 inch minimum thickness, ASTM B221 aluminum sheet.
- B. Finish: Acrylic polyurethane paint. Color to be as selected by Architect from manufacturer's full range of colors.
- C. Electronics: Low voltage, solid state, 2-wire cable, multiplex system, quartz crystal controlled.
- D. Provide fiber optic communication interface to reduce threat of damage from electrical storms.
- E. LED (light emitting diode) units: Seven-bar, segmented digits in protective aluminum cover, rated typical life 100,000 hours, and designed to provide excellent visibility from all angles and sides.
- F. Provide location specific universal power cord with plug for world-wide installation.
- G. Control cable where required shall be UL listed, 2-wire, type RG-58/U, coaxial cable, 1/4 inch diameter.
- H. Junction boxes where required: Sheet metal box and cover, 4-1/2 x 2-1/8 x 2-1/8 inches minimum. complying with NEMA standards.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 73 00 - Execution: Verification of existing conditions before starting work.
- B. Verify exact scoreboard and control center quantities and locations.
- C. Verify and coordinate equipment electrical requirements to ensure proper power source, conduit, wiring, boxes, points of connectivity are provided and in locations required. Prior to installation, verify type and location of power supply.
- D. Verify that power supplies are as required and that points of connection are located where required.
- E. Verify that field measurements are as required.
- F. Verify that surfaces and conditions are ready to accept the work of this Section.
- G. Verify that building roof structure has been designed for loads of suspended scoreboards.
- H. Examine products to be installed for damage and other conditions detrimental to completion of the Work.
- I. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Section 01 73 00 - Execution: Prepare field conditions and existing construction for installation of work of this Section.
- B. Prepare materials to be installed and equipment to be used during installation.
- C. Coordinate requirements for electrical power, wall blocking, auxiliary framing and supports, suspension cables, and other components to be provided under other Specification Sections to ensure adequate provisions are made for complete, functional installation of scoreboards.

3.3 INSTALLATION

- A. Section 01 73 00 - Execution: Related to installation of Work.
- B. Install the work in compliance with the design requirements, applicable codes, manufacturer's recommendations, and the contract documents.
- C. Before installation, field test scoreboards and accessories for operating functions. Ensure that scoreboards accurately perform all operations. Correct deficiencies.
- D. Rigidly mount scoreboards and accessories level and plumb with brackets and fasteners.
- E. Clean exposed surfaces.
- F. Protect scoreboards and finishes from other construction operations.

3.4 ADJUSTING

- A. Section 01 73 00 - Execution: Starting, testing, adjusting, and balancing.
- B. Test and adjust system operation to function as required.

3.5 DEMONSTRATING AND TRAINING

- A. Section 01 79 00 - Demonstration and Training: Provide demonstration and training to the Owner regarding operation and maintenance of components of the installed Work.

END OF SECTION

SECTION 12 24 13

ROLLER WINDOW SHADES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes roller window shades:
 - 1. Manually operating shades.
 - 2. Electric motorized operating shades.
- B. Related Requirements:
 - 1. Section 06 10 53 - Miscellaneous Rough Carpentry: Wood blocking and grounds for mounting roller shades and accessories.
 - 2. Section 08 41 13 - Aluminum-Framed Entrances and Storefronts.
 - 3. Section 09 21 16 - Gypsum Board Assemblies: Coordination with gypsum board assemblies for installation of shade pockets, closures, and related accessories.
 - 4. Section 09 51 13 - Acoustical Panel Ceilings: Coordination with acoustical ceiling systems for installation of shade pockets, closures, and related accessories.
 - 5. Division 26 - Electrical: Coordination with electric service for motor controls.

1.2 REFERENCES

- A. ASTM International (ASTM):
 - 1. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, Editorial Changes 2021.
- B. National Fire Protection Association (NFPA):
 - 1. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
 - 2. NFPA 701 - Fire Tests for Flame-Resistant Textiles and Films; 2023, Errata 2023.

1.3 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this Section. Review the work requirements, project conditions, sequencing, application procedures, quality control, testing and inspection and production schedule.

1.4 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate with electrical contractor for appropriate location for power outlets as required by manufacturer's equipment and installation requirements.
- C. Coordinate with requirements of roller shade installer/dealer to ensure that no inaccessible areas are constructed.

1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Styles, material descriptions, dimensions of individual components, profiles, features, finishes and operating instructions.

3. Storage and handling requirements and recommendations.
 4. Mounting details and installation methods.
 5. Typical wiring diagrams.
- C. Shop Drawings: Plans, elevations, sections, product details, installation details, operational clearances, wiring diagrams and relationship to adjacent work.
1. Include wiring diagram.
 2. Include Shade Schedule indicating size, location, width, and keys to details.
 3. Window Treatment Schedule: For all roller shades. Use same room designations as indicated on the Drawings and include opening sizes and key to typical mounting details.
- D. Samples for Initial Selection: For each finish product specified, submit two sets of shade material options and aluminum finish color samples representing manufacturer's full range of available colors and patterns. Include sample of shade material indicating fully fabricated bottom and side edges.
- E. Samples for Verification: From the Architect's initial selections, prepare and submit two samples for each selection of metal finishes, shade system components, unassembled, demonstrating compliance with specified requirements. Include shade material selection samples, 12 x 12 inches with face of material marked to indicate interior faces.
- F. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.6 CLOSEOUT SUBMITTALS

- A. Section 01 78 23 - Operation and Maintenance Data.
- B. Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of shop drawings.
- C. Manufacturer's Instructions and Maintenance Data: Methods for maintaining roller shades, precautions and recommendations regarding cleaning methods, cleaning materials and stain removal methods, instructions for operating hardware and controls.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this Section, with a minimum of five (5) years documented experience in manufacturing products specified in this Section.
- B. Obtain roller shades through one source from a single manufacturer.
- C. Installer Qualifications: Installer trained and certified by the manufacturer. Company specializing in performing the type of work required in this Section, with a minimum of five (5) years documented experience.
- D. Fire-Test-Response Characteristics: Passes NFPA 701 small and large-scale vertical burn. Materials tested shall be identical to products proposed for use.
- E. Electrical Components: NFPA Article 100 listed and labeled by either UL or ETL or other testing agency acceptable to authorities having jurisdiction, marked for intended use, and tested as a system. Individual testing of components will not be acceptable in lieu of system testing.
- F. Fungal Resistance: No growth when tested according to ASTM G21.

1.8 MOCK-UP

- A. Section 01 40 00 - Quality Requirements: Mock-up requirements.

- B. Provide a mock-up of one roller shade assembly for evaluation of mounting, appearance, and accessories.
 - 1. Locate mock-up at location designated by Architect.
 - 2. Do not proceed with remaining work until, mock-up is accepted by Architect.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Deliver shades in factory-labeled packages, marked with manufacturer and product name, fire-test-response characteristics, and location of installation using same room designations indicated on Drawings and in the submittal Shade Schedule.

1.10 PROJECT CONDITIONS

- A. Section 01 60 00 - Product Requirements: Requirements before, during and after installation of Work.
- B. Environmental Limitations: Install roller shades after finish work including painting is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.11 WARRANTY

- A. Section 01 77 00 - Closeout Procedures: Product warranties.
- B. Roller Shade Hardware and Chain Warranty: Manufacturer's standard non-depreciating twenty-five (25) year warranty.
- C. Roller Shade Motors and Motor Control Systems: Manufacturer's standard non-depreciating five (5) year warranty.

1.12 SPARE PARTS AND MAINTENANCE PRODUCTS

- A. Section 01 60 00 - Product Requirements: Extra materials, spare parts, and maintenance products.
 - 1. Two (2) of each size and type of shade assembly installed.
 - 2. Two (2) of each type of control cord, control chain, and wand.

PART 2 PRODUCTS

2.1 ROLLER SHADES

- A. Manufacturers:
 - 1. Draper, Inc.
 - 2. Hunter Douglas Corporation.
 - 3. Lutron Electronics Company, Inc.
 - 4. MechoShade Systems, Inc.
 - 5. TimberBlindMetroShade.
- B. Basis of Design:

2.2 Draper, IncMANUAL OPERATING SHADES

- A. Mounting:
 - 1. As indicated on Drawings.

2. Provide factory finished headbox with removable fascia to conceal roller(s) and operating mechanisms from view at all sides.
- B. Width and Length:
 1. Shades are to cover entire wall opening unless indicated otherwise on Drawings.
- C. Colors: Colors for fabrics and components exposed to view unless indicated otherwise on Drawings.
 1. As indicated on Drawings.
- D. Single Roller Type.
 1. Fabric Material Type:
 - a. As indicated on the drawings.
 2. Locations:
 - a. As indicated on Drawings.
- E. Fabric Material Types:
 1. Solar (glare) Shade Material:
 - a. As selected by Architect from manufacturer's full range.
- F. Clutch Operator: Manufacturer's standard material and design integrated with bracket/brake assembly.
 1. Provide a permanently lubricated brake assembly mounted on an oil-impregnated hub with wrapped spring clutch.
 2. Brake must withstand minimum pull force of 50 pounds (22.7 kg) in the stopped position.
 3. Mount clutch/brake assembly on the support brackets, fully independent of the roller tube components.
- G. Drive Chain: Continuous loop stainless steel beaded ball chain, 95 pound (43 kg) minimum breaking strength. Provide upper and lower limit stops.
 1. Chain Retainer: Chain tensioning device complying with WCMA A100.1.

2.3 ELECTRIC MOTORIZED OPERATING SHADES

- A. Mounting:
 1. As indicated on Drawings.
 2. Provide factory finished headbox with removable fascia to conceal roller(s) and operating mechanisms from view at all sides.
 3. Fabric Retention System: Manufacturer's system of side channels with fabric retainer and light seal, and shade fabric fabricated with steel stays.
- B. Width and Length:
 1. Shades are to cover entire wall opening unless indicated otherwise on Drawings.
- C. Colors: Colors for fabrics and components exposed to view unless indicated otherwise on Drawings.
 1. As indicated on Drawings.
- D. Single Roller Type.
 1. Material Type:
 - a. Blackout material.
 2. Locations:
 - a. Gymnasium.
- E. Fabric Material Types:
 1. Blackout Material: Opaque.
- F. Controls:

1. Provide single, 3-position, keyed switch control operation for raising and lowering of shades in synchronized level of motion and at variable stopping locations between fully open and fully closed positions. Motor operation is to automatically disengage when shades are in fully open and fully closed position as to not damage shade and roller and motorized drive mechanism. Install keyed switch control device at location as indicated on Drawings or as designated by Architect.
 2. Provide wireless hand-held remote control device for each room in which motorized shades are installed. Furnish with each remote device, a wall-mountable device holder for installation by Owner.
- G. Motorized Shade Hardware and Shade Brackets:
1. Provide shade hardware constructed of minimum 1/8 inch thick plated steel, or heavier, thicker, as required to support 150 percent of the full weight of each shade.
 2. Provide shade hardware system that allows for field adjustment of motor or replacement of any operable hardware component without requiring removal of brackets, regardless of mounting position (inside, or outside mount).
- H. Shade Motor Drive System:
1. Shade Motors:
 - a. Tubular motors with built-in reversible capacitor operating at 110v AC (60hz), single phase, temperature Class B, thermally protected, totally enclosed, maintenance free with line voltage power supply equipped with locking disconnect plug assembly furnished with each motor.
 - b. Provide for controlled operation for raising and lowering of shades in synchronized level of motion and at variable stopping locations between fully open and fully closed positions. Motor operation is to automatically disengage when shades are in fully open and fully closed position as to not damage shade and roller and motorized drive mechanism.
 - c. Conceal motors inside shade roller tube.
 - d. Maximum current draw for each shade motor of 2.3 amps.
 - e. Use motors rated at the same nominal speed for all shades in the same room.
 2. Total hanging weight of shade band shall not exceed 80 percent of the rated lifting capacity of the shade motor and tube assembly.

2.4 SHADE BAND

- A. Shade Bands: Construction of shade band includes the fabric, the hem weight, hem-pocket, shade roller tube, and the attachment of the shade band to the roller tube. Sewn hems and open hem pockets are not acceptable.
1. Hem Pockets and Hem Weights: Fabric hem pocket with RF-welded seams (including welded ends) and concealed hem weights. Hem weights shall be of appropriate size and weight for shade band. Hem weight shall be continuous inside a sealed hem pocket. Hem pocket construction and hem weights shall be similar, for all shades within one room.
 2. Shade Band and Shade Roller Attachment:
 - a. Use extruded aluminum shade roller tube of a diameter and wall thickness required to support shade fabric without excessive deflection.
 - b. Provide for positive mechanical engagement with drive / brake mechanism.
 - c. Provide for positive mechanical attachment of shade band to roller tube; shade band shall be made removable / replaceable with a "snap-on" "snap-off" spline mounting, without having to remove shade roller from shade brackets.
 - d. Mounting spline shall not require use of adhesives, adhesive tapes, staples, and/or rivets.
 - e. Any method of attaching shade band to roller tube that requires the use of adhesive, adhesive tapes, staples, and/or rivets are not acceptable.

2.5 SHADE FABRICATION

- A. Fabricate units to completely fill existing openings from head to sill and jamb-to-jamb, unless specifically indicated otherwise.
- B. Provide battens in standard shades as required to assure proper tracking and uniform rolling of the shadebands. Contractor shall be responsible for assuring the width-to-height (W:H) ratios shall not exceed manufacturer's standards or, in absence of such standards, shall be responsible for establishing appropriate standards to assure proper tracking and rolling of the shade cloth within specified standards. Battens shall be roll-formed stainless steel or tempered steel, as required.
- C. For railroaded shadebands, provide seams in railroaded multi-width shadebands as required to meet size requirements and in accordance with seam alignment as acceptable to Architect. Seams shall be properly located. Furnish battens in place of plain seams when the width, height, or weight of the shade exceeds manufacturer's standards. In absence of such standards, ensure proper use of seams or battens as required to, and assure the proper tracking of the railroaded multi-width shadebands.
- D. Provide battens for railroaded shades when width-to-height (W:H) ratios meet or exceed manufacturer's standards. In absence of manufacturer's standards, be responsible for proper use and placement of battens to assure proper tracking and roll of shadebands.
- E. Blackout shadebands, when used inside channels, shall have horizontally mounted, roll-formed stainless steel or tempered-steel battens not more than 3 feet on center extending fully into the side channels. Battens shall be concealed in an integrally colored fabric to match the inside and outside colors of the shadeband, in accordance with manufacturer's published standards for spacing and requirements.
 - 1. Battens shall be roll formed of stainless steel or tempered steel and concave to match the contour of the roller tube.
 - 2. Batten pockets shall be self-colored fabric front and back RF welded into the shade cloth. A self-color opaque liner shall be provided front and back to eliminate any see through of the batten pocket that shall not exceed 1-1/2 inches high and be totally opaque. A see-through moiré effect, which occurs with multiple layers of transparent fabrics, shall not be acceptable.

2.6 COMPONENTS

- A. Access and Material Requirements:
 - 1. Provide shade hardware allowing for the removal of shade roller tube from brackets without removing hardware from opening and without requiring end or center supports to be removed.
 - 2. Provide shade hardware that allows for removal and re-mounting of the shade bands without having to remove the shade tube, drive, or operating support brackets.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 73 00 - Execution: Verification of existing conditions before starting work.
- B. Verify field measurements are as shown on shop drawings.
- C. Examine substrates for conditions detrimental to installation of the Work. Proceed with installation only after unsatisfactory conditions have been corrected.

- D. Examine products to be installed for damage and other conditions detrimental to completion of the Work. Proceed with installation only after unsatisfactory conditions have been corrected.
- E. Verify that required electrical service is available, in proper location, and ready for installation of the work of this Section.

3.2 PREPARATION

- A. Section 01 73 00 - Execution: Prepare field conditions and existing construction for installation of work of this Section. Prepare materials to be installed and equipment used during installation.
- B. Clean surfaces thoroughly prior to installation.
- C. Prepare surfaces for installation of the work.

3.3 INSTALLATION

- A. Section 01 73 00 - Execution: Related to installation of Work.
- B. Install roller shades level, plumb, square, and true according to components in accordance with manufacturer's written instructions and located so shade band is not closer than 2 inches to interior face of glass. Allow proper clearances for window operation hardware.
- C. Motorized Operating Shades:
 - 1. Turn-Key Single-Source Responsibility: To control the responsibility for performance of motorized roller shade systems, assign the design, engineering, and installation of motorized roller shade systems, motors, controls, and low voltage electrical control wiring specified in this Section to a single manufacturer and their authorized installer/dealer. The Architect will not produce a set of electrical drawings for the installation of control wiring for the motors, or motor controllers of the motorized roller shades. Power wiring (line voltage) shall be provided by the roller shade installer/dealer, in accordance with the requirements provided by the manufacturer. Coordinate the following with the roller shade installer/dealer:
 - a. Contractor shall provide power panels and circuits of sufficient size to accommodate roller shade manufacturer's requirements, as indicated on the mechanical and electrical drawings.
 - b. Contractor shall coordinate with requirements of roller shade installer/dealer to ensure that no inaccessible areas are constructed.
 - c. Roller shade installer/dealer shall run line voltage as dedicated home runs (of sufficient quantity, in sufficient capacity as required) terminating in junction boxes in locations designated by roller shade dealer.
 - d. Roller shade installer/dealer shall provide and run all line voltage (from the terminating points) to the motor controllers, wire all roller shade motors to the motor controllers, and provide and run low voltage control wiring from motor controllers to switch/control locations indicated on Drawings or otherwise designated by the Architect. All above-ceiling and concealed wiring shall be plenum-rated, or installed in conduit, as required by the electrical code having jurisdiction.
 - e. Contractor shall provide conduit with pull wire in all areas, which might not be accessible to roller shade contractor due to building design, equipment location or schedule.
 - 2. Ensure that all wiring is concealed in a tight, uniform installation. Coordinate with electrical contractor for appropriate location for power outlets as required by manufacturer's equipment and installation requirements.

3.4 ADJUSTING

- A. Section 01 73 00 - Execution: Starting, testing, adjusting, and balancing.
- B. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.5 CLEANING

- A. Section 01 73 00 - Execution and Section 01 77 00 - Closeout Procedures: Related to cleaning.
- B. Clean roller shade surfaces after installation, according to manufacturer's written instructions.

3.6 PROTECTION OF INSTALLED CONSTRUCTION

- A. Section 01 73 00 - Execution: Protecting installed construction.
- B. Protect installed work from damage.

3.7 DEMONSTRATION AND TRAINING

- A. Section 01 79 00 – Demonstration and Training.
- B. Provide demonstration and train to Owner's maintenance personnel to adjust, operate and maintain roller shade systems.

END OF SECTION

SECTION 12 32 16

MANUFACTURED PLASTIC-LAMINATE-CLAD CASEWORK

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Manufactured plastic-laminate-clad casework.
 - 2. Countertops.
 - 3. Casework hardware.
- B. Related Requirements:
 - 1. Section 09 65 00 - Resilient Flooring: Rubber base.
 - 2. Division 22 - Plumbing Fixtures: Sinks set in countertops.

1.2 DEFINITIONS

- A. Identification of Casework Parts by Surface Visibility:
 - 1. Unit Body with Open Interior: Storage unit surfaces without solid door or drawer fronts, and units with glass sliding or glass framed doors.
 - 2. Unit Body with Closed Interior: Storage unit surfaces with closable solid door or drawer fronts.
 - 3. Exposed Surface: Surface that is visible.
 - 4. Concealed Surface: Surface that is not visible after installation.

1.3 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. ANSI A135.4 - Basic Hardboard; 2012, Reapproval 2020.
 - 2. ANSI A208.1 - Particleboard; 2022.
- B. ASTM International (ASTM):
 - 1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- C. Architectural Woodwork Manufacturers Association of Canada (AWMAC) and the Woodwork Institute (WI):
 - 1. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.
- D. California Department of Public Health (CDPH):
 - 1. CDPH Standard Method VOC V1.2 - Standard Method For The Testing And Evaluation Of Volatile Organic Chemical Emissions From Indoor Sources Using Environmental Chambers - Version 1.2; 2017.
- E. National Electrical Manufacturers Association (NEMA):
 - 1. NEMA LD 3 - High Pressure Decorative Laminates; 2005.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting not less than one week before starting work of this Section; require attendance by all affected installers.

1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

- B. Product Data: Submit data describing casework finishes and construction.
- C. Shop Drawings:
 - 1. Scale of Drawings: 1-1/2 inch to 1 foot, minimum.
 - 2. Provide the information required by AWMAC/WI (NAAWS) and to include the following:
 - a. Indicate component dimensions, configurations, elevations, cross-sections, construction details, joint details, hardware locations, service run spaces and location of services. Include layout of units with relation to surrounding walls, doors, windows, and other building components.
 - b. Include details for fabrication of vanity and countertop supports, brackets, and finishes.
- D. Samples for Initial Selection: Two manufacturer's color samples illustrating the full range of finishes, patterns, and colors available for each finish surface type, trim and hardware indicated; submit for Architect's initial selections.
- E. Samples for Verification: From the Architect's initial selections, prepare and submit two samples for each selected finish, pattern, and color; minimum 4 x 4 inch samples and actual hinge and pull. Where finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.
- F. Certificate: Submit labels and certificates required by quality assurance and quality control programs.

1.6 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum ten (10) years documented experience.
- B. Installer: Company specializing in the installation of casework with minimum five (5) years documented experience and approved by the manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Store completed casework and countertops in a ventilated space with relative humidity range of 20 to 50 percent.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.
- B. Do not install casework in unconditioned spaces, or in spaces where relative humidity is not within acceptable limits.

1.9 SPARE PARTS AND MAINTENANCE PRODUCTS

- A. Section 01 60 00 - Product Requirements: Extra materials, spare parts, and maintenance products.
 - 1. Two (2) of each type of cabinet hardware installed; refer to Components article, Cabinet Hardware paragraph.
 - 2. Ten (10) additional cabinet locks with keys, keyed to owner key system.
 - 3. Twenty-five (25) linear feet roll of each color and type PVC edge banding installed.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Work of this Section is to comply with AWMAC/WI (NAAWS), unless indicated otherwise.
- B. AWMAC/WI (NAAWS) Quality Standard:
 - 1. Custom Grade.

2.2 MANUFACTURED PLASTIC-LAMINATE-CLAD CASEWORK

- A. Manufacturers:
 - 1. Biggs Casework, Inc.
 - 2. Blair-Dumond, Inc.
 - 3. Cabinets by Design, Inc., Duluth GA.
 - 4. Case Systems.
 - 5. Cleora Sterling Corporation.
 - 6. Interior Wood Specialties, Inc.
 - 7. Kewaunee Scientific Corporation.
 - 8. Pridgen Cabinetworks.
 - 9. Stevens Industries Inc.
 - 10. TMI Systems Design Corporation.
 - 11. Substitutions: Section 01 60 00 - Product Requirements.

2.3 COMPONENTS

- A. Particleboard: ANSI A208.1; 45 pound density, fir, or pine.
 - 1. Interior Composite Wood Products: CDPH Standard Method VOC V1.2.
 - 2. Use Moisture Resistant Particleboard on countertops in wet areas and at sinks.
- B. Hardboard: ANSI A135.4; prefinished; 1/4 inch thick.
- C. Melamine: Melamine resin laminate sheet; thermally fused to panel core material. Colors indicated in FINISHES article in this Section.
- D. PVC Edging: Extruded PVC, self-locking serrated tongue, of width to match component thickness. Colors indicated in FINISHES article in this Section.
 - 1. Convex face with smooth finish.
- E. Plastic Laminate: High Pressure Decorative Laminate (HPDL) complying with AWMAC/WI (NAAWS) and NEMA LD 3. Colors indicated in FINISHES article in this Section.
- F. Phenolic Resin: non-glare, black finish; minimum 1 inch thick with radiused edges.
 - 1. As indicated in drawings.
- G. Cabinet Hardware:
 - 1. Pulls:
 - a. Attachment:
 - 1) 4 inch centers.
 - b. Finish and Color:
 - 1) Powder coated wire; color as selected by Architect from manufacturer's full range.
 - 2. Hinges: Heavy duty, exposed 5 knuckle, fixed pin, hospital-tip style.
 - a. Finish and Color:
 - 1) To match Pulls.
 - 3. Magnetic Catches: Aluminum case with zinc plated steel strike, 6 lb. pull minimum.

4. Door & Drawer Locks: Cam type, disc tumbler capable of being master keyed; stainless steel, satin finish. Each room, keyed alike and separate from other rooms and all locks master keyed.
 - a. Drawers: Lock quantities and locations.
 - 1) Provide keyed locks at locations indicated on Drawings.
 - b. Doors: Lock quantities and locations.
 - 1) Provide keyed locks at locations indicated on Drawings. For double door cabinet units receiving keyed lock, provide interior release/latch for adjacent door.
5. Coat Hooks: Ceiling and wall surface mounted types.
 - a. Double prong wardrobe design; stainless steel.
 - b. Finish and Color: To match Pulls.
 - c. Hook quantities and locations; to be mounted in casework units as follows:
 - 1) Provide coat hooks at locations indicated on Drawings.
6. Hardware Fasteners: Exposed fasteners to match material and finish of installed device.
7. Where door opens against adjacent construction, provide chain or other restraint device to prevent door and door hardware from contacting adjacent construction.
8. Drawer Slides:
 - a. Standard Drawers: Nylon ball bearing, self-closing; 75 pound capacity.
 - b. File Drawers: Full extension, ball bearing, self-closing; 100 pound capacity.
9. Adjustable Shelf Supports:
 - a. Heavy duty, polycarbonate; clear; pin type; shelf locking clip.
10. Casters: Double ball bearing mounting to heavy gage zinc plated fork; 5 inch soft rubber wheels. Provide two brake units per mobile unit.
- H. Fixed Vanity and Countertop Brackets:
 1. Brackets to comply with Americans with Disabilities Act (ADA) where applicable.
 2. Material:
 - a. Stainless steel; satin finish.
- I. :Bolts, Nuts, Washers, Lags, Anchors, Pins, Fasteners, and Screws: As indicated on Drawings and otherwise to be of size and type to suit application; galvanized finish in concealed locations and stainless steel in exposed locations.

2.4 FABRICATION

- A. Verify field measurements prior to fabrication.
- B. Fabricate laminate clad casework to dimensions, profiles and details shown.
- C. Joinery Dowels: Hardwood dowels, glued and clamped tight.
- D. Construct cabinet bodies with 3/4 inch particleboard for sides, fixed intermediates, subtops, and bottoms. Stretchers, where allowed, to be minimum 4 inch wide.
 1. Subtops to be solid particleboard; no stretchers allowed for subtops.
- E. Construct shelving up to 30 inches wide with 3/4 inch particleboard. Construct shelving greater than 30 inches wide with 1 inch particleboard.
- F. Construct cabinet backs with 1/2 inch particleboard.
- G. Construct drawers with 1/2 inch particleboard for sides, back, and subfront. Construct drawer bottoms with 1/2 inch prefinished hardboard.
- H. Construct doors, and drawer fronts with 3/4 inch particleboard.
- I. Construct countertops as follows:
 1. Use Moisture Resistant Particleboard in wet areas and countertops with sinks.

2. Use 1-1/8 inch particleboard for countertops finished with Plastic Laminate.
 3. Use 3/4 inch particleboard for countertops finished with Solid Surface (Synthetic Surface) type material.
- J. All components to be of balanced construction. Plastic laminate faced particleboard to be balanced with high pressure cabinet liner on opposite side unless otherwise noted. Melamine faced particleboard to be balanced with melamine.
- K. Wall Hung Units:
1. Top surfaces of wall hung units to be finished with same material as visible vertical end panels.
 2. Bottom surfaces of wall hung units to be finished with melamine on surfaces and color matching PVC panel edging.

2.5 FINISHES

- A. Doors:
1. Front and Interior: Plastic laminate VGS28 with 3mm PVC edging.
- B. Drawers:
1. Fronts: Plastic laminate VGS28 with 3mm PVC edging.
 2. Interiors: Melamine with 1mm PVC edging.
- C. Unit Body with Closed and Open Interiors:
1. Interior Surfaces: Melamine with 1mm PVC edging.
 2. Exposed Surfaces: Plastic laminate VGS28 with 1mm PVC edging.
 3. Shelves: Melamine on both sides.
 - a. Shelf Edging for Closed Interiors: 1mm PVC edging.
 - b. Shelf Edging for Open Interiors: 3mm PVC edging.
- D. Countertops:
1. Plastic Laminate Clad Type: HGS/HGP48 with 3mm PVC edging.
 - a. Locations: All countertops unless otherwise indicated.
 2. Solid Surface Material Type: Cast polymeric resin.
 - a. Locations: As indicated on Drawings.
 3. Phenolic Resin: non-glare, black finish; minimum 1 inch thick with radiused edge.
 - a. Locations: As indicated on Drawings.
- E. Finishes Colors and Textures:
1. Melamine: White.
 2. PVC Edging:
 - a. Colors and textures as selected by Architect from manufacturer's full range.
 3. Plastic Laminate:
 - a. Colors and textures as indicated on Drawings.
 4. Solid Surface Material:
 - a. Colors and textures as indicated on Drawings.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 73 00 - Execution: Verification of existing conditions before starting work.
- B. Verify adequacy of backing and support framing.
- C. Verify location and sizes of utility rough-in associated with work of this Section.

3.2 PREPARATION

- A. Section 01 73 00 - Execution: Prepare field conditions and existing construction for installation of work of this Section.
- B. Prepare materials to be installed and equipment to be used during installation.

3.3 INSTALLATION

- A. Section 01 73 00 - Execution: Related to installation of Work.
- B. Install work in accordance with AWMAC/WI (NAAWS) requirements for grade indicated.
- C. Set and secure casework in place; rigid, plumb, and level.
- D. Use fixture attachments in concealed locations for wall mounted components.
- E. Use concealed joint fasteners to align and secure adjoining cabinet units and counter tops.
- F. Carefully scribe casework abutting other components and construction, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.
- G. Secure cabinets, brackets and bases to floor and wall substrates using appropriate angles and anchorages.
- H. Seal joints at abutment to other construction with appropriate sealant matching casework finish.
- I. Sequence installation and erection to ensure mechanical and electrical connections are achieved in an orderly and expeditious manner.

3.4 ADJUSTING

- A. Section 01 73 00 - Execution: Starting, testing, adjusting, and balancing.
- B. Adjust moving or operating parts to function smoothly, without binding and correctly.
- C. Repair or remove and replace defective work to new condition.

3.5 CLEANING

- A. Section 01 73 00 - Execution and Section 01 77 00 - Closeout Procedures: Related to cleaning.
- B. Clean casework, counters, shelves, hardware, fittings, and fixtures.

3.6 PROTECTION OF INSTALLED CONSTRUCTION

- A. Section 01 73 00 - Execution: Protecting installed construction.
- B. Protect Work from damage, including damage from detrimental air temperature and humidity levels.

END OF SECTION

SECTION 12 66 13

TELESCOPING BLEACHERS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Telescoping bleachers.
 - a. Electric motor operators, controls, and internal wiring.
- B. Related Requirements:
 - 1. Division 09 - Finishes: Sections indicating flooring system on which bleachers set and operate. Refer to COORDINATION article in this Section.
 - 2. Contract Documents related to wall construction adjacent to rear of bleachers system.
 - 3. Division 26 - Electrical: Sections regarding electrical work.

1.2 REFERENCE STANDARDS

- A. Americans with Disabilities Act (ADA):
 - 1. ADA Standards - ADA Standards for Accessible Design; Current Edition.
- B. ASTM International (ASTM):
 - 1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
 - 2. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.
 - 3. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2022.
 - 4. ASTM D1248 - Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable; 2016.
 - 5. ASTM D1929 - Standard Test Method for Determining Ignition Temperature of Plastics; 2023.
 - 6. ASTM D2843 - Standard Test Method for Density of Smoke from the Burning or Decomposition of Plastics; 2022.
 - 7. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- C. American Welding Society (AWS):
 - 1. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, Errata 2023.
 - 2. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, Errata 2022.
- D. International Code Council (ICC); International Building Code (IBC):
 - 1. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
 - 2. ICC 300 - Bleachers, Folding And Telescopic Seating, And Grandstands; 2023.
- E. National Fire Protection Association (NFPA):
 - 1. NFPA 102 - Standard for Grandstands, Folding and Telescopic Seating, Tents, and Membrane Structures; 2021.
- F. National Institute of Standards and Technology (NIST):
 - 1. NIST PS 1 - Structural Plywood; 2023.

1.3 COORDINATION

- A. Coordinate requirements of the work of this Section with finish flooring requirements for adequate support and operation of the bleacher system.

1. In the case of a composite finish flooring systems (e.g. wood strip flooring on plywood and sleepers), coordinate flooring and bleachers requirements for solid blocking within the flooring assembly for adequate weight support of retracted, fully extended, and fully loaded bleacher system supports.

1.4 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures: Submittal Procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used.
- C. Shop Drawings: Indicate layout and dimensions of bleacher units including seat heights, row spacing and rise, aisle widths and locations, overall dimensions in closed and open position, connections, and relationship to adjoining work, accessories, types of materials and finishes.
 1. Include data for structural computations, materials properties, and other information needed for structural analysis. Data is to be signed and sealed by a qualified Professional Engineer responsible for preparation of data, and licensed in the State in which the project is located.
 2. Provide shop drawings specific to this Project.
 3. Graphics Layout Drawings: Indicate pattern of seat colors as indicated on Drawings.
 4. Wiring Diagrams: Show locations of motors, electrical wiring, and rough-in connections.
- D. Samples for Initial Selection: For each material for which color selection is required, submit samples, 2 by 2 inches in size, illustrating the full range colors and finishes available; submit for Architect's initial selection.
- E. Samples for Verification: From the Architect's initial selections, submit samples of actual finish or product, for verification of color selection.
- F. Certifications: Provide qualifications certification for the following:
 1. Manufacturer.
 2. Installer.
 3. Engineer.
 4. Welders.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 77 00 - Closeout Procedures.
- B. Operation and Maintenance Data: Manufacturer's operation and maintenance instructions, including annual inspection and maintenance and bi-annual inspection by a Professional Engineer or manufacturer factory service personnel.
- C. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

- A. Design to comply with all applicable code requirements.
- B. Seating Layout: Comply with current ICC 300 for Folding and Telescopic Seating, except where additional requirements are indicated or imposed by authorities having jurisdiction.
- C. Welding Standards & Qualification: Comply with AWS D1.1/D1.1M and AWS D1.3/D1.3M.

1.7 QUALIFICATIONS

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this Section, with not less than ten (10) years of documented experience.
- B. Installer Qualifications: Certified as approved by Manufacturer.
- C. Engineer Qualifications: Bleacher system to be designed, sealed and signed by a Registered Professional Engineer.
- D. Welder Qualifications: Certified by AWS for the processes employed.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept products in manufacturer's packaging clearly labeled with manufacturer name and content. Inspect for damage.
 - 1. Store, in original packaging, under cover and elevated above grade.

1.9 WARRANTY

- A. Section 01 77 00 - Closeout Procedures: Product warranties.
- B. Manufacturer's five (5) year warranty for all work and materials to be free of defects. Replace parts that fail under normal use at no extra charge to Owner.

PART 2 PRODUCTS

2.1 BLEACHERS

- A. Manufacturers:
 - 1. Hussey Seating Company.
 - 2. Interkal, LLC.
 - 3. Irwin Seating Company.
 - 4. Kodiak Seating by Royal Stewart Ltd.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Basis of Design:
 - 1. Interkal, LLC.

2.2 TELESCOPING BLEACHERS

- A. Telescoping Bleachers: Factory assembled tiered benches that retract horizontally into depth approximately the same as a single row depth, with fixed seats mounted on leading edge of platforms.
 - 1. Bleacher system to be designed, sealed and signed by a licensed Professional Engineer licensed in the State in which the Project is located.
 - 2. Provide a design that has been in use for at least 5 years; submit documentation.
 - 3. Design to comply with applicable requirements of NFPA 102 and requirements of code authorities having jurisdiction; where conflicts between requirements occur, comply with whichever is more stringent.
 - 4. Design with solid seat fronts that conceal interior mechanisms when fully retracted, fitting tightly enough to prevent climbing up face; at front row provide key locked, hinged fascia (skirt) to cover gap between seat riser/fascia and floor.
 - 5. Configurations: As indicated on Drawings.
 - 6. Operation:

- a. Electric motor operation.
 7. Extension Direction:
 - a. Forward-Fold Extension: Top row fixed to floor, adjacent to wall under overhang, forward extension (away from wall); attachment to wall is acceptable when Registered Engineer's design includes anchorage designed for wall construction.
 8. Wheelchair Viewing Spaces: Provide wheelchair viewing spaces as follows. Provide removable railings at row behind wheelchair spaces. All wheelchair viewing spaces are to comply with ADA Standards.
 - a. Retractable Wheelchair Spaces: Provide manually retractable spaces with operation that does not affect other seating rows. Number of spaces and locations to be as follows:
 - 1) Evenly distribute the following spaces across entire set of bleachers front row (floor level):
 - a) 4 spaces, evenly distributed.
 - b. Permanently Open Wheelchair Space: Provide permanently open spaces. Number of spaces and locations to be as follows:
 - 1) Evenly distribute the following spaces across entire set of bleachers front row (floor level):
 - a) 2 spaces, evenly distributed.
 9. Cutouts: Fit units to irregular wall surfaces, columns, pilasters, roof drain leaders, and other obstructions; take field measurements prior to fabrication.
- B. Design Loads: Design to withstand the following loading conditions, in addition to its own weight:
1. Live Load on Structural Supports: 100 pounds per square foot minimum, of gross horizontal projection.
 2. Live Load on Seats and Walking Surfaces: 120 pounds per linear foot.
 3. Structural Supports Sway Parallel to Seats: 24 pounds per linear foot of row combined with Uniformly Live Load.
 4. Structural Supports Sway Perpendicular to Seats: 10 pounds per linear foot of row combined with Uniformly Live Load.
- C. Dimensions:
1. Overall dimensions as indicated on Drawings.
 2. Other dimensions unless indicated otherwise on Drawings:
 - a. Rise Per Row:
 - 1) 11-1/2 inches.
 - b. Row Depth:
 - 1) 26 inches from seat front to next seat front (13.2 inches minimum clear aisle. Comply with ICC (IBC)).
 - c. Seat Height Above Tread: 6-1/2 inches.
- D. Structural Supports: Steel or aluminum; wheeled carriages supporting each tier separately, with moving parts permanently lubricated and metal parts cushioned to prevent metal-to-metal contact during operation.
1. Design each row carriage so that it will individually support the design loads and is self-supporting when fully assembled without dependence on platform panels or boards, seats, or fascia.
 2. Vertical columns and deck supports.
 3. Stabilized by sway braces attached to the vertical columns and steel risers for strength and resistance to movement. Sway braces fabricated from steel to resist compression and tension forces created when the bleachers are loaded.
 4. Vertical columns, minimum 2 x 3 inches closed seam, rectangular structural steel tubing. Post size as required for row height and load bearing requirements.

5. Rigid deck support brackets to prevent sagging and binding during operation.
 6. All deck supports are to incorporate rollers for efficient operation and deck stability.
 7. Continuous structural galvanized steel nose-beam to which the seat surface is attached for a uniform understructure providing strength and continuous support for the plywood deck.
 8. Low friction flexible rod sliding system with positive engagement of vertical supports without binding. Provide smooth operation over floor. Maintain proper vertical column spacing and eliminate racking damage.
 9. Welding: In accordance with AWS D1.1/D1.1M and AWS D1.3/D1.3M.
 10. Bolting: Use lock-washers or locknuts.
 11. Wheels: Minimum 5 inches diameter by 1-1/8 inch wide, with non-marring heavy duty composition rubber tires; ball, roller, or oil-impregnated metal bearings; minimum of 2 wheels at each floor support.
 12. Finish: Manufacturer's standard enamel or powder coating. Color, black.
 13. Row Locking: Automatically mechanically lock each carriage to adjacent carriages when fully extended.
 14. Unlocking (Motorized Operation): Automatically unlock all rows before engaging retraction mechanism.
 15. Rollers On Each Deck Support: Provide nylon rollers at the top of every deck to reduce friction, provide smooth and quiet operation, provide deck stability, and to eliminate steel-to-steel contact that might hinder the operation of the bleacher.
 16. Nose-beam splice, 4-bolt pattern, minimum.
 17. Section splice, 8-bolt pattern joint connections, minimum.
- E. Motor Operation:
1. Integral Power: Integral automatic electromechanical powered frame propulsion system, to open and close telescopic seating. Integral Power and Control System shall be Underwriters Laboratories, Inc. (UL) approved and listed.
 2. Operation with removable pendant control unit which plugs into seating bank for operator management of stop, start, forward, and reverse control of the power operation.
 3. Each Powered Frame unit consists of output shaft gear reducer. Reducers shall be fitted with 3 phase induction motors which will provide an average operating speed of 46 fpm.
 4. Operating Loads: Each Powered Frame is to provide 220 lbs pull force which equals approximately 28 psi lateral force on the floor.
 5. Limit Switches: Provide both open and closed limit switches for the integral power system. The limit switches will automatically stop integral power operation when seating has reached the fully extended or closed position.
 6. Motion Monitor: Provide flashing light with self-contained warning horn rated at 85 db at 10 feet mounted under telescopic seating for audio and visual warning during integral power operation.
 7. Electrical: Each power frame unit is power operated by a 1/2 horsepower, 1,725 RPM, 208 Volts, 60 Hz., three phase, 1.25 service factor motor.
 8. Provide access to motor from front side of bleachers; a hinged front skirt or hinged section at least 30 inches (760 mm) wide is acceptable.

2.3 MATERIALS

- A. Plywood: NIST PS 1, A-C Exterior Grade.
- B. Structural Steel Shapes, Plates and Bars: ASTM A36/A36M.
- C. Structural Tubing: ASTM A500/A500M, Grade B.
- D. Polyethylene Plastic: ASTM D1248, Type III, Class B.

2.4 SEAT AND PLATFORM COMPONENTS

- A. Seat/Fascia Assembly: Continuous, molded UV-stabilized high-density polyethylene plastic, seat minimum 1 inch thick, textured finish, homogeneous color throughout, color as selected from manufacturer's full range color selection; independently removable with tongue-and-groove or rabbeted interlock at end joints; stain and warp resistant.
 1. Attaching clamp for a steel-to-steel connection of the module to the 14-gauge galvanized steel nose beam.
 2. Each module to incorporate full 1/2 inch perimeter interlocks to secure one module to the next for increased strength.
 - a. Minimum five (5) vertical and two (2) lateral ribs inside each module for strength.
 - b. 360 degree interlocking connection.
 3. 18 inches wide interlocking seat module with seat height of 18-1/2 inches.
 4. Seat depth as required by applicable codes and as indicated herein and on Drawings.
 5. Shape: Ergonomically contoured, with internal ribs spaced for natural flexibility; rear edge cantilevered to provide toe room of not less than 3 inches; no openings to trap debris.
 6. Fire Retardance: Self-ignition temperature of 650 degrees F (343 degrees C) or greater when tested in accordance with ASTM D1929; smoke developed index of 450 or less, when tested in accordance with ASTM E84, or 75 or less when tested in thickness intended for use in accordance with ASTM D2843; and burning extent of 1 inch or less when tested in thickness intended for use in accordance with ASTM D635.
 7. Provide end caps of same material and finish on each exposed end.
 8. Supports: Internal steel reinforcement of each seat segment bolted to platform nose member; minimum two bolts per segment.
 9. Seat Numbers: Provide each plastic seat module with a 1-3/4 x 1-1/4 inch oval etched polycarbonate plate. Provide black numerals on plate fitted in a vandal resistant recess.
 10. Row Letters: Provide at each row end of plastic seat a 1-3/4 x 1-1/4 inch oval etched polycarbonate plate with black numerals. Plates to be fitted flush in vandal resistant end cap recess.
- B. Platform, Tread, and Step Structure: Plywood continuously supported on front and rear and with aluminum "H" Beam at every plywood joint for continuous support from rear riser to nose-beam.
 1. Plywood: PS 1, 5-ply southern pine or polyethylene-overlaid Douglas Fir or Southern Pine, Grade A-C.
 2. Plywood Thickness: 5/8 inch, minimum.
 3. Platform (Deck) Plywood Finish: Exposed wear surfaces to be finished with a layer of High Density polyethylene plastic 0.025 - 0.030 thick, Light Gray in color. Concealed surfaces sealed with manufacturer's standard sealer or urethane sealer.
 4. Front (Nose), Rear, and Intermediate Supports: Steel channel or tube, hot-dipped galvanized.
 5. Nosings: Formed steel, minimum, G60/Z275 hot-dipped galvanized.
 6. Rear Riser: Continuous metal sheet, formed to conceal vertical void from bottom of seat modules to platform (deck). Form bottom edge to continuously receive edge of platform (deck) edge and conceal joint. Form top edge to continuously conceal undercarriage supports for upper platform (deck) framing, but allow continuous access joint for removal of seat modules. Minimum 14-gauge, grade 50, galvanized steel sheet.
 7. Provide end caps of same material and finish on each exposed end.

8. At aisles provide permanently attached intermediate steps of same construction and finish.
 - a. Designed to comply with applicable code requirements, providing an equal depth and height foot surface between rows.
 - b. Provide safety abrasive tread on all steps with 2 inches wide contrasting stripe at nosing.
9. At bottom of aisles provide step in front of first riser, hinged to first platform to fold for storage.

2.5 HANDRAILS AND RAILINGS

- A. Provide the following railings:
 1. Aisle Handrails: Self-Storing Aisle Rails (SSAR). 36 inches high, permanently bolted in position and automatically store in the deck, ensuring that the rails are in place at all times for spectator safety.
 2. End of Row Guardrails: 42 inches high and required on open ends of telescopic seating systems. Self-Storing End Rails designed and tested to meet all current national building code requirements.
 3. Top Row Rear Guardrail: Only required in such conditions where the top row does not abutt to a wall that is a minimum height of 48 inches above the top row. Non-removable self-storing, mounted behind rear seat with tubular supports, running full width of section.
 4. Wheelchair Spaces Guardrails: Removable; 42 inches high.
 5. Height: 42 inches (1067 mm) above adjacent platform or tread.
 6. Removable Railings: Provide steel post sockets attached to platform supports.
- B. Engineer handrail, railing and guardrail systems to withstand the following loads:
 1. Handrailings, Posts and Supports:
 - a. Concentrated Load: 200 pounds applied at any point and in any direction.
 - b. Uniform Load: 50 pounds per foot applied in any direction.
 2. Guardrailings, Posts and Supports:
 - a. Concentrated Load: 200 pounds applied at any point and in any direction along top rail.
 - b. Uniform Load: 50 pounds per foot applied horizontally at top rail and a simultaneous uniform load of 100 pounds per foot applied vertically downward.
 - c. Guardrailings system shall not allow a 4 inches diameter sphere to pass through.
- C. Railing Construction: Round steel or aluminum pipe or tube, with formed elbows at corners and caps at ends of straight runs.
 1. Aluminum: 1.66 inches minimum outside diameter; textured powder coat epoxy finish.
 2. Steel: 1-1/2 inch minimum outside diameter, with 11 gage, 0.12 inch minimum wall thickness; textured powder coat epoxy finish.

2.6 ACCESSORIES

- A. Fillers and Closures:
 1. Ends of Retracted Units: Plywood panels, finished to match platforms.
 2. Top Row: Provide seat level rear filler panels to close openings between top row seat and wall; finish to match platforms.
 3. Back of Units: Only required in such conditions where the back of the bleacher system is not concealed by a wall.
 - a. Full width plywood panels, finished to match platforms, up to 8 feet above floor; vinyl curtains above to underside of top platform.

4. Sides of Extended Units: Laminated Vinyl Side Curtains to close-off the ends of the bleachers.
 - a. Grommets at every hanger location, chain weight bottom hem.
 - b. Color as selected by Architect from manufacturer's full range of colors.
- B. Motion Monitor: Strobe light and warning horn rated at 150 dB, both of which operate continuously during movement of any section of bleachers; mount strobe light where it is clearly visible to entire bleacher installation.
- C. Removable Timer's Table:
 1. 15 inches wide by 96 inches long.
 2. High pressure laminated work surface with removable legs for use at any location.
 3. Table legs assembly shall be constructed of finished tubular steel and shall be removable for storage within the seating system.
- D. Fasteners: Provide hardware and fasteners in accordance with manufacturer's recommendations.
- E. Anchorage: Provide anchorage hardware in accordance with manufacturer's recommendations and as indicated on Drawings.
- F. Provide manufacturer's tool (device) used as an operating handle for manually extending and retracting the bleachers. Provide total number of tools needed for easy operation, but no less than four (4) such devices.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 73 00 - Execution: Verification of existing conditions before starting work.
- B. Verify that field measurements are consistent with those on the shop drawings.
- C. Verify that electrical rough-ins have been installed and are accessible.
- D. Do not begin installation until substrates have been properly prepared and area has been cleared of obstructions.
- E. Verify that flooring support and solid blocking has been stalled where required.
- F. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Section 01 73 00 - Execution: Prepare field conditions and existing construction for installation of work of this Section. Prepare materials to be installed and equipment used during installation.
- B. Clean surfaces thoroughly prior to installation.
- C. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. Section 01 73 00 - Execution: Related to installation of Work.
- B. Install in accordance with manufacturer's instructions.
- C. Do not field cut or alter seats, fascia, or structural members without approval.

- D. Provide manufacturer's field representative to inspect completed installation.

3.4 ADJUSTING

- A. Section 01 73 00 - Execution: Starting, testing, adjusting, and balancing.
- B. Set limit switches to provide fully closed and fully extended positions.
- C. Lubricate, test, and adjust each moving assembly to ensure proper operation in compliance with manufacturer's recommendations.

3.5 CLEANING

- A. Section 01 73 00 - Execution and Section 01 77 00 - Closeout Procedures: Related to cleaning.
- B. Clean and remove excess construction debris from area. Coordinate cleaning of flooring with the flooring installer to avoid improper or damaging cleaning efforts.
- C. Clean exposed and semi-exposed assembly surfaces.
- D. Touch up finishes on damaged or soiled areas.

3.6 PROTECTION OF INSTALLED CONSTRUCTION

- A. Section 01 73 00 - Execution: Protecting installed construction.
- B. Protect installed products until completion of project.
- C. Touch-up, repair, or replace damaged products.

3.7 DEMONSTRATION AND TRAINING

- A. Section 01 79 00 - Demonstration and Training.
- B. Provide manufacturer's field representative to provide training and demonstration.
 - 1. Location: On site using installed equipment.
 - 2. Time: As agreed between Owner and Contractor.
- C. Train Owner's representative on the operation and safety features for fully extending and retracting bleachers.
- D. Identify service requirements and serviceable parts.
- E. Identify remedial procedures for common operational errors such as jammed mechanisms.

END OF SECTION

SECTION 21 01 00

FIRE PROTECTION GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 STIPULATIONS

- A. General provisions of the contract documents including general and supplementary conditions apply to all work in this division.
- B. The general conditions shall be carefully examined before proposals for any work are submitted. Division twenty-one shall not be interpreted as waiving or overruling any requirements expressed in the general conditions unless division twenty-one specifications contain statements more definitive or more restrictive.
- C. Nothing contained herein shall be so construed as to relieve the contractor from performing their work according to the true intent and meaning of the contract drawings and specifications. The contractor will be held responsible for providing all materials and equipment and shall provide all labor necessary for the complete, prompt, and satisfactory execution of the work. The contractor is also responsible for the proper coordination of their work with all other trades.
- D. The contractor shall bear all expenses incidental to the satisfactory completion of the work contained in the contract drawings and specifications.

1.2 DEFINITIONS

- A. Where words and phrases used throughout the contract documents are not specifically defined in the reference standards, they shall be interpreted by the meanings given to them in the latest edition of the Merriam-Webster dictionary.
- B. Words and phrases used throughout the contract documents shall be interpreted as indicated below:
 - 1. Contractor: The person or organization awarded the contract for construction services. In the case of a construction project administered as a multiple-prime contract, the term shall be further defined as the contractor holding a prime contract for fire protection construction work.
 - 2. Others: A person or organization other than the contractor, owner, or professional.
 - 3. Owner: The person or organization that awards the construction contract, or their designated representative.
 - 4. Professional: The engineer of record.
 - 5. Provide: To furnish and install materials, equipment, or systems.
 - 6. Submittals: Industry standards, manufacturer's data, manufacturer's warranties, operation and maintenance instructions, shop drawings, and test reports.
 - 7. Work: All labor, materials, equipment, and services necessary and reasonably incidental to the proper completion and proper operation of the fire protection systems.

1.3 REFERENCES

- A. The contractor shall comply with all laws, ordinances, and regulations of all authorities having jurisdiction, including those of all applicable city, county, state, federal, and public utility entities.
- B. The publications listed below form a part of this specification. All publications shall be the latest edition as adopted by the authority having jurisdiction at the date of bid advertisement.

The minimum standard of work under this contract shall be in accordance with the following model building codes or standards:

1. International Building Code (IBC) with North Carolina Amendments:
 - a. North Carolina Building Code.
 - b. North Carolina Fire Prevention Code.
 - c. North Carolina Mechanical Code.
 - d. North Carolina Plumbing Code.
2. National Fire Protection Association:
 - a. NFPA 13 – Standard for the Installation of Sprinkler Systems.
 - b. NFPA 20 – Standard for the Installation of Stationary Pumps for Fire Protection.
 - c. NFPA 25 – Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.
 - d. NFPA 70 – National Electric Code.
 - e. NFPA 72 – National Fire Alarm and Signaling Code.

1.4 SCOPE

- A. Wet-pipe sprinkler systems: The wet-pipe sprinkler systems shall be extended to all equipment and accessories, including those provided by others as determined in the construction contract. For systems with piping outside of the building, the wet-pipe sprinkler systems shall be extended from a point twelve (12) inches above the finish floor. A final connection at the point of utility installation shall be made by the contractor.
- B. Fire pumps: Provide installation of fire pumps and all associated piping, accessories, control equipment, alarm devices, etc.

1.5 RELATED WORK

- A. The contractor shall obtain all licenses, permits, etc. and shall pay all associated connection fees, tapping fees, inspection fees, etc. These costs shall be included in the contract price.
- B. All work related to providing complete fire protection systems and equipment shall be the responsibility of the contractor. The following related work shall be provided as indicated in other specification divisions:
 1. General contractor:
 - a. Installation of access panels.
 - b. Concrete housekeeping and structural pads for equipment.
 - c. Cutting and patching: The general contractor shall perform cutting and patching of floors and roofs when necessary for the installation of the work. All costs associated with this work shall be paid by the contractor.
 - d. The general contractor shall provide final painting of walls, floors, and ceilings where the surfaces are being provided, refinished, or remodeled under the general contract. The general contractor shall perform all required painting of piping provided by the contractor.
 2. Fire alarm contractor:
 - a. Connection of all pipelines installed alarm devices to the building fire alarm system.
 - b. Installation of all supervisory signal devices for pipeline installed accessories and connection of these devices to the building fire alarm system.
 3. Electrical contractor:

- a. Verification of the proper rotation of three-phase equipment, and any modifications required to correct improper rotation.
- b. Installation of all combination starters/disconnects and overload protectors.
- c. Installation of all line side wiring and junction boxes and/or receptacles supplying fire protection equipment.

1.6 QUALITY ASSURANCE

- A. The contractor shall become thoroughly familiarized with all specifications and drawings for the project so that they clearly understand their responsibility in relationship to the work to be performed. The contractor shall plan and perform their work to permit the use of the building at the earliest possible date.
- B. Changes from the contract documents necessary to coordinate the work with other trades, to conform to the building conditions, or to conform to the rules and regulations of authorities having jurisdiction shall be made only after obtaining written permission from the professional.
- C. The contractor is responsible for the proper installation of all materials and equipment required for a complete installation within the intent and meaning of the contract documents.
- D. The contractor shall expressly and completely follow the manufacturer's instructions required for validation of the manufacturer's warranty agreement including but not limited to service, maintenance, and adjustments of the equipment.
- E. The contractor shall guarantee all work, materials, and equipment furnished against defects, leaks, performance, and non-operation for a period of one (1) year after the date of the owner's final acceptance, or as indicated in the general conditions. Defects shall be interpreted as defective materials or equipment or unsatisfactory installation and are not intended to apply to ordinary wear and tear. The contractor shall pay for any repairs or replacements caused by these defects within the period covered by the guarantee, including all incidental work required to fix the deficiency.

1.7 MATERIALS

- A. Any device that has the physical appearance of life safety or fire protection equipment but that does not perform that life safety or fire protection function shall be prohibited.
- B. Provide products requiring electrical connections listed and labeled by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.8 FIELD MEASUREMENTS

- A. Before ordering any equipment and material, or performing any work, the contractor shall verify all measurements and dimensions at the job site. The contractor is responsible for the correctness of this information.
- B. Any difference identified by the contractor shall be submitted to the professional for consideration before proceeding with the work.
- C. No extra compensation will be considered based on differences between actual dimensions and measurements and those indicated on the drawings.

1.9 PROTECTION OF UTILITIES

- A. All existing service utilities shall remain active during construction. Any service underground, aboveground, interior, or exterior damaged, broken, or otherwise rendered inoperative during the course of construction due to activities on the part of the contractor shall be properly repaired by the contractor at their own expense. The method used in repairing, replacing, or maintaining the services shall be submitted to the professional for review and approval.

1.10 INTERRUPTION OF UTILITIES

- A. The contractor shall schedule their work to avoid interruption of any utility services.
- B. Existing utilities serving occupied facilities shall not be interrupted except when such interruptions have been authorized by the owner. Interruptions may occur only after acceptable temporary utility services have been provided. The contractor shall provide a minimum of ten (10) working days' notice to the owner and receive written notice to proceed before interrupting any utility.

1.11 PROTECTION OF WORK

- A. At their own expense, the contractor shall protect their work, materials, or equipment that is subject to damage during the project duration. All openings into any piping, ducts, or equipment shall be securely covered, or otherwise protected, to prevent injury due to carelessly or maliciously dropped tools or materials, grit, dirt, or any foreign material. The contractor is responsible for all damage until their work is fully and finally accepted.

1.12 CHASES AND OPENINGS

- A. All chases and openings required for the installation of the work shall be coordinated with the work of other trades. The contractor shall provide the other trades with sufficient time for coordination of all chases and openings. The contractor shall be responsible for cutting and patching all openings in walls and partitions necessary for the work.
- B. The contractor shall provide all sleeves, hangers, and anchors required for installation of the work in chases and openings.

1.13 MISCELLANEOUS STEEL AND ACCESSORIES

- A. The contractor shall provide all necessary steel angles, channels, pipe, rods, nuts, bolts, etc. as shown on plans, as specified, or as may be required for complete and proper installation of fire protection systems and equipment. All material and workmanship shall be of the best quality and shall be installed in accordance with the best practices of the trade.

1.14 CROSS CONNECTION CONTROL

- A. The contractor shall coordinate water service requirements in accordance with the local water utility regulations, including required permits, backflow preventers, meters, piping, valves, bypasses, supports, and other accessories.
- B. Where these services are provided by others, the contractor shall verify that they are complete and have been inspected prior to making final connection(s).

1.15 CLEANUP

- A. The contractor shall provide containers for collection of waste materials, debris, and rubbish. Waste materials, debris, and rubbish shall be removed from the job site and legally disposed of at a landfill area in accordance with all applicable regulations. Burning or burying waste materials, debris, or rubbish on project site is not permitted.
- B. The contractor shall maintain buildings, grounds, and public properties free from accumulations of waste materials, debris, and rubbish. At reasonable intervals during the progress of work, and when directed by the owner, the site and public properties shall be cleaned, and waste materials, debris, and rubbish disposed of in an appropriate manner.
- C. At the completion of the project, the contractor shall remove waste materials, rubbish, tools, equipment, machinery, surplus materials, etc., and clean all sight-exposed accessories and equipment; remove grease, dust, dirt, stains, labels, fingerprints, and other foreign materials

from sight-exposed accessories and equipment; broom clean paved and concrete surfaces; rake clean other ground surfaces; repair, patch, and touch-up marred surfaces to the specified finish or to match adjacent surfaces.

1.16 PROJECT CLOSEOUT DOCUMENTATION

- A. The contractor shall keep a record of construction changes and deviations from the original contract documents. All changes shall be recorded on a separate set of prints, which shall be kept at the project site specifically for that purpose. The record shall be made immediately after the work is completed. Documentation shall include:
 - 1. Location and elevation of new utility lines.
 - 2. Changes in pipe size and routing location.
 - 3. Valve locations.
 - 4. Equipment locations.
 - 5. Actual capacities and values of equipment provided.
- B. The marked-up record set of construction documents shall be delivered to the professional after final acceptance of the work.
- C. The contractor shall deliver operation and maintenance manuals per section 21 01 05 to the professional before the instruction of the owner and after final acceptance of the work.

1.17 INSTRUCTION OF THE OWNER

- A. After acceptance of the project, the contractor shall furnish the services of personnel thoroughly familiar with the completed installation to instruct the owner in the proper operation and maintenance of all equipment and appurtenances provided.
- B. The contractor shall provide the owner with ten (10) business days' advance notice before the instruction session(s).

PART 2 - PRODUCTS

2.1 ACCESS PANELS

- A. The contractor shall furnish access doors to the general contractor for installation in ceilings, walls, partitions, and floors for access to valves, fittings, and all appurtenances.
- B. Access panels shall be of sufficient size to permit removal or access, except that the minimum size shall be twelve (12) inches by sixteen (16) inches.
- C. Access door locations shall be as determined by field conditions for optimum access to equipment and shall be reviewed by the professional before final installation. Access door locations shall be subject to the following:
 - 1. Bottom of access doors shall not be lower than the top of the partition base, or a minimum of six (6) inches above floor, whichever is greater.
 - 2. Tops and/or sides of access panels shall be a minimum of six (6) inches from the ceiling, opening, or from the edge of a wall.
- D. Access doors shall be suitable for installation in the finish material of the ceilings, walls, partitions, and floors.
- E. Frame and panel access doors in restrooms, kitchens, and as indicated shall be stainless steel.
- F. Access doors with an Underwriter's Laboratory listing shall be provided in rated construction assemblies. Access doors shall have a fire-resistance rating of no less than that required by the North Carolina Building and Fire Prevention Codes for each assembly in which they are installed. Maximum size shall be twenty (20) inches by twenty (20) inches or four hundred

(400) square inches in area. Frame shall be sixteen (16) gauge minimum steel, panel shall be twenty (20) gauge minimum steel.

- G. Access doors without an Underwriter's Laboratory label shall be provided in all non-rated construction assemblies. Frame shall be sixteen (16) gauge minimum steel, panel shall be fourteen (14) gauge minimum steel.
- H. Access doors shall be provided with a baked-on enamel finish (prime coat), concealed spring type hinges, flush-face type lock with key operation, and self-latching cylinder locks.
- I. Access doors shall open a minimum of one-hundred-seventy-five (175) degrees.
- J. All access doors shall be keyed alike.

PART 3 - EXECUTION

3.1 GENERAL:

- A. The contract documents are diagrammatic and are indicative of the work to be performed. It is not intended that they show every pipe, fitting, offset, change in direction, or appurtenance required for a complete installation.
- B. All materials and equipment used shall be installed in strict accordance with the standards under which the materials are accepted and approved, and in strict accordance with the manufacturer's printed instructions.

3.2 INSPECTION AND TESTING

- A. Fire detection and alarm systems, fire-extinguishing systems, fire hydrant systems, fire standpipe systems, fire pump systems, private fire service mains and all other fire protection systems and appurtenances thereto shall be subject to acceptance tests as contained in the installation standards and as approved by the fire code official.
- B. It is unlawful to occupy any portion of a building or structure until the required fire detection, alarm, and suppression systems have been tested and approved.
- C. The fire code official shall be notified before any required acceptance testing.
- D. The contractor shall notify the professional of a minimum of five (5) working days prior to testing to coordinate the testing and inspection procedures.
- E. The contractor shall provide all equipment, material, labor, etc. required for testing the fire protection systems.
- F. All new, altered, extended, or replaced fire protection systems shall be left uncovered and unconcealed until they have been inspected, tested, and accepted by the professional and fire code official. Where such work has been covered or concealed before it has been inspected, tested, and accepted, it shall be uncovered by the contractor, at their own expense as directed by the professional and/or fire code official.
- G. If the professional or fire code official determines that the fire suppression systems do not pass the prescribed tests, then the contractor shall be required to make the necessary repairs, at their own expense, and the contractor shall re-inspect and re-test the systems. Repairing, inspection and testing shall be continued until all systems pass as determined by the professional or fire code official.
- H. The contractor shall have all associated NFPA inspection forms prepared and on site at the time of inspection for review and acceptance by the professional or fire code official. No other forms will be accepted. All non-signature form information shall be typed.

- I. The contractor shall maintain a readily available copy of all inspection forms on site and shall forward a copy of each form to the owner, professional, and fire code official after testing has been completed.

END OF SECTION

SECTION 21 01 05

FIRE PROTECTION SUBMITTAL REQUIREMENTS

PART 1 - GENERAL

1.1 STIPULATIONS

- A. General provisions of the contract documents including general and supplementary conditions apply to all work in this division.
- B. Failure of the contractor to provide a complete submittal package may result in a delay in processing time. All such delays to the project resulting from the contractor's failure to provide submittals in a timely fashion will be the responsibility of the contractor.

1.2 DEFINITIONS

- A. Industry standard: Printed copies of the current standards recognized in the industry. Current means the latest issue as of the date of these specifications; within the text of these specifications the date suffix frequently shown with identification numbers has been omitted.
- B. Manufacturer's data: Product manufacturer's standard printed information, including promotional brochures, product specifications, installation instructions and diagrams, statements of compliance with standard performance charts or curves, and similar information concerning the standard portions of a manufacturer's products.
- C. Manufacturer's warranty: Manufacturer's standard printed commitment in reference to a specific product and normal application, stating that certain acts of restitution will be performed for the purchaser or owner by the manufacturer, if and when the product fails within certain operational conditions and time limits.
- D. Operation and maintenance instructions: The written instructions by the manufacturer, fabricator, or installer of equipment or systems, detailing the procedures to be followed by the owner in operation, maintenance, control, and shutdown of each operating item of the equipment or system.
- E. Shop drawings: Project shop drawings and other data prepared specifically for fulfillment of the project requirements. Shop drawings include fabrication, layout, setting, installation, coordination, and similar drawings and diagrams, and include performance data associate therewith, including weights, capacities, speeds, outputs, consumption, efficiencies, voltages, amperages, cycles, phases, noise levels, operating ranges, and similar information.
- F. Test reports: Specific reports prepared by an independent testing laboratory, showing the results of specified testing on either the material or equipment provided or on identical material or equipment.

1.3 SUBSTITUTIONS

- A. Submittals are not opportunities for gaining acceptance of substitutions. Where three or more manufacturers are specified by name or by catalog reference, the contractor shall select for use any of those so specified.
- B. Should the contractor desire to substitute another manufacturer's equipment for one specified by name, the contractor shall apply in writing at least ten (10) business days prior to the bid date for such permission. The contractor shall provide submittal data for the professional's consideration. No substitution shall be made for any material, article, or process under the contract unless approved by the professional.
- C. Any time that is required by the professional for a request to review submittals for substitutions after the award of bids will be billed to the contractor at the professional's published hourly

billing rate. The professional's review time will be billed to the contractor whether the proposed substitution is accepted or rejected.

1.4 SUBMITTAL FORM AND PROCEDURES

- A. Submittals shall be assembled as single-file electronic submittals. Transmittals shall be included within the file as the first page.
- B. Submittals shall be made in separate packages containing all the required documentation indicated in each specification section. Only one (1) submittal package shall be made for each specification section. Partial submissions will not be addressed.
- C. Submittals shall be complete and clearly identified and cross-referenced to the appropriate specification section.
- D. The data shown on the submittals shall be complete with respect to dimensions, design criteria, materials of construction, and the like to enable the professional to review the information as required.
- E. The contractor shall stamp the submittals and verify by signature that the submittals have been checked for compliance with the contract documents and appropriate means have been taken to ensure that the material or equipment will fit into the space available.
- F. At the time of each submission, the contractor shall in writing call the professional's attention to any deviations that the submittal may have from the requirements of the contract documents.
- G. The submittals shall be clearly marked indicating which specific options are being considered and with all related information.
- H. The professional's review of submittals is for general conformance with design concept only. Corrections or comments made on the submittals during review do not relieve the contractor from compliance with requirements of the contract documents.
- I. The contractor is responsible for all quantities, dimensions, and coordination of the work of all trades. The contractor is responsible for selecting fabrication processes and techniques of construction and for performing all work in a safe and satisfactory manner.
- J. No work requiring a submittal shall be commenced until the submittal has been reviewed by the professional.
- K. A copy of each approved submittal shall be kept in good order by the contractor and shall be made available on the site.

1.5 OPERATION AND MAINTENANCE MANUALS

- A. Submit after final approval for review by the professional.
- B. The contents of the submittal shall be prepared as follows:
 - 1. Table of contents.
 - 2. A directory listing names, addresses, and telephone numbers of professionals, contractors, subcontractors, and equipment suppliers.
 - 3. Project documents and certificates:
 - a. Certificates of compliance.
 - b. Photocopies of warranties and bonds.
 - c. Material safety data sheets (MSDS).
 - 4. Operation and maintenance instructions subdivided by specification section. For each item, identify the following:
 - a. Significant design criteria.
 - b. Parts list for each component.
 - c. Maintenance instructions for equipment and systems.
 - d. Maintenance instructions for finishes including recommended cleaning methods and materials and operating instructions.
 - e. Special precautions identifying detrimental agents.

- f. Special requirements of other sections of this specification noted to be included in the operation and maintenance manual.
- C. Submit copies for review by the owner ten (10) business days prior to owner training.

END OF SECTION

SECTION 21 05 32

FIRESTOPPING FOR FIRE PROTECTION SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY:

- A. Section includes:
 - 1. Firestopping relating to fire protection work.
 - 2. Firestopping accessories.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM E84 – Test Method for Surface Burning Characteristics of Building Materials.
 - 2. ASTM E814 – Test Method of Fire Tests of Through Penetration Firestops.
- B. Underwriters Laboratories, Inc.:
 - 1. UL 1479 – Fire Tests of Through-Penetration Firestops.

1.3 DEFINITIONS

- A. Firestopping (through-penetration protection system): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire-rated construction.

1.4 SUBMITTALS

- A. Refer to specification section 21 01 05 for submittal requirements, definitions, and procedures.
- B. Submit manufacturer's data for the following:
 - 1. Firestopping relating to fire protection work.
 - 2. Firestopping accessories.
- C. Submit a schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire-resistance rating of adjacent assembly.
- D. Submit manufacturer's preparation and installation instructions for each listed design number.

1.5 QUALITY ASSURANCE

- A. Through-penetration firestopping of fire-rated assemblies: UL 1479, ASTM E814; with one-tenth (0.1) inch water gauge minimum positive pressure differential to achieve fire F-ratings and temperature T-ratings as indicated on life safety drawings, but not less than one- (1) hour.
- B. Surface burning characteristics: Flame spread index of twenty-five (25) and smoke developed index of fifty (50) when tested in accordance with ASTM E84.
- C. Perform work in accordance with the latest edition of the North Carolina Fire Prevention Code and any local codes, ordinances, or construction standards.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply firestopping materials when the temperature of substrate material and ambient air is below sixty (60) degrees Fahrenheit.
- B. Maintain this minimum temperature before, during, and for minimum three (3) days after installation of firestopping materials.
- C. Provide ventilation in areas to receive solvent cured materials.

PART 2 - PRODUCTS

2.1 FIRESTOPPING

- A. Product description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
 - 1. Silicone/elastomeric firestopping: Single component silicone elastomeric compound and compatible silicone sealant.
 - 2. Foam firestopping compounds: Single component foam compound.
 - 3. Formulated firestopping compound of incombustible fibers: Formulated compound mixed with incombustible non-asbestos fibers.
 - 4. Fiber stuffing and sealant firestopping: Composite of mineral fiber stuffing insulation with silicone elastomer for smoke stopping.
 - 5. Intumescent firestopping: Intumescent putty compound which expands exposure to surface heat gain.
- B. Color: As selected from manufacturer's full range of colors to match adjacent surfaces.

2.2 FIRESTOPPING ACCESSORIES

- A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.
- B. Installation accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.
- C. General:
 - 1. Furnish UL listed products.
 - 2. Select products with rating not less than rating of wall or floor being penetrated.
- D. Non-rated surfaces:
 - 1. Stamped steel, chrome-plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where piping is exposed.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Verify openings are ready to receive firestopping.
- B. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.
- C. Remove incompatible materials affecting bond.
- D. Install backing or damming materials to arrest liquid material leakage.

3.2 INSTALLATION

- A. Install material at fire-rated construction perimeters and openings containing penetrating sleeves, piping, and other items, requiring firestopping.
- B. Apply primer where it is recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating to uniform density and texture.

END OF SECTION

SECTION 21 13 00

AUTOMATIC SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Aboveground pipe and tube.
 - 2. Pipe fittings.
 - 3. Valves.
 - 4. Sprinklers.
 - 5. System attachments.
 - 6. Fire department connections.
 - 7. Hangers and supports.
 - 8. System signage.

1.2 REFERENCES

- A. American Welding Society (AWS):
 - 1. AWS B2.1 – Specification for Welding Procedure and Performance Qualification.
- B. ASME International:
 - 1. ASME B1.20.1 – Pipe Threads, General Purpose (Inch).
 - 2. ASME B16.1 – Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
 - 3. ASME B16.3 – Malleable Iron Threaded Fittings: Classes 150 and 300.
 - 4. ASME B16.4 – Gray Iron Threaded Fittings: Classes 125 and 250.
 - 5. ASME B16.5 – Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.
 - 6. ASME B16.9 – Factory-Made Wrought Butt welding Fittings.
 - 7. ASME B16.11 – Forged Fittings, Socket-Welding and Threaded.
 - 8. ASME B16.25 – Butt welding Ends.
 - 9. ASME Boiler and Pressure Vessel Code, Section IX – Welding and Brazing Qualifications.
- C. ASTM International:
 - 1. ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - 2. ASTM A135 – Standard Specification for Electric-Resistance Welded Steel Pipe.
 - 3. ASTM A234 – Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
 - 4. ASTM A795 – Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use.
- D. International Building Code with North Carolina Amendments:
 - 1. North Carolina Building Code.
 - 2. North Carolina Fire Prevention Code.
 - 3. North Carolina Plumbing Code.
- E. National Fire Protection Association (NFPA):
 - 1. NFPA 13 – Standard for the Installation of Sprinkler Systems.
 - 2. NFPA 25 – Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.
 - 3. NFPA 70 – National Electrical Code.
 - 4. NFPA 72 – National Fire Alarm and Signaling Code.

1.3 SUBMITTALS

- A. Refer to specification section 21 01 05 for submittal requirements, definitions, and procedures.
- B. Submit manufacturer's data for the following:
 - 1. Aboveground pipe and tube.
 - 2. Pipe fittings.
 - 3. Valves.
 - 4. Sprinklers.
 - 5. System attachments.
 - 6. Fire department connections.
 - 7. Hangers and supports.
 - 8. System signage.
- C. Submit shop drawings in accordance with the following:
 - 1. Working plans shall be submitted for approval to the authority having jurisdiction before any equipment is installed or remodeled.
 - 2. Deviation from approved plans shall require permission of the authority having jurisdiction.
 - 3. Working plans shall be drawn to an indicated scale, on sheets of uniform size, with a plan of each floor, and shall show those items from the following list that pertain to the design of the system:
 - a. Name of the owner and occupant.
 - b. Location, including street address.
 - c. Point of compass.
 - d. Full height cross section, or schematic diagram, including structural member information if required for clarity and including ceiling construction.
 - e. Location of partitions.
 - f. Location of fire walls.
 - g. Occupancy class of each area or room.
 - h. Location and size of concealed spaces, closets, attics, and bathrooms.
 - i. Any small enclosures in which no sprinklers are to be installed.
 - j. Size of city main in street and whether dead end or circulating; if dead end, direction, and distance to nearest circulating main; and city main test results and system elevation relative to test hydrant.
 - k. Other sources of water supply, with pressure or elevation.
 - l. Make, type, model, and nominal K-factor of sprinklers including sprinkler identification number.
 - m. Temperature rating and location of high-temperature sprinklers.
 - n. Total area protected by each system on each floor.
 - o. Number of sprinklers on each riser per floor.
 - p. Pipe type and schedule of wall thickness.
 - q. Nominal pipe size and cutting lengths (or center-to-center dimensions). Where typical branch lines prevail, it shall be necessary to size only one typical line.
 - r. Location and size of riser nipples.
 - s. Type of fittings and joints and location of all welds and bends. The contractor shall specify on drawing any sections to be shop-welded and the type of fittings or formations to be used.
 - t. Type and locations of hangers, sleeves, braces, and methods of securing sprinklers when applicable.
 - u. All control valves, check valves, drainpipes, and test connections.
 - v. Make, type, model, and size of alarm valve.
 - w. Kind and location of alarm bells.

- x. Private fire service main sizes, lengths, locations, weights, materials, point of connection to city main; the sizes, types, and locations of valves, valve indicators, regulators, meters, and valve pits; and the depth that the top of the pipe is laid below grade.
 - y. Piping provisions for flushing.
 - z. For hydraulically designed systems, the information on the hydraulic data nameplate.
 - aa. A graphic representation of the scale used on all plans.
 - bb. Name and address of the contractor.
 - cc. Hydraulic reference points shown on the plan correspond with comparable reference points on the hydraulic calculation sheets.
 - dd. The minimum rate of water application (density or flow or discharge pressure), the design area of water application, and the water required for hose streams both inside and outside.
 - ee. The total quantity of water and the pressure required are noted at a common reference point for each system.
 - ff. Relative elevations of sprinklers, junction points, and supply or reference points.
 - gg. If room design method is used, all unprotected wall openings throughout the floor are protected.
 - hh. Calculation of loads for sizing and details of sway bracing.
 - ii. Information about backflow preventers.
 - jj. Static and residual hydrants that were used in flow tests shall be shown.
 - kk. Size, location, and piping arrangement of fire department connections.
 - ll. Ceiling/roof heights and slopes not shown in the full height cross section.
 - mm. Edition year of NFPA 13 to which the sprinkler system is designed.
- 4. A signed copy of the owner's certificate and the shop drawing submittal shall include the manufacturer's installation instructions for any specially listed equipment, including descriptions, applications, and limitations for any sprinklers, devices, piping, or fittings.
- 5. Water supply information:
 - a. Include the following water supply capacity information:
 - 1) Location and elevation of static and residual test gauge with relation to the riser reference point.
 - 2) Flow location.
 - 3) Static pressure in psi.
 - 4) Residual pressure in psi.
 - 5) Flow in gpm.
 - 6) Date.
 - 7) Time.
 - 8) Name of person who conducted the test or supplied the information.
 - 9) Other sources of water supply, with pressure or elevation.
 - b. Where a waterflow test is used for the purposes of system design, the test shall be conducted no more than twelve (12) months prior to working plan submittal unless otherwise approved by the authority having jurisdiction.
 - c. The following information shall be included when water supply treatment is provided:
 - 1) Type of condition that requires treatment.
 - 2) Type of treatment needed to address the problem.
 - 3) Details of treatment plan.
- D. Submit hydraulic calculations in accordance with the following:
 - 1. Hydraulic calculations shall be prepared on form sheets that include a summary sheet, a graph sheet, a water supply analysis, a node analysis, and detailed worksheets.

2. Safety factor: For source data inputs, reduce the hydrant flow rate by 10% and the hydrant residual pressure by 10 psi.
3. The data shall be presented in the order shown in NFPA 13.
 - a. Only the order of information shall be maintained. Standard formats provided by approved calculation software shall be permitted so long as they include all required information listed in each subsequent section.
4. The summary sheet shall contain the following information, where applicable:
 - a. Project name and date.
 - b. Location, including street address.
 - c. Drawing number.
 - d. Remote area number.
 - e. Remote area location.
 - f. Occupancy or commodity classification.
 - g. System design requirements, as follows:
 - 1) Design area of water application in square feet.
 - 2) Minimum rate of water application in gpm/sf.
 - 3) Area per sprinkler in square feet.
 - h. Total water requirements as calculated, including allowance for inside hose and outside hydrants in gpm.
 - i. Type of system.
 - j. Water supply information, including the following:
 - 1) Date.
 - 2) Location.
 - 3) Source.
 - 4) Elevation relative to finished floor.
 - k. Name and address of installing contractor.
 - l. Name of designer.
 - m. Authority having jurisdiction.
 - n. Notes that include items such as peaking information for calculations performed by a computer program, limitations (dimension, flow, and pressure) on extended coverage or other listed special sprinklers.
5. A graphic representation of the complete hydraulic calculation shall be plotted on semi exponential graph paper ($Q^{1.85}$) and shall include the following:
 - a. Water supply curve.
 - b. Sprinkler system demand.
 - c. Hose demand.
 - d. Additional pressures supplied by a fire pump or other source.
6. Information summarized from the graph sheet shall include the following:
 - a. Node tag at the source.
 - b. Static pressure available at the source in psi.
 - c. Residual pressure available at the source in psi.
 - d. Total flow available at the source in gpm.
 - e. Available pressure at the source when the total calculated demand is flowing in psi.
 - f. Total calculated demand at the source in gpm.
 - g. Required pressure when flowing total calculated demand in psi.
7. Organized information regarding the node tags given to each hydraulic reference point on the system as indicated on the shop drawings shall include the following information:
 - a. Node tag for each specific point on the system used in the hydraulic calculations.
 - b. Elevation of each node tag in feet.
 - c. K-factor of flowing nodes.
 - d. Hose allowance requirements for the node tag in gpm.

- e. Pressure at the node in psi.
 - f. Discharge calculated at the node in gpm.
 - g. Notes that indicate any special requirements for the node.
 8. Detailed worksheets shall contain the following information:
 - a. Sheet number.
 - b. Hydraulic reference points used in each step.
 - c. Elevation at each hydraulic reference point in feet.
 - d. Sprinkler description and discharge constant for the flowing reference point.
 - e. Flow for the flowing reference point in gpm.
 - f. Total flow through each step-in gpm.
 - g. Nominal pipe size in inches.
 - h. Actual internal diameter of pipe in inches.
 - i. Quantity and length of each type of fitting and device in feet.
 - j. Pipe lengths from center-to-center of fittings in feet.
 - k. Equivalent pipe lengths of fittings and devices for the step-in feet.
 - l. Total equivalent length of pipes and fittings for the step-in feet.
 - m. C-factor used in each step.
 - n. Friction loss of pipe in psi/ft.
 - o. Sum of the pressures from the previous step (starting pressure at beginning).
 - p. Elevation head between reference points in psi.
 - q. Total friction loss between reference points in psi.
 - r. Required pressure at each reference point in psi.
 - s. Notes and other information shall include the following:
 - 1) Velocity pressure and normal pressure if included in calculations.
 - 2) Notes to indicate starting points or reference to other sheets or to clarify data shown.
 - 3) Diagram to accompany gridded system calculations to indicate flow quantities and directions for lines with sprinklers operating in the remote area.
 - 4) Combined K-factor calculations for sprinklers on drops, armovers, or sprigs where calculations do not begin at the sprinkler.
 - 5) The pressure loss assigned to the backflow device when included in a system in psi.
 - 6) Friction factor and Reynold's number when the Darcy-Weibach equation is used.
 9. Water allowance for outside hose shall be added to the sprinkler and inside hose requirement at the connection to the city water main or a yard hydrant, whichever is closer to the system riser.
- E. Submittals shall be prepared by a qualified design professional currently employed by the contractor as follows:
1. Plans shall be prepared under the direct supervision of either a licensed professional engineer registered in the state of North Carolina or a NICET level III technician certified in water-based suppression systems.
 2. The design professional shall be on good standing with the associated accreditation board and shall have paid all required board fees, performed all necessary renewal procedures, and paid any required state taxes or licensing fees associated with maintaining accreditation.
 3. The design professional shall also affix their individual certification mark, indicating registration/certification number and their name as it is recorded with the associated accreditation board, and shall provide a unique signature to each sheet of the submittal.

1.4 OPERATION AND MAINTENANCE MANUALS

- A. Refer to specification section 21 01 05 for submittal requirements, definitions, and procedures.
- B. Submit manufacturer's data, manufacturer's warranties, and operation and maintenance instructions for the following:
 - 1. Aboveground pipe and tube.
 - 2. Pipe fittings.
 - 3. Valves.
 - 4. Sprinklers.
 - 5. System attachments.
 - 6. Fire department connections.
 - 7. Hangers and supports.
 - 8. System signage.
- C. Project record documents: Record actual locations of sprinklers and deviations of piping from drawings. Indicate drain and test locations. Provide as-built hydraulic calculations.

1.5 SPARE STOCK

- A. A supply of at least six (6) spare sprinklers shall be maintained on the premises so that any sprinklers that have operated or been damaged in any way can be promptly replaced.
 - 1. A minimum of two (2) sprinklers of each type and temperature rating shall be provided.
 - 2. The sprinklers shall correspond to the types and temperature ratings of the sprinklers in the property.
- B. The sprinklers shall be kept in a cabinet located where the temperature to which they are subjected will at no time exceed one hundred (100) degrees Fahrenheit.
- C. Where dry sprinklers of different lengths are installed, spare dry sprinklers shall not be required, provided that a means of returning the system to service is furnished.
- D. The stock of spare sprinklers shall include all types and ratings installed and shall be as follows:
 - 1. For protected facilities having under three hundred (300) sprinklers – no fewer than six (6) sprinklers.
 - 2. For protected facilities having three hundred (300) to one thousand (1000) sprinklers – no fewer than twelve (12) sprinklers.
 - 3. For protected facilities having over one thousand (1000) sprinklers – no fewer than twenty-four (24) sprinklers.
- E. One sprinkler wrench as specified by the sprinkler manufacturer shall be provided in the cabinet for each type of sprinkler installed to be used for the removal and installation of sprinklers in the system.
- F. A list of the sprinklers installed in the property shall be posted in the sprinkler cabinet. The list shall include the following:
 - 1. Sprinkler identification number (SIN) if equipped, or the manufacturer, model, orifice, deflector type, thermal sensitivity, and pressure rating.
 - 2. General description – including upright, pendant, sidewall, etc.
 - 3. Quantity of each type to be contained in the cabinet.
 - 4. Issue or revision date of the list.

1.6 LEVEL OF PROTECTION

- A. A building, where protected by an automatic sprinkler system installation, shall be provided with sprinklers in all areas except where specific sections of NFPA 13 permit the omission of sprinklers.

1.7 SPECIAL CONSIDERATIONS

- A. Additives or chemicals intended to stop leaks, such as sodium silicate or derivatives of sodium silicate, brine, or similar acting chemicals, shall not be used in sprinkler systems.

1. Biocides and other chemicals that are approved and used for prevention and mitigation of microbiologically influenced corrosion (MIC) and that do not adversely affect the fire-fighting properties of the water or the performance of the fire sprinkler system components are not prohibited.
- B. Additives to the water supply intended for control of microbiological or other corrosion shall be listed for use within fire sprinkler systems.
- C. Internal pipe coatings, excluding galvanizing, intended for control of microbiological or other corrosion shall be listed for use within fire sprinkler systems.
- D. Sprinkler system components shall not be used to support non-sprinkler system components unless expressly permitted by NFPA 13.

1.8 MATERIAL LISTING REQUIREMENTS

- A. Materials or devices not specifically designated by NFPA 13 shall be used in accordance with all conditions, requirements, and limitations of their special listing.
 1. All special listing requirements shall be included and identified in the product submittal literature and installation instructions.
- B. Unless the requirements of the following are met, all materials and devices essential to successful system operation shall be listed:
 1. Valve components (including valve trim, internal parts, gaskets, and the like) shall not be required to be individually listed.
 2. The following equipment shall not be required to be listed:
 - a. Pipe or tube materials and dimensions as indicated in NFPA 13.
 - b. Fitting materials and dimensions as indicated in NFPA 13.
 3. The following equipment shall not be required to be listed:
 - a. Hangers certified by a registered professional engineer as an acceptable approved alternate to the hanger requirements of NFPA 13.
 - b. Mild steel hangers formed from rods.
 - c. Fasteners certified by a registered professional engineer as part of a shared support structure.
 4. Components that do not affect system performance such as drain piping, drain valves, and signs shall not be required to be listed.
- C. The new materials or devices listing instructions shall identify and specify the existing system components, including the fluids conveyed, with which the new listed materials, devices, or components are compatible.
 1. This listing requirement shall also apply to chemical or material modifications made to components listed in NFPA 13.

1.9 RATED PRESSURE REQUIREMENTS

- A. System components shall be rated for the maximum system working pressure to which they are exposed but shall not be rated at less than one-hundred-seventy-five (175) psi for components installed aboveground and one-hundred-fifty (150) psi for components installed underground.

PART 2 - PRODUCTS

2.1 ABOVEGROUND PIPE AND TUBE

- A. Steel pipe: ASTM A53, ASTM A135, ASTM A795.
 1. When joined by welding or roll-grooved piping and fittings, the minimum wall thickness for pressures up to three-hundred (300) psi shall be schedule ten (10) for pipe sizes up to twelve (12) inches.

2. When jointed by threaded or cut-grooved piping and fittings, the minimum wall thickness for pressures up to three hundred (300) psi shall be schedule forty (40) for pipe sizes up to eight (8) inches and schedule thirty (30) for pipes sizes eight (8) inches and larger.
- B. CPVC Pipe: ASTM F442/F442M and UL 1821, SDR 13.5, for 175-psig rated pressure at 150 deg F (62 deg C), with plain ends. Include "LISTED" and "CPVC SPRINKLER PIPE" markings.
- C. Pipe and tube identification:
 1. All pipes shall be marked along their length by the manufacturer in such a way as to properly identify the type of pipe.
 - a. Where indicated, the pipe identification can be covered with paint or other protective coatings before installation.
 2. The marking shall be visible on every piece of pipe over two (2) feet long.
 3. Pipe identification shall include the manufacturer's name, model designation, or schedule.

2.2 PIPE FITTINGS

- A. Cast iron: ASME B16.4, ASME B16.1.
 1. Standard weight pattern cast iron fittings two (2) inches in size and smaller shall be permitted where pressures do not exceed three hundred (300) psi.
 2. All other fittings shall be extra-heavy pattern where pressures exceed one-hundred-seventy-five (175) psi.
- B. Malleable iron: ASME B16.3.
 1. Standard weight pattern malleable iron fitting six (6) inches in size and smaller shall be permitted where pressures do not exceed three hundred (300) psi.
 2. All other fittings shall be extra-heavy pattern where pressures exceed one-hundred-seventy-five (175) psi.
- C. Steel: ASME B16.5, ASME B16.9, ASME B16.11, ASME B16.25, ASTM A234.
 1. All fittings shall be extra-heavy pattern where pressures exceed one-hundred-seventy-five (175) psi.
- D. Couplings and unions:
 1. Screwed unions shall not be used on pipes larger than two (2) inches.
 2. Couplings and unions of other than screwed type shall be of types listed specifically for use in sprinkler systems.
- E. Reducers and bushings:
 1. A one-piece reducing fitting shall be used wherever a change is made in the size of the pipe.
 - a. Hexagonal or face bushings shall be permitted in reducing the size of openings of fittings when standard fittings of the required size are not available.
 - b. In new installations, it shall be permitted to provide a minimum of one (1) inch outlets with hexagonal bushings to accommodate sprinklers attached directly to branch line fittings to allow for future system modifications.
- F. CPVC Fittings: [UL listed] [or] [FM Global approved], for 175-psig rated pressure at 150 deg F, socket type. Include "LISTED" and "CPVC SPRINKLER FITTING" markings.
 1. NPS 3/4 to NPS 1-1/2: ASTM F438 and UL 1821, Schedule 40, socket type.
 2. NPS 2 to NPS 3: ASTM F439 and UL 1821, Schedule 80, socket type.
 3. Fittings in "CPVC-to-Metal Transition Fittings" Subparagraph below are generally available in NPS 3/4 to NPS 3.

4. CPVC-to-Metal Transition Fittings: CPVC, one piece, with dimensions equivalent to pipe; one end with threaded brass insert, and one socket end.
5. Unions in "CPVC-to-Metal Transition Unions" Subparagraph below are generally available in NPS 1 to NPS 2.
6. CPVC-to-Metal Transition Unions: CPVC, with dimensions equivalent to pipe; one end with threaded brass insert, and one socket end.
7. Flanges in "Flanges" Subparagraph below are generally available in NPS 3/4 to NPS 3.
8. Flanges: CPVC, one or two pieces.
9. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F493 solvent cement recommended by pipe and fitting manufacturer and made for joining CPVC sprinkler pipe and fittings. Include cleaner or primer recommended by pipe and fitting manufacturer.
10. Plastic Pipe-Flange Gasket and Bolts and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.3 VALVES

- A. General requirements:
 1. When water pressures exceed one-hundred-seventy-five (175) psi, valves shall be used in accordance with their pressure ratings.
- B. Listed indicating valves:
 1. Listed indicating valves shall not close in less than five (5) seconds when operated at maximum possible speed from the fully open position.
 2. All valves controlling connections to water supplies and to supply pipes to sprinklers shall be listed indicating valves.
 - a. A listed underground gate valve equipped with a listed indicator post shall be permitted.
 - b. A listed water control valve assembly with a reliable position indication connected to a remote supervisory station shall be permitted.
 - c. A non indicating valve, such as an underground gate valve with approved roadway box, complete with T-wrench, and where accepted by the authority having jurisdiction, shall be permitted.
- C. Wafer-type valves:
 1. Wafer-type valves with components that extend beyond the valve body shall be installed in a manner that does not interfere with the operation of any system components.
- D. Drain and test valves:
 1. Drain valves and test valves shall be approved.

2.4 SPRINKLERS

- A. Pendent:
 1. Type: Concealed pendant type with matching screw on escutcheon plate.
 2. Finish: White enamel.
 3. Escutcheon plate finish: White enamel.
 4. Fusible link: Glass bulb type temperature rated for specific area hazard.
- B. Upright:
 1. Type: Standard upright type.
 2. Finish: Brass.
 3. Fusible link: Glass bulb type temperature rated for specific area hazard.
- C. Sidewall:
 1. Type: Semi-recessed horizontal sidewall type with matching screw on escutcheon plate.
 2. Finish: White enamel.
 3. Escutcheon plate finish: White enamel.

4. Fusible link: Glass bulb type temperature rated for specific area hazard.
- D. Guards: Finished to match sprinkler finish.
- E. All sprinklers shall be permanently marked with one (1) or two (2) English uppercase alphabetic characters to identify the manufacturer, immediately followed by three (3) or four (4) numbers, to uniquely identify a sprinkler as to K-factor (orifice size) or orifice shape, deflector characteristic, pressure rating, and thermal sensitivity.
- F. All sprinkler K-factors, relative discharge, and marking identification for sprinklers having different K-factors shall be in accordance with NFPA 13.
1. Listed sprinklers having pipe threads different from those shown in NFPA 13 shall be permitted.
 2. Sprinklers listed with nominal K-factors greater than K-28 shall increase the flow by one hundred (100) percent increments when compared with a nominal K-5.6 sprinkler.
- G. Sprinklers shall not be listed for protection of a portion of an occupancy classification.
- H. Automatic sprinklers shall have their frame arms, deflector, coating material, or liquid bulb colored in accordance with the requirements of NFPA 13.
1. A dot on the top of the deflector, the color of the coating material, or colored frame arms shall be permitted for color identification of corrosion-resistant sprinklers.
 2. Color identification shall not be required for ornamental sprinklers such as factory-plated or factory-painted sprinklers or for recessed, flush, or concealed sprinklers.
 3. The frame arms of bulb-type sprinklers shall not be required to be color coded.
 4. The liquid in bulb-type sprinklers shall be color coded in accordance with NFPA 13.
- I. Sprinklers with ornamental finishes where utilized shall be specifically listed.
- J. Plates, escutcheons, or other devices used to cover the annular space around a sprinkler shall be metallic or shall be listed for use around a sprinkler.
1. Escutcheons used with recessed, flush-type, or concealed sprinklers shall be part of a listed sprinkler assembly.
 2. Cover plates used with concealed sprinklers shall be part of the listed sprinkler assembly.
- K. Temperature ratings:
1. Unless one of the following is met, ordinary and intermediate temperature sprinklers shall be used throughout.
 - a. Where maximum ceiling temperatures exceed one hundred (100) degrees Fahrenheit, sprinklers with temperature ratings in accordance with the maximum ceiling temperatures of NFPA 13 shall be used.
 - b. High temperature sprinklers shall be permitted to be used throughout ordinary and extra hazard occupancies, storage occupancies, and as allowed by NFPA 13.
 - c. Sprinklers of intermediate and high temperature classifications shall be installed in the following specific locations as defined below in NFPA 13:
 - 1) Sprinklers in a high temperature zone shall be of the high temperature classification, and sprinklers in the intermediate temperature zone shall be of the intermediate temperature classification.
 - 2) Sprinklers under glass or plastic skylights exposed to the direct rays of the sun shall be of the intermediate temperature classification.
 - 3) Sprinklers in an unventilated, concealed space, under an uninsulated roof, or in an unventilated attic shall be of the intermediate temperature classification.
- L. Thermal sensitivity:
1. Sprinklers in light hazard occupancies shall be of the quick response type.
 2. Where quick response sprinklers are installed, all sprinklers within the same compartment shall be quick response.
- M. Sprinklers shall have a minimum nominal K-factor of K-5.6.

- N. Sprinklers having a K-factor exceeding K-5.6 and having one-half (1/2) inch national pipe thread shall not be installed in new sprinkler systems.

2.5 SYSTEM ATTACHMENTS

- A. Waterflow alarm devices:
 - 1. Waterflow alarm devices shall be listed for the service and so constructed and installed that any flow of water from a sprinkler system equal to or greater than that from a single automatic sprinkler of the smallest K-factor installed on the system will result in an audible alarm on the premises within five (5) minutes after such flow begins and until such flow stops.
- B. Waterflow detection devices:
 - 1. The alarm apparatus for a wet pipe system shall consist of a listed alarm check valve or other listed waterflow detection alarm device with the necessary attachments required to give an alarm.
 - 2. Paddle-type waterflow alarm indicators shall be installed in wet systems only.
- C. General attachments:
 - 1. An alarm unit shall include a listed mechanical alarm, horn, or siren or a listed electric gong, bell, speaker, horn, or siren.
 - a. Audible alarms shall be located on the outside of the building.
 - b. Where desired by the owner, additional audible alarms shall be provided inside the building.
 - c. Outdoor alarms shall not be required where audible alarms are part of a central station, auxiliary, remote station, or proprietary signaling fire alarm system, utilizing listed audible indoor alarm devices.
 - 2. Electrically operated bells shall be weatherproofed and guarded.
 - a. All alarm apparatus should be so located and installed that all parts are accessible for inspection, removal and repair, and such apparatus shall be substantially supported.
 - 3. Piping between the sprinkler system and a pressure-actuated alarm-initiating device shall be galvanized steel, brass, copper, or other approved metallic corrosion-resistant material of not less than three-eighths (3/8) inch nominal pipe size.
- D. Electrically operated attachments:
 - 1. Electrically operated alarm attachments forming a part of an auxiliary, central station, local protective, proprietary, or remote station signaling system shall be installed in accordance with NFPA 72.
 - 2. Sprinkler waterflow alarm systems that are not part of a required protective signaling system shall not be required to be supervised and shall be installed in accordance with NFPA 70, article 760.
 - 3. Outdoor electric alarm devices shall be listed for outdoor use.
 - 4. Where switches are provided that will silence electric alarm-sounding devices by interruption of electric current, then it shall be arranged so that, when the sounding device is electrically silenced, that fact shall be indicated by means of a conspicuous light located in the vicinity of the riser or alarm control panel.
 - a. This light shall remain in operation during the entire period of the electric circuit interruption.
- E. Alarm device drains:
 - 1. Drains from alarm devices shall be arranged so that there will be no overflowing at the alarm apparatus, at domestic connections, or elsewhere with the sprinkler drains wide open and under system pressure.

2.6 FIRE DEPARTMENT CONNECTIONS

- A. Fire department connections:
 - 1. Type: Flush mounted wall type with brass finish.
 - 2. Outlets: Two-way with fire department thread size. Threaded dust-cap and chain of matching material and finish.
 - 3. Drain: Three-quarters- (3/4) inch automatic drip, routed directly to exterior.
 - 4. Label: "Sprinkler – Fire Department Connection".
- B. The fire department connection(s) shall consist of two two-and-one-half (2-1/2) inch connections using national hose internal threaded swivel fitting(s) with 2.5" to 7.5" national hose standard thread, as specified in NFPA 1963.
 - 1. Where local fire department connections do not conform to NFPA 1963, the authority having jurisdiction shall be permitted to designate the connection to be used.
 - 2. The use of threadless couplings shall be permitted where required by the authority having jurisdiction and where listed for such use.
 - 3. Fire hose threads and fittings used with automatic sprinkler systems shall be as prescribed by the fire code official.
- C. Fire department connections shall be equipped with approved plugs or caps, properly secured and arranged for easy removal by fire departments.
- D. Fire department connections shall be of an approved type.

2.7 HANGERS AND SUPPORTS

- A. Hangers certified by a registered professional engineer in the state of North Carolina that include all of the following are an acceptable alternative to the prescriptive requirements of this specification:
 - 1. Hangers shall be designed to support five times the weight of the water-filled pipe plus two-hundred-fifty (250) pounds at each point of piping support.
 - 2. These points of support shall be adequate to support the system.
 - 3. The spacing between hangers shall not exceed the value for the type of pipe as indicated in NFPA 13.
 - 4. Hanger components shall be ferrous.
 - 5. Detailed calculations shall be submitted showing stresses developed in hangers, piping, and fittings, and safety factors allowed.
- B. Shared support structures shall be certified by a registered professional engineer in the state of North Carolina in accordance with the following:
 - 1. The design of a shared support structure shall be based on either of the following:
 - a. Sprinkler pipe and other distribution systems shall be permitted to be supported from a shared support structure designed to support five (5) times the weight of water-filled sprinkler pipe and other supported distribution systems plus two-hundred-fifty (250) pounds, based on the allowable ultimate stress.
 - b. Sprinkler pipe and other distribution systems shall be permitted to be supported from a shared support structure designed to support five (5) times the weight of the water-filled sprinkler pipe plus two-hundred-fifty (250) pounds, and one-and-one-half (1.5) times the weight of all other supported distribution systems.
 - 2. The building structure shall not be considered a shared support structure.
 - 3. Systems that are incompatible with the fire sprinkler systems based on vibration, thermal expansion and contraction, or other factors shall not share support structures.
- C. Component material:
 - 1. Hangers and their components shall be ferrous.
 - a. Nonferrous components that have been proven by fire tests to be adequate for the hazard application, that are listed for this purpose, and that are in compliance with the other requirements of chapter nine of NFPA 13 shall be acceptable.

- b. Holes through solid structural members shall be permitted to serve as hangers for the support of system piping provided such holes are permitted by the structural engineer and the spacing and support provisions for hangers of NFPA 13 are satisfied.
- D. Trapeze hangers:
 - 1. The minimum size of steel angle or pipe span between purlins or joists shall be such that the section modulus required does not exceed the available section modulus of the trapeze member as indicated in NFPA 13.
 - 2. Any other sizes or shapes giving equal or greater section modulus shall be acceptable.
 - 3. All angles shall be installed with the longer leg vertical.
 - 4. The trapeze member shall be secured to prevent slippage.
 - 5. All components of each hanger assembly that attach to a trapeze member shall conform to the material listing requirements and be sized to support the suspended sprinkler pipe.
 - 6. The ring, strap, or clevis installed on a pipe trapeze shall be manufactured to fit the pipe size of the trapeze member.
 - 7. Holes for bolts shall not exceed one-sixteenth (1/16) inch greater than the diameter of the bolt.
 - 8. Bolts shall be provided with a flat washer and nut.
- E. Support of non-system components:
 - 1. Sprinkler piping or hangers shall not be used to support non-system components.
 - 2. Sprinkler piping shall be permitted to utilize shared support structures.
- F. Hanger rods:
 - 1. Hanger rod size shall be the same as that approved for use with the hanger assembly, and the size of rods shall not be less than that given in NFPA 13.
 - 2. Where the pitch of the branch line is six (6) in twelve (12) or greater, a reduction in the lateral loading on branch line hanger rods shall be done by one of the following:
 - a. Second hanger installed in addition to the required main hangers.
 - b. Lateral sway brace assemblies on the mains.
 - c. Branch line hangers utilizing an articulating structural attachment.
 - d. Equivalent means providing support to the branch line hanger rods.
 - 3. The size of the rod material of U-hooks shall not be less than that given in NFPA 13.
 - 4. Eye rods:
 - a. The size of the rod material for eye rods shall not be less than specified in NFPA 13.
 - b. Eye rods shall be secured with lock washers to prevent lateral motion.
 - 5. Threaded sections of rods shall not be formed or bent.
- G. Fasteners in concrete:
 - 1. The use of listed inserts set in concrete and listed post-installed anchors to support hangers shall be permitted for mains and branch lines.
 - a. Post-installed anchors shall not be used in cinder concrete, except for branch lines where the post-installed anchors are alternated with through-bolts or hangers attached to beams.
 - b. Post-installed anchors shall not be used in ceilings of gypsum or other similar soft material.
 - 2. Post-installed anchors shall be installed in a horizontal position in the sides of concrete beams.
 - a. Post-installed anchors shall be permitted to be installed in the vertical position under any of the following conditions:
 - 1) When used in concrete having gravel or crushed stone aggregate to support pipes four (4) inches or less in diameter.

- 2) When post-installed anchors are alternated with hangers connected directly to the structural members, such as trusses and girders, or to the sides of concrete beams to support pipes five (5) inches or larger.
 - 3) When post-installed anchors are spaced not over ten (10) feet apart to support pipe four (4) inches or larger.
3. Holes for post-installed anchors in the side of beams shall be above the centerline of the beam or above the bottom reinforcement steel rods.
4. Holes for post-installed anchors used in the vertical position shall be drilled to provide uniform contact with the shield over its entire circumference.
5. The depth of the post-installed anchor hole shall not be less than specified for the type of shield used.
6. Powder-driven studs:
 - a. Powder-driven studs, welding units, and the tools used for installing these devices shall be listed.
 - b. Pipe size, installation position, and construction material into which they are installed shall be in accordance with individual listings.
 - c. Representative samples of concrete into which studs are to be driven shall be tested to determine that the studs will hold a minimum load of seven-hundred-fifty (750) pounds for two (2) inches of smaller pipe; one-thousand (1000) pounds for two-and-one-half (2.5) to three-and-one-half (3.5) inches pipe; and one-thousand-two-hundred (1200) pounds for four (4) or five (5) inches pipe.
 - d. Increaser couplings shall be attached directly to the powder-driven studs.
7. Minimum bolt size for concrete:
 - a. The size of a bolt used with a hanger and installed through concrete shall not be less than specified in NFPA 13.
 - b. Holes for bolts shall not exceed one-sixteenth (1/16) inch greater than the diameter of the bolt.
 - c. Bolts shall be provided with a flat washer and nut.
- H. Fasteners in steel:
 1. Powder-driven studs, welding studs, and the tools used for installing these devices shall be listed.
 - a. Powder-driven studs shall not be used in steel of less than three-sixteenths (3/16) inch total thickness.
 2. Pipe size, installation position, and construction material into which they are installed shall be in accordance with individual listings.
 3. Increaser couplings shall be attached directly to the powder-driven studs or welding studs.
 4. Welding studs or other hanger parts shall not be attached by welding to steel less than US standard twelve (12) gauge.
 5. Minimum bolt size for steel:
 - a. The size of a bolt used with a hanger and installed through steel shall not be less than specified in NFPA 13.
 - b. Holes for bolts shall not exceed one-sixteenth (1/16) inch greater than the diameter of the bolt.
 - c. Bolts shall be provided with a flat washer and nut.

2.8 SYSTEMS SIGNAGE

- A. Systems signage shall be as indicated in NFPA 13.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Automatic sprinkler systems shall be automatically activated.

3.2 WATER SUPPLY REQUIREMENTS

- A. Water supplies for automatic sprinkler systems shall comply with NFPA 13 and the requirements of this section.
- B. The potable water supply to automatic sprinkler and standpipe systems shall be protected against backflow as required by the North Carolina Plumbing Code.

3.3 SYSTEM SUPERVISION AND ALARM

- A. All valves controlling the water supply for automatic sprinkler systems, pumps, tanks, water levels and temperatures, critical air pressures, and water-flow switches on all sprinkler systems shall be electrically supervised by a listed fire alarm control unit.
- B. Alarm, supervisory, and trouble signals shall be distinctly different and shall be automatically transmitted to an approved supervising station or, when approved by the fire code official, shall sound an audible signal at a constantly attended location.
 - 1. In occupancies required to be equipped with a fire alarm system, the backflow preventer valves shall be electrically supervised by a tamper switch installed in accordance with NFPA 72 and separately annunciated.
- C. Approved audible devices shall be connected to every automatic sprinkler system. Such sprinkler water-flow alarm devices shall be activated by water flow equivalent to the flow of a single sprinkler of the smallest orifice size installed in the system.
- D. Alarm devices shall be provided on the exterior of the building in an approved location.
- E. Where a fire alarm system is installed, actuation of the automatic sprinkler system shall actuate the building fire alarm system.

3.4 PIPING INSTALLATION

- A. Pipe and tube bending:
 - 1. Bending of schedule ten (10) steel pipe, or any steel pipe of wall thickness equal to or greater than schedule ten (10), shall be permitted when bends are made with no kinks, ripples, distortions, or reductions in diameter or any noticeable deviations from round.
 - 2. For all other steel pipe, the minimum radius of a bend shall be twelve (12) pipe diameters for all sizes.
- B. Drainage:
 - 1. General:
 - a. All sprinkler pipe and fittings shall be installed so that the system can be drained.
 - 1) All piping shall be arranged where practicable to drain to the main drain valve.
 - b. On wet pipe systems, sprinkler pipes shall be permitted to be installed level.
 - c. Trapped piping shall be drained in accordance with the requirements for auxiliary drains.
 - 2. System, main drain, or sectional drain connections:
 - a. Provisions shall be made to properly drain all parts of the system.
 - b. Drain connections for system supply risers and mains shall be sized in accordance with NFPA 13.
 - c. Where an interior sectional or floor control valve is provided, it shall be provided with a drain connection having a minimum size in accordance with NFPA 13 to drain that portion of the system controlled by the sectional valve.

- d. Drains shall discharge outside or to a drain connection capable of handling the flow of the drain.
 - e. The test connection of pressure type contactors or water motor operated alarm devices shall be permitted to be used as main drain connections.
 - f. Where subject to freezing, a minimum of four (4) feet of exposed drain pipe shall be in a heated area between the drain valve and the exterior wall when drain piping extends through the wall to the outside.
- 3. Auxiliary drains:
 - a. Auxiliary drains shall be provided where a change in piping direction prevents drainage of system piping through the main drain valve.
 - b. Where the capacity of isolated trapped sections of pipe is fifty (50) gallons or more, the auxiliary drain shall consist of a valve not smaller than one (1) inch, piped to an accessible location.
 - c. Where the capacity of isolated trapped sections of pipe is more than five (5) gallons and less than fifty (50) gallons, the auxiliary drain shall consist of a valve three-quarters (3/4) inch or larger and a plug or a nipple and cap.
 - d. Where the capacity of trapped sections of pipes is less than five (5) gallons, one of the following arrangements shall be provided:
 - 1) An auxiliary drain shall consist of a nipple and cap or plug not less than one-half (1/2) inch in size.
 - 2) An auxiliary drain shall not be required for trapped sections less than five (5) gallons where the system piping can be drained by removing a single pendent sprinkler.
 - 3) Where flexible couplings or other easily separated connections are used, the nipple and cap or plug shall be permitted to be omitted.
 - e. Tie-in drains shall not be required on wet pipe systems protecting nonfreezing environments.
- 4. Discharge of drain valves:
 - a. Direct interconnections shall not be made between sprinkler drains and sewers.
 - b. The drain discharge shall conform to any local health or water department regulations.
 - c. Where drainpipes are buried underground, approved corrosion resistant pipe shall be used.
 - d. Drainpipes shall not terminate in blind spaces under the building.
 - e. When exposed to the atmosphere, drainpipes shall be fitted with a turned down elbow.
 - f. Drainpipes shall be arranged to avoid exposing any of the water-filled portions of the sprinkler system to freezing conditions.
- C. Provisions for flushing systems:
 - 1. All sprinkler systems shall be arranged for flushing.
 - 2. Readily removable fittings shall be provided at the end of all cross mains.
 - 3. All cross mains shall terminate in one-and-one-quarter (1.25) inches or larger pipe.
 - 4. All branch lines on gridded systems shall be arranged to facilitate flushing.
- D. Protection of piping:
 - 1. Protection of piping against corrosion:
 - a. Where approved, the pipe identification can be covered with paint or other protective coatings before installation.
 - b. Where corrosive conditions are known to exist due to moisture or fumes from corrosive chemicals or both, special types of fittings, pipes and hangers that resist corrosion shall be used, or a protective coating shall be applied to all unprotected exposed surfaces of the sprinkler system.

- c. Where water supplies or environmental conditions are known to have unusual corrosive properties, piping shall have a corrosion resistance ratio of one (1) or more, and the system shall be treated in accordance with NFPA 13.
- d. Where corrosive conditions exist, or piping is exposed to the weather, corrosion resistant types of pipes, fittings, and hangers or protective corrosion resistant coatings shall be used.

3.5 PIPE FITTING INSTALLATION

- A. Threaded pipe and fittings:
 - 1. All threaded pipe and fittings shall have threads cut to ASME B1.20.1.
 - 2. Steel pipe with wall thickness less than schedule forty (40) less than eight (8) inches in diameter shall only be permitted to be joined by threaded fittings where the threaded assembly is investigated for suitability in automatic sprinkler installations and listed for this service.
 - 3. Joint compound or tape shall be applied only to male threads.
- B. Welded pipe and fittings:
 - 1. Fabrication:
 - a. When welding sprinkler pipe, the pipe shall be shop welded.
 - 1) Where any part of the piping system is to be welded in place, welding of sprinkler piping shall be permitted where the welding process is performed in accordance with NFPA 51B and the mechanical fittings required by NFPA 13 are provided.
 - 2) Tabs for longitudinal earthquake bracing shall be permitted to be welded to in-place piping where the welding process is performed in accordance with NFPA 51B.
 - b. Welding shall not be performed where there is impingement of rain, snow, sleet, or high wind on the weld area of the pipe product.
 - c. Torch cutting and welding shall not be permitted as a means of modifying or repairing sprinkler systems.
 - 2. Fittings:
 - a. Welded fittings used to join pipe shall be listed fabricated or manufactured fittings.
 - 1) Listed, shaped, and contoured nipples meet the definition of fabricated fittings.
 - b. Fittings shall be joined in conformance with a qualified welding procedure as set forth in this section and shall be an acceptable product under this standard, provided that materials and wall thickness are compatible with other sections of this standard.
 - c. Fittings shall not be required where pipe ends are butt welded.
 - d. When the pipe size in a run of piping is reduced, a reducing fitting designed for that purpose shall be used.
 - 3. Welding requirements:
 - a. Welds between pipe and welding outlet fittings shall be permitted to be attached by full penetration welds, partial penetration groove welds, or fillet welds.
 - b. The minimum throat thickness shall be not less than the thickness of the pipe, the thickness of the welding fitting, or three-sixteenths (3/16) inch, whichever is least.
 - c. Circumferential butt joints shall be cut, beveled, and fit so that full penetration is achievable.
 - d. Full penetration welding shall not be required.
 - e. Where slip-on flanges are welded to pipe with a single fillet weld, the weld shall be on the hub side of the flange and the minimum throat weld thickness shall not be

less than one-and-one-quarter (1.25) times the pipe wall thickness or the hub thickness, whichever is less.

- 1) Face welds on the internal face of the flange shall be permitted as a water seal in addition to a hub weld.
- f. Tabs for longitudinal earthquake bracing shall have minimum throat weld thickness not less than one-and-one-quarter (1.25) times the pipe wall thickness and welded on both sides of the longest dimension.
- g. When welding is performed, the following shall apply:
 - 1) Holes in piping for outlets shall be cut to the full inside diameter of fittings prior to welding in place of the fittings.
 - 2) Discs shall be retrieved.
 - 3) Openings cut into piping shall be smooth bore, and all internal slag and welding residue shall be removed.
 - 4) Fittings shall not penetrate the internal diameter of the piping.
 - 5) Steel plates shall not be welded to the ends of piping or fittings.
 - 6) Fittings shall not be modified.
 - 7) Nuts, clips, eye rods, angle brackets, or other fasteners shall not be welded to pipe or fittings, except as specifically permitted.
 - 8) Completed welds shall be free from cracks, incomplete fusion, surface porosity greater than one-sixteenth (1/16) inch diameter and undercut deeper than twenty-five (25) percent of the wall thickness or one-thirty-seconds (1/32) inch, whichever is less.
 - 9) Completed circumferential but weld reinforcement shall not exceed three-thirty-seconds (3/32) inch.
4. Qualifications:
 - a. A welding procedure shall be prepared and qualified by the contractor or fabricator before any welding is done.
 - b. Qualification of the welding procedure to be used and the performance of all welders and welding operators shall be required and shall meet or exceed the requirements of AWS B2.1, or ASME Boiler and Pressure Vessel Code, Section IX, or other applicable qualification standard as required by the authority having jurisdiction.
 - 1) Successful procedure qualification of complete joint penetration groove welds shall qualify partial joint penetration (groove/fillet) welds and fillet welds in accordance with the provisions of NFPA 13.
 - c. Welding procedures qualified under standards recognized by previous editions of NFPA 13 shall be permitted to be continued in use.
 - 1) Each contractor or fabricator shall have available to the authority having jurisdiction an established written quality assurance procedure ensure compliance.
 - d. Contractors or fabricators shall be responsible for all welding they produce.
5. Records:
 - a. Welders or welding machine operators shall, upon completion of each welded pipe, place their identification mark or label onto each piece adjacent to a weld.
 - b. Contractors or fabricators shall maintain certified records, which shall be available to the authority having jurisdiction, or the procedures used, and the welders or welding machine operators employed by them, along with their welding identification.
 - c. Records shall show the date and the results of the procedure and performance qualifications.
- C. Grooved joints:

1. Pipe, fittings, valves, and devices to be joined with grooved couplings shall contain cut, rolled, or cast grooves that are dimensionally compatible with the couplings.
 - a. Pipe fittings, valves, devices, and couplings that conform with or are listed in compliance with standardized groove specifications shall be considered compatible.
 - b. Other groove dimensions and grooving methods shall be acceptable when investigated for suitability in automatic sprinkler installations and listed for this service shall be permitted where installed in accordance with their listing limitations, including installation instructions.
- D. Outlet fittings:
 1. Rubber-gasketed outlet fittings that are used on sprinkler systems shall meet the following requirements:
 - a. Be installed in accordance with the listing and manufacturer's installation instructions.
 - b. Have all disks retrieved.
 - c. Have smooth bores cut into the pipe, with all cutting residue removed.
 - d. Not to be modified.
- E. End treatment:
 1. After cutting, pipe ends shall have burrs and fins removed.
 2. Pipe used with listed fittings and its end treatment shall be in accordance with the fitting manufacturer's installation instructions and the fitting's listing.
- F. CPVC, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
 2. CPVC Piping: Join according to ASTM D2846/D2846M Appendix.

3.6 VALVE INSTALLATION

- A. Identification:
 1. All control, drain, and test connection valves shall be provided with permanently marked weatherproof metal or rigid plastic identification signs.
 2. The identification sign shall be secured with corrosion-resistant wire, chain, or other approved means.
 3. The control valve sign shall identify the portion of the building served.
 - a. Systems that have more than one (1) control valve that must be closed to work on a system or space shall have a sign referring to existence and location of other valves.
- B. Relief valves:
 1. A wet pipe system shall be provided with a listed relief valve not less than one-half (1/2) inch in size and set to operate at one-hundred-seventy-five (175) psi or ten (10) psi more than the maximum system pressure, whichever is greater.
 - a. Where auxiliary air reservoirs are installed to absorb pressure increases, a relief valve shall not be required.
- C. Control valves:
 1. General installation requirements:
 - a. Each sprinkler system shall be provided with a listed indicating valve in an accessible location, so located as to control all automatic sources of water supply.
 - 1) All valves controlling water supplies for sprinkler systems or portions thereof, including floor control valves, shall be accessible to authorized persons during emergencies.

- 2) Permanent ladders, clamped treads on risers, chain-operated hand wheels, or other accepted means should be provided where necessary.
 - b. At least one listed indicating valve shall be installed in each source of water supply.
 - c. These requirements shall not apply to fire department connections, and there shall be no shutoff valve in the fire department connection.
2. Supervision:
 - a. Valves on connections to water supplies, sectional control and isolation valves, and other valves in supply pipes to sprinklers and other fixed water-based suppression systems shall be supervised by one of the following methods:
 - 1) Central station, proprietary, or remote station signaling service.
 - 2) Local signaling service that will cause the sounding of an audible signal at a constantly attended point.
 - 3) Valves locked in the correct position.
 - 4) Valves located within fenced enclosures under the control of the owner, sealed in the open position, and inspected weekly as part of an approved procedure.
 - b. These requirements shall not apply to underground gate valves with roadway boxes.
 - c. Where control valves are installed overhead, they shall be positioned so that the indicating feature is visible from the floor below.
 - d. A listed backflow prevention assembly shall be permitted to be considered a control valve, provided both control valves are listed for fire protection system use and an additional control valve shall not be required.
3. Check valves:
 - a. Where there is more than one source of water supply, a check valve shall be installed in each connection.
 - b. A listed backflow prevention device shall be considered a check valve, and an additional check valve shall not be required.
 - c. Check valves shall be installed in a vertical or horizontal position in accordance with their listing.
4. Control valves with check valves:
 - a. In a connection serving as one source of supply, listed indicating valves or post indicator valves shall be installed on both sides of all check valves.
 - 1) This requirement shall not apply to the check valve located in the fire department connection piping, and there shall be no control valves in the fire department connection piping.
 - 2) This requirement shall not apply where the city connection serves as the only automatic source of supply to a wet pipe sprinkler system; a control valve is not required on the system side of the check valve or the alarm check valve.
 - b. The city services control valve (non-indicating control valve) shall be permitted to serve as the supply side control valve.
5. All control valves shall be located where accessible and free of obstructions.
6. Identification signs shall be provided at each valve to indicate its function and what it controls.

3.7 SPRINKLER INSTALLATION

- A. Sprinklers shall be installed throughout in accordance with NFPA 13.
 1. Automatic sprinklers shall not be required in the following rooms or areas where such rooms or areas are protected with an approved automatic fire detection system in

- accordance with the North Carolina Fire Prevention Code that will respond to visible or invisible particles of combustion:
 - a. Any room where the application of water, or flame and water, constitutes a serious life or fire hazard.
 - b. Any room or space where sprinklers are considered undesirable because of the nature of the contents, when approved by the fire code official.
 - c. Generator and transformer rooms separated from the remainder of the building by walls and floor/ceiling or roof/ceiling assemblies having a fire-resistance rating of not less than two (2) hours.
 - d. Rooms or areas that are of noncombustible construction with wholly noncombustible contents.
 - e. Fire service access elevator machine rooms and machinery spaces.
- 2. Sprinklers will not be omitted from any room merely because it is damp, of fire-resistance rated construction, or contains electrical equipment.
- B. Quick-response automatic sprinklers shall be installed in light-hazard occupancies as defined in NFPA 13 in accordance with their listings.
- C. Automatic sprinklers shall be installed with due regard to obstructions that will delay activation or obstruct the water distribution pattern.
 - 1. Automatic sprinklers shall be installed in or under covered kiosks, displays, booths, concession stands, or equipment that exceeds four (4) feet in width.
 - a. Kitchen equipment under exhaust hoods protected with an alternative fire-extinguishing system installed in accordance with the North Carolina Fire Prevention code shall not require automatic sprinkler protection.
- D. Only new sprinklers shall be installed.
 - 1. When a sprinkler has been removed for any reason, it shall not be reinstalled.
- E. Listed corrosion-resistant sprinklers shall be installed in locations where chemicals, moisture, or other corrosive vapors sufficient to cause corrosion of such devices exist.
 - 1. Corrosion-resistant coatings shall be applied only by the manufacturer of the sprinkler.
 - a. Care shall be taken in the handling and installation of wax-coated or similar sprinklers to avoid damaging the coating.
 - b. Any damage to the protective coating occurring at the time of installation shall be repaired at once using only the coating of the manufacturer of the sprinkler in the approved manner so that no part of the sprinkler will be exposed after installation has been completed.
- F. Sprinklers shall only be painted by the sprinkler manufacturer.
 - 1. Where sprinklers have had paint applied by other than the sprinkler manufacturer, they shall be replaced with new listed sprinklers of the same characteristics, including K-factor, thermal response, and water distribution.
 - 2. Where cover plates on concealed sprinklers have been painted by other than the sprinkler manufacturer, the cover plate shall be replaced.
- G. Ornamental finishes shall only be applied to sprinklers and, if applicable, their concealed cover plates, by the sprinkler manufacturer.
- H. The use of caulking or glue to seal the penetration or to affix the components of a recessed escutcheon or concealed cover plate shall not be permitted.
- I. Sprinklers subject to mechanical injury shall be protected with listed guards.
- J. Sprinklers shall be installed in accordance with their listing.
- K. Upright sprinklers shall be installed with the frame arms parallel to the branch line, unless specifically listed for other orientation.
- L. Protective caps and straps:
 - 1. Protective caps and straps shall be removed using means that are in accordance with the manufacturer's installation instructions.

2. Protective caps and straps shall be removed from all sprinklers prior to the time when the sprinkler system is placed in service.
 - a. Protective caps and straps shall not be removed until construction has progressed to the point where the sprinklers will not be subject to damage.
 - b. Protective caps on sidewall and pendent sprinklers shall remain until the wall and ceiling systems are complete and shall be removed as finished escutcheons are installed.
 - c. Protective caps and straps on all upright sprinklers or on any sprinklers installed more than ten (10) feet above the floor shall be permitted to be removed from sprinklers immediately following their installation.
- M. Application of sprinkler types:
 1. Standard upright and pendent spray sprinklers:
 - a. Upright and pendent spray sprinklers shall be permitted in all occupancy hazard classifications and building construction types.
 - b. Quick response sprinklers shall not be permitted for use in extra hazard occupancies under the density/area design method.
 2. Sidewall spray sprinklers shall only be installed as follows:
 - a. Light hazard occupancies with smooth, horizontal, or sloped, flat ceilings.
 - b. Ordinary hazard occupancies with smooth, flat ceilings where specifically listed for such use.
 - c. To protect areas below overhead doors.
 3. Extended coverage sprinklers shall only be installed as follows:
 - a. Unobstructed construction consisting of flat, smooth ceilings with a slope not exceeding a pitch of two (2) in twelve (12).
 - b. Unobstructed or noncombustible obstructed construction, where specifically listed for such use.
 - c. Within trusses or bar joists having web members not greater than one (1) inch maximum dimension or where trusses are spaced greater than seven-and-one-half (7.5) feet on center and where the ceiling does not exceed a pitch of two (2) in twelve (12).
 - d. Extended coverage upright and pendent sprinklers installed under smooth, flat ceilings that have slopes not exceeding a pitch of four (4) in twelve (12), where specifically listed for such use.
 - e. Extended coverage sidewall sprinklers installed in accordance with NFPA 13 in slopes exceeding a ceiling pitch of two (2) in twelve (12) where listed for such use.
 - f. In each bay of obstructed construction consisting of solid structural members that extend below the deflector of the sprinkler.
 4. Dry sprinklers:
 - a. Where dry sprinklers are connected to wet pipe sprinkler systems protecting areas subject to freezing temperatures, the minimum exposed length of the barrel of the dry sprinkler shall be in accordance with NFPA 13.
 - b. The minimum barrel length shall be measured from the face of the fitting to which the dry sprinkler is installed to the inside surface of the insulation, wall, or ceiling leading to the cold space, whichever is closest to the fitting.
 - c. Where dry sprinklers are connected to wet pipe sprinkler systems protecting insulated freezer structures, the clearance space around the sprinkler barrel shall be sealed.
- N. Position, location, spacing, and use of sprinklers:
 1. Sprinklers shall be located, spaced, and positioned in accordance with the requirements of NFPA 13.

2. Sprinklers shall be positioned to provide protection of the area consistent with the overall objectives of NFPA 13 by controlling the positioning and allowing area of coverage for each sprinkler.

3.8 SYSTEM ATTACHMENTS

- A. Waterflow alarms:
 1. A local waterflow alarm shall be provided on every sprinkler system having more than twenty (20) sprinklers.
- B. Retarding devices:
 1. On each alarm check valve used under conditions of variable water pressure, a retarding device shall be installed.
- C. Alarm bypass test connections:
 1. Alarm valves shall be fitted with an alarm bypass test connection for an electric alarm switch, water motor gong, or both.
 2. The alarm bypass test connection for alarm valves shall be made on the water supply side of the system and provided with a control valve and drain for the alarm piping.
 3. The alarm bypass connection for alarm valves at the riser shall be permitted to be made on the system side of an alarm valve.
- D. Indicating control valves:
 1. Where a control valve is installed in the connection to pressure-type contactors or water motor-operated alarm devices, it shall be of the indicating type.
 2. Such valves shall be sealed, locked, or electrically supervised in the open position.
- E. Gauges:
 1. An approved pressure gauge shall be installed in each system riser.
 2. Pressure gauges shall be installed above and below each alarm check valve or system riser check valve where such devices are present.
 3. A pressure gauge with a connection not smaller than one-quarter (1/4) inch shall be installed at the system main drain, at each main drain associated with a floor control valve, and on the inlet and outlet side of each pressure-reducing valve.
 4. Each gauge connection shall be equipped with a shutoff valve and provisions for draining.
 5. The required pressure gauges shall be approved, and they shall have a maximum limit not less than twice the normal system working pressure at the point where installed.
 6. Gauges shall be installed to permit removal and shall be located where they will not be subject to freezing.
- F. System connections:
 1. Main drain test connections:
 - a. Main drain test connections shall be provided at locations that will permit flow tests of water supplies and connections.
 - b. They shall be installed so that the valve can be opened wide for a sufficient time to assure a proper test without causing water damage.
 - c. Main drain test connections shall be sized in accordance with the requirements for main drains.
 2. Alarm test connections:
 - a. An alarm test connection not less than one (1) inch in diameter, terminating in a smooth bore corrosion-resistant orifice, giving a flow equal to or less than one sprinkler of a type having the smallest K-factor installed on the system, shall be provided to test each waterflow alarm device for each system.
 - b. The test connection shall be accessible.

- c. The discharge shall be made to the outside, to a drain connection capable of accepting full flow under system pressure, or to another location where water damage will not result.
- d. The alarm test connection shall be permitted to be installed in any location on the fire sprinkler system downstream of the waterflow alarm.

3.9 FIRE DEPARTMENT CONNECTION INSTALLATION

- A. Fire department connections shall be installed in accordance with NFPA 13.
- B. With respect to hydrants, driveways, buildings, and landscaping, fire department connections shall be so located that fire apparatus and hose connected to supply the system will not obstruct access to the buildings for other fire apparatus.
 - 1. The location of fire department connections shall be approved by the fire chief.
 - 2. Fire department connections shall be located on the street side of buildings, fully visible and recognizable from the street or nearest point of fire department vehicle access or as otherwise approved by the fire chief.
- C. Immediate access to fire department connections shall be maintained always and without obstruction by fences, bushes, trees, walls, or any other fixed or moveable object.
 - 1. Access to fire department connections shall be approved by the fire chief.
 - 2. The fire code official is authorized to require locking caps on fire department connections for automatic sprinkler systems where the responding fire department carries appropriate key wrenches for removal.
 - 3. A working space of not less than thirty-six (36) inches wide by thirty-six (36) inches long by seventy-eight (78) inches high shall be provided and maintained in front of wall-mounted fire department connections and around the circumference of free-standing fire department connections, except as otherwise required or approved by the fire chief.
 - 4. Where fire department connections are subject to impact by a motor vehicle, vehicle impact protection shall be provided in accordance with the North Carolina Building Code.
- D. A metal sign with raised letters at least one (1) inch in size shall be mounted on all fire department connections serving automatic sprinklers, standpipes, or fire pump connections.
 - 1. Such signs shall read, "AUTOMATIC SPRINKLERS" or "TEST CONNECTION" or a combination thereof as applicable.
 - 2. Where the fire department connection does not serve the entire building, a sign shall be provided indicating the portions of the building served.
- E. The fire department connection shall be located not less than eighteen (18) inches and not more than four (4) feet above the level of the adjacent grade or access level.
- F. The size of the pipe for the fire department connection shall be in accordance with one of the following:
 - 1. For hydraulically calculated systems, the fire department connection shall be permitted to be less than four (4) inches and no less than the size of the system riser, where serving one system riser.
- G. Arrangement:
 - 1. The check valve shall be located to reduce the length of non-pressurized pipe in the fire department connection supply line.
 - 2. The fire department connection shall be on the system side of the water supply check valve.
 - a. The fire department connection shall not be attached to branch line piping.
 - b. The fire department connection shall be permitted to be connected to main piping on the system it serves.
 - 3. Fire department connections shall be located at the nearest point of fire department apparatus accessibility or at a location approved by the authority having jurisdiction.

4. Signs:
 - a. Each fire department connection to sprinkler systems shall be designated by a sign having raised or engraved letters at least one (1) inch in height on plate or fitting reading service design, "AUTOSPKR".
 - b. A sign shall also indicate the pressure required at the inlets to deliver the greatest system demand.
 - 1) This sign shall not be required where the system demand pressure is less than one-hundred-fifty (150) psi.
5. Fire department connections shall not be connected on the suction side of fire pumps.
6. Fire department connections shall be properly supported.
- H. Valves:
 1. A listed check valve shall be installed in each fire department connection and shall be in an accessible location.
 2. There shall be no shutoff valve in the fire department connection piping.
- I. The piping between the check valve and the outside hose coupling shall be equipped with an approved automatic drip in areas subject to freezing.
 1. In cases where water piping between the system side and the fire department connection check valve would be trapped, an auxiliary drain shall be provided.

3.10 HANGER AND SUPPORT INSTALLATION

- A. General requirements:
 1. Ceiling sheathing:
 - a. Sprinkler piping shall be supported independently of the ceiling sheathing.
 - 1) Fasteners used to support sprinkler system piping shall not be attached to ceilings of gypsum or other similar soft material.
 - b. Toggle hangers shall be permitted only for the support of pipe one-and-one-half (1.5) inches or smaller in size under ceilings of hollow tile or metal lath and plaster.
 2. Building structure:
 - a. Sprinkler piping shall be substantially supported from the building structure, which must support the added load of the water-filled pipe plus a minimum of two-hundred-fifty (250) pounds applied at the point of hanging, except where explicitly permitted by NFPA 13.
 - b. Trapeze hangers shall be used where necessary to transfer loads to appropriate structural members.
 3. Metal deck:
 - a. Branch line hangers attached to metal deck shall be permitted only for the support of pipe one (1) inch or smaller in size, by drilling or punching the vertical portion of the metal deck and using through bolts.
 - b. The distance from the bottom of the bolt hole to the bottom of the vertical member shall be not less than three-eighths (3/8) inch.
 4. Where sprinkler piping is installed below ductwork, piping shall be supported from the building structure or from the ductwork supports, provided such supports are capable of handling both the load of the ductwork and the load required of the building structure.
- B. Maximum distance between hangers:
 1. The maximum distance between hangers shall not exceed that specified in NFPA 13, except where the provisions for location of hangers for mains apply.
- C. Location of hangers on branch lines:
 1. This section shall apply to the support of steel pipe and is subject to the provisions for maximum distance between hangers.
 2. Minimum number of hangers:

- a. There shall not be less than one (1) hanger for each section of the pipe.
- b. Where sprinklers are spaced less than six (6) feet apart, hangers spaced up to a maximum of twelve (12) feet shall be permitted.
- c. For welded or mechanical outlets on a continuous section of pipe, hanger spacing shall be in accordance with NFPA 13.
- d. Starter lengths less than six (6) feet shall not require a hanger, unless on the end line of a side feed system or where an intermediate cross main hanger has been omitted.
- e. A single section of pipe shall not require a hanger when the cumulative distance between hangers on the branch line does not exceed the spacing required by NFPA 13.
3. The distance between a hanger and the centerline of an upright sprinkler shall not be less than three (3) inches.
4. Unsupported lengths:
 - a. For steel pipe, the unsupported horizontal length between the end sprinkler and the last hanger on the line shall not be greater than thirty-six (36) inches for one (1) inch pipe, forty-eight (48) inches for one-and-one-quarter (1.25) inches pipe, and sixty (60) inches for one-and-one-half (1.5) inches or larger pipe.
 - b. Where the limits prescribed above are exceeded, the pipe shall be extended beyond the end sprinkler and shall be supported by an additional hanger.
 - c. Unsupported length with maximum pressure exceeding one hundred (100) psi and branch line above ceiling supplying sprinklers in pendent position below ceiling:
 - 1) Where the maximum static or flowing pressure, whichever is greater at the sprinkler, applied other than through the fire department connection, exceeds one hundred (100) psi and a branch line above a ceiling supplies sprinklers in a pendent position below the ceiling, the hanger assembly supporting the pipe supplying an end sprinkler in a pendent position shall be of a type that prevents upward movement of the pipe.
 - 2) The unsupported length between the end sprinkler in a pendent position or drop nipple and the last hanger on the branch line shall not be greater than twelve (12) inches for steel pipe.
 - 3) Where this limit is exceeded, the pipe shall be extended beyond the end sprinkler and supported by an additional hanger.
 - 4) The hanger closest to the sprinkler shall be of a type that prevents upward movement of the pipe.
5. Unsupported armover length:
 - a. The cumulative horizontal length of an unsupported armover to a sprinkler, sprinkler drop, or sprig shall not exceed twenty-four (24) inches for steel pipe.
 - b. Unsupported armover length with maximum pressure exceeding one hundred (100) psi and branch line above ceiling supplying sprinklers in pendent position below ceiling:
 - 1) Where the maximum static or flowing pressure, whichever is greater at the sprinkler, applied other than through the fire department connection, exceeds one hundred (100) psi and a branch line above a ceiling supplies sprinklers in a pendent position below the ceiling, the cumulative horizontal length of an unsupported armover to a sprinkler or sprinkler drop shall not exceed twelve (12) inches for steel pipe.
 - 2) The hanger closest to the sprinkler shall be of a type that prevents upward movement of the pipe.
6. Wall-mounted sidewall sprinklers shall be restrained to prevent movement.
7. Sprigs four (4) feet or longer shall be restrained against lateral movement.

- D. Location of hangers on mains:
1. Hangers for mains shall be in accordance with the maximum distance between hangers between each branch line, or on each section of pipe, whichever is the lesser dimension.
 2. For welded or mechanical outlets on a continuous section of pipe, hanger spacing shall be in accordance with NFPA 13.
 3. For cross mains in steel pipe systems in bays having two (2) branch lines, the intermediate hanger shall be permitted to be omitted, provided that a hanger attached to a purlin is installed on each branch line located as near to the cross main as the location of the purlin permits.
 - a. The remaining branch line hangers shall be installed in accordance with the requirements for the location of hangers on branch lines.
 4. For cross mains in steel pipe systems only in bays having three (3) branch lines, either side or center feed, only one intermediate hanger shall be permitted to be omitted, provided that a hanger attached to a purlin is installed on each branch line located as near to the cross main as the location of the purlin permits.
 - a. The remaining branch line hangers shall be installed in accordance with the requirements for the location of hangers on branch lines.
 5. For cross mains in steel pipe systems only in bays having four (4) or more branch lines, either side or center feed, two (2) intermediate hangers shall be permitted to be omitted, provided that the maximum distance between hangers does not exceed the maximum distance between hangers and a hanger attached to a purlin on each branch line is located as near to the cross main as the purlin permits.
 6. At the end of the main, intermediate trapeze hangers shall be installed unless the main is extended to the next framing member with a hanger installed at this point, in which event an intermediate hanger shall be permitted to be omitted as previously described above.
 7. A single section of pipe shall not require a hanger when the cumulative distance between hangers on the main does not exceed the spacing required by NFPA 13.
- E. Support of risers:
1. Riser shall be supported by riser clamps or by hangers located on the horizontal connections within twenty-four (24) inches of the centerline of the riser.
 2. Riser clamps supporting risers by means of set screws shall not be used.
 3. Riser clamps anchored to walls using hanger rods in the horizontal position shall not be permitted to vertically support risers.
 4. Multistory buildings:
 - a. In multistory buildings, riser supports shall be provided at the lowest level, at each alternate level above, above and below offsets, and at the top of the riser.
 - b. Supports above the lowest level shall also restrain the pipe to prevent movement by an upward thrust where flexible fittings are used.
 - c. Where risers are supported from the ground, the ground support shall constitute the first level of riser support.
 - d. Where risers are offset or do not rise from the ground, the first ceiling level above the offset shall constitute the first level of riser support.
 5. Distance between supports for risers shall not exceed twenty-five (25) feet.
- F. Pipe stands:
1. Pipe stands shall be sized to support a minimum of five (5) times the weight of the water-filled pipe plus two-hundred-fifty (250) pounds.
 2. The pipe stand base shall be secured by an approved method.
 3. Where pipe stands are utilized, they shall be approved.

3.11 SYSTEM SIGNAGE INSTALLATION

- A. Hydraulic design information sign:

1. The installing contractor shall identify a hydraulically designed sprinkler system with a permanently marked weatherproof metal or rigid plastic sign secured with corrosion-resistant wire, chain, or other approved means. Such signs shall be placed at the alarm valve supplying the corresponding hydraulically designed area.
 2. The sign shall include the following information:
 - a. Location of the design area(s).
 - b. Discharge densities over the design area(s).
 - c. Required flow and residual pressure demand at the base of the riser.
 - d. Occupancy classification or commodity classification and maximum permitted storage height and configuration.
 - e. Hose stream allowance included in addition to the sprinkler demand.
 - f. The name of the installing contractor.
- B. General information sign:
1. The installing contractor shall provide a general information sign used to determine system design basis and information relevant to the inspection, testing, and maintenance requirements required by NFPA 25.
 2. General information shall be provided with a permanently marked weatherproof metal or rigid plastic sign, secured with corrosion-resistant wire, chain, or other acceptable means.
 3. Such signs shall be placed at each system control valve and auxiliary system control valve.
 4. The sign shall include the following information:
 - a. Name and location of the facility protected.
 - b. Occupancy classification.
 - c. Flow test data.
 - d. Original results of main drain flow test.
 - e. Name of installing contractor or designer.
 - f. Indication of presence and location of auxiliary systems.
 - g. Where injection systems are installed to treat MIC or corrosion, the type of chemical, concentration of the chemical, and where information can be found as to the proper disposal of the chemical.

3.12 INSPECTION

- A. Spot checks shall be performed to ensure that the sprinkler identification number(s) on the plans match those that have been installed. No less than twenty-five (25) percent of each different sprinkler shall be inspected.

3.13 SYSTEM ACCEPTANCE TESTS

- A. Hydrostatic tests:
 1. All piping and attached appurtenances subjected to system working pressure shall be hydrostatically tested at two hundred (200) psi and shall maintain that pressure without loss for two (2) hours.
 2. Portions of systems normally subjected to system working pressures more than one-hundred-fifty (150) psi shall be tested at a pressure of fifty (50) psi in excess of system working pressure and shall maintain that pressure without loss for two (2) hours.
 3. Loss shall be determined by a drop in gauge pressure or visual leakage.
 4. The test pressure shall be read from a gauge located at the low elevation point of the system or portion being tested. The pressures in piping at higher elevations shall be permitted to be less than two hundred (200) psi when accounting for elevation losses. Systems of portions of systems that can be isolated shall be permitted to be tested separately.

5. Additives, corrosive chemicals such as sodium silicate, or derivatives of sodium silicate, brine, or similar acting chemicals shall not be used while hydrostatically testing systems for stopping leaks.
 6. Piping between the exterior fire department connection and the check valve in the fire department inlet pipe shall be hydrostatically tested in the same manner as the balance of the system. After repair or replacement work affecting the fire department connection, the piping between the exterior and the check valve in the fire department inlet pipe shall be isolated and hydrostatically testing at one-hundred-fifty (150) psi.
 7. When systems are being hydrostatically tested, tests shall be permitted to be conducted with the pendant of horizontal sidewall sprinklers or plugs installed in fittings. Any plugs shall be replaced with pendant or horizontal sidewall sprinklers after the test is completed.
 8. Provision shall be made for the proper disposal of water used for flushing or testing.
 9. Test blanks:
 - a. Test blanks shall have painted lugs protruding in such a way as to clearly indicate their presence.
 - b. The test blanks shall be numbered, and the installing contractor shall have a recordkeeping method ensuring their removal after the work is completed.
 - c. When subject to hydrostatic test pressures, the clapper of a differential-type valve shall be held off its seat to prevent damaging the valve.
- B. System operational tests:
1. Waterflow detecting devices including the associated alarm circuits shall be flow tested through the inspector's test connection and shall result in an audible alarm on the premises within five (5) minutes after such flow begins and until such flow stops.
 2. Main drain valves:
 - a. The main drain valve shall be opened and remain open until the system pressure stabilizes.
 - b. The static and residual pressures shall be recorded on the contractor's material and test certificate.
 3. All control valves shall be fully closed and opened under system water pressure to ensure proper operation.
- C. Backflow prevention assemblies:
1. The backflow prevention assembly shall be forward flow tested to ensure proper operation.
 2. The minimum flow rate shall be the system demand, including hose stream where applicable.

3.14 PLACING THE SYSTEM IN OPERATION

- A. The contractor shall perform the following prior to requesting final approval of sprinkler systems:
1. Notify the authority having jurisdiction and the property owner or the property owner's authorized representative of the time and date testing will be performed.
 2. Perform all required acceptance tests.
 3. Complete and sign the appropriate contractor's material and test certificate(s).
 4. Remove all caps and straps prior to placing the sprinkler system in service.

END OF SECTION

**SECTION 21 14 00
HOSE SYSTEMS**

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Pipe and tube.
 - 2. Pipe fittings.
 - 3. Valves.
 - 4. Hose stations.
 - 5. Hose connections.
 - 6. Fire department connections.
 - 7. System signage.

1.2 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. ANSI B16.1 – Cast Iron Pipe Flanges and Flanged Fittings.
 - 2. ANSI B16.3 – Malleable Iron Threaded Fittings.
 - 3. ANSI B16.4 – Gray Iron Threaded Fittings.
 - 4. ANSI B16.5 – Pipe Flanges and Flanged Fittings.
 - 5. ANSI B16.9 – Factory Made Wrought Steel Buttwelding Fittings
 - 6. ANSI B16.11 – Forged Fittings, Socket-Welding and Threaded.
 - 7. ANSI B16.25 – Buttwelding Ends.
 - 8. ANSI Z97.1 – Safety Glazing Materials Used in Buildings – Safety Performance Specifications and Methods of Test.
- B. American Water Works Associations (AWWA):
 - 1. AWWA C104 – American National Standard for Cement-Mortar Lining for Ductile Iron Pipe and Fittings for Water.
 - 2. AWWA C110 – Ductile Iron and Gray Iron Fittings.
 - 3. AWWA C115 – Flanged Ductile Iron Pipe with Ductile Iron or Gray Iron Threaded Flanges.
 - 4. AWWA C151 – Ductile Iron Pipe, Centrifugally Cast, for Water.
 - 5. AWWA C153 – Ductile Iron Compact Fittings for Water Service.
- C. American Welding Society (AWS):
 - 1. AWS A5.8 – Specification for Filler Metals for Brazing and Braze Welding.
 - 2. AWS B2.1 – Specification for Welding Procedure and Performance Qualification.
- D. ASME International:
 - 1. ASME B1.20.1 – Pipe Thread, General Purpose.
 - 2. ASME Boiler and Pressure Vessel Code, Section IX – Welding and Brazing Qualifications.
- E. ASTM International:
 - 1. ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - 2. ASTM A135 – Standard Specification for Electric-Resistance Welded Steel Pipe.
 - 3. ASTM A234 – Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
 - 4. ASTM A795 – Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use.
 - 5. ASTM B75 – Standard Specification for Seamless Copper Tube.
 - 6. ASTM B88 – Standard Specification for Seamless Copper Water Tube.

7. ASTM B251 – Standard Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube.
- F. National Fire Protection Association (NFPA):
 1. NFPA 13 – Standard for the Installation of Sprinkler Systems.
 2. NFPA 24 – Standard for the Installation of Private Fire Service Mains and Their Appurtenances.
 3. NFPA 25 – Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.
 4. NFPA 51B – Standard for Fire Prevention During Welding, Cutting, and Other Hot Work.
 5. NFPA 72 – National Fire Alarm and Signaling Code.
 6. NFPA 170 – Standard for Fire Safety and Emergency Symbols.
 7. NFPA 1963 – Standard for Fire Hose Connections.

1.3 SUBMITTALS

- A. Refer to specification section 210105 for submittal requirements, definitions, and procedures.

1.4 OPERATION AND MAINTENANCE MANUALS:

- A. Refer to specification section 21 01 05 for submittal requirements, definitions, and procedures.
- B. Submit manufacturer's data, manufacturer's warranties, and operation and maintenance instructions for the following:
 1. Pipe and tube.
 2. Pipe fittings.
 3. Valves.
 4. Hose stations.
 5. Hose connections.
 6. Fire department connections.
 7. System signage.
- C. Project record documents: Record actual locations of hose connections and deviations of piping from drawings. Indicate drain and test locations. Provide as-built hydraulic calculations.

1.5 MATERIAL LISTING REQUIREMENTS

- A. Components that do not affect system performance, such as drain piping, drain valves, and signs, shall not be required to be listed. (NFPA 14.4.1.3)

PART 2 - PRODUCTS

2.1 PIPE AND TUBE

- A. Ductile iron pipe: AWWA C115, AWWA C151. (NFPA 14.4.2.1)
 1. Where a ductile iron pipe is installed, it shall be lined in accordance with AWWA C104. (NFPA 14.4.2.2)
- B. Steel pipe: ASTM A53, ASTM A135, ASTM A795. (NFPA 14.4.2.1)
 1. When joined by welding or roll-grooved piping and fittings, the minimum wall thickness for pressures up to three hundred (300) psi shall be schedule ten (10) for pipe sizes up to ten (10) inches. (NFPA 14.4.2.3)
 2. When jointed by threaded or cut-grooved piping and fittings, the minimum wall thickness for pressures up to three hundred (300) psi shall be schedule forty (40) for pipe sizes up to eight (8) inches and schedule thirty (30) for pipes sizes eight (8) inches and larger. (NFPA 14.4.2.4)

3. Pressure limitations and wall thickness for steel pipe specially listed shall be permitted to be in accordance with the pipe listing requirements. (NFPA 14.4.2.3.1 and NFPA 14.4.2.4.1)
- C. Copper tube: ASTM B75, ASTM B88, ASTM B251. (NFPA 14.4.2.1)
 1. Copper tube shall have a wall thickness of type K, type L, or type M. (NFPA 14.2.5)

2.2 PIPE FITTINGS:

- A. Cast iron: ANSI B16.1, ANSI B16.4. (NFPA 14.4.3.1)
 1. Standard weight pattern cast iron fittings two (2) inches in size and smaller shall be permitted where pressures do not exceed three hundred (300) psi. (NFPA 14.3.3.1)
 2. All other fittings shall be extra-heavy pattern where pressures exceed one-hundred-seventy-five (175) psi. (NFPA 14.3.3)
- B. Malleable iron: ANSI B16.3. (NFPA 14.4.3.1)
 1. Standard weight pattern malleable iron fitting six (6) inches in size and smaller shall be permitted where pressures do not exceed three hundred (300) psi. (NFPA 14.4.3.3.2)
 2. All other fittings shall be extra-heavy pattern where pressures exceed one-hundred-seventy-five (175) psi. (NFPA 14.4.3.3)
- C. Ductile iron: AWWA C110, AWWA C153 (NFPA 14.4.3.1)
- D. Steel: ANSI B16.5, ANSI B16.9, ANSI B16.11, ANSI B16.25, ASTM A234. (NFPA 14.3.1)
 1. All fittings shall be extra-heavy pattern where pressures exceed one-hundred-seventy-five (175) psi. (NFPA 14.4.3.3)

2.3 HOSE STATIONS

- A. Closets and cabinets: (NFPA 14.6.1)
 1. Closets and cabinets used to contain fire hose shall be of a size to allow the installation of the necessary equipment at hose stations and designed so they do not interfere with the prompt use of the hose connection, the hose, and other equipment and the time of fire. (NFPA 14.4.6.1.1)
 - a. Within the cabinet, the hose connections shall be located so that there are at least two (2) inches between any part of the cabinet, other than the door and the handle of the valve when the valve is in any position ranging from fully open to fully closed. (NFPA 14.6.1.1.1)
 - b. The cabinet shall be used for fire equipment only, and each cabinet shall be conspicuously identified. (NFPA 14.6.1.1.2)
 2. Where a “break-glass” type protective cover for a latching device is provided, the device provided to break the glass panel shall be attached in the immediate area of the break glass panel and shall be arranged so that the device cannot be used to break other glass panels in the cabinet door. (NFPA 14.4.6.1.2)
 - a. All glazing shall be either tempered safety glass or plastic glazing in accordance with ANSI Z97.1. (NFPA 14.6.1.2.1)
 3. Where a fire-resistive assembly is penetrated by a cabinet, the fire-resistance of the assembly shall be maintained as required by the NC Building Code. (NFPA 14.4.6.1.3)
 4. Hose cabinets shall be marked to indicate the contents. (NFPA 14.4.6.1.4)
- B. Hose: (NFPA 14.6.2)
 1. Each hose connection provided for use by trained personnel shall be equipped with not more than one hundred (100) feet of listed, one-and-one-half (1.5) inch, lined,

- collapsible or non-collapsible fire hose attached and ready for use. (NFPA 14.4.6.2.1)
 - 2. Where hose less than one-and-one-half (1.5) inch is used for one-and-one-half (1.5) inch hose stations, listed non-collapsible fire hose shall be used. (NFPA 14.4.6.2.2)
- C. Hose racks: (NFPA 14.6.3)
 - 1. Each one-and-one-half (1.5) inch hose station provided with one-and-one-half (1.5) inch hose shall be equipped with a listed rack or approved storage method. (NFPA 14.4.6.3.1)
 - 2. Each one-and-one-half (1.5) inch hose station provided with hose less than one-and-one-half (1.5) inch shall be equipped with a listed continuous flow reel. (NFPA 14.4.6.3.2)
- D. Nozzles: (NFPA 14.6.4)
 - 1. Nozzles provided for Class II service shall be listed.
- E. Label: (NFPA 14.6.5)
 - 1. Each rack or storage facility for one-and-one-half (1.5) inch or smaller hose shall be provided with a label that includes the wording "FIRE HOSE FOR USE BY TRAINED PERSONNEL" and operating instructions.

2.4 HOSE CONNECTIONS

- A. Hose valves shall be listed. (NFPA 14.7.1)
- B. Hose connections shall have external National Hose Standard (NHS) threads, for the valve size specified, in accordance with NFPA 1963. (NFPA 14.7.2)
- C. Hose connections shall be equipped with caps to protect hose threads. (NFPA 14.7.3)
- D. Where local fire department hose threads do not conform to NFPA 1963, the authority having jurisdiction shall designate the hose threads that shall be used. (NFPA 14.7.4)
- E. Hose connections shall be located so that there is at least three (3) inches clearance between any adjacent object and the handle of the valve when the valve is in any position ranging from fully open to fully closed. (NFPA 14.7.5)

2.5 FIRE DEPARTMENT CONNECTIONS

- A. Fire department connections shall be listed for a working pressure equal to or greater than the pressure requirement of the system demand. (NFPA 14.8.1)
- B. Each fire department connection shall have at least two (2) two-and-one-half (2.5) inches internal threaded swivel fittings having NHS threads, as specified in NFPA 1963. (NFPA 14.8.2)
 - 1. Fire department connections shall be equipped with caps to protect the system from the entry of debris. (NFPA 14.8.2.1)
 - 2. Where the local fire department uses fittings that differ from those specified, fittings compatible with local fire department equipment shall be used and their minimum size shall be two-and-one-half (2.5) inches. (NFPA 14.8.2.2)

2.6 SYSTEM SIGNAGE

- A. Signs shall be permanently marked and shall be constructed of weather-resistant metal or rigid plastic materials. (NFPA 14.4.10)

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

- A. Bending of pipe and tube: (NFPA 14.4.2.7)

1. Bending of schedule forty (40) steel pipe and Types K and L copper tube shall be permitted where bends are made with no kinks, ripples, distortions, reductions in diameter, or any noticeable deviations from a round shape. (NFPA 14.4.2.7.1)
2. The minimum radius of a bend shall be six (6) pipe diameters for pipe sizes two (2) inches or less, and five (5) pipe diameters for pipe sizes two-and-one-half (2.5) inches or more. (NFPA 14.4.2.7.2)

3.2 PIPE FITTING INSTALLATION

- A. A one-piece reducing fitting shall be used wherever a change is made in the size of the pipe. (NFPA 14.3.5)
 1. Hexagonal or face bushings shall be permitted for reducing the size of openings of fittings where standard fittings of the required size are not available. (NFPA 14.4.3.5.1)
- B. Threaded pipe and fittings: (NFPA 14.4.4.1)
 1. All threaded pipe and fittings shall have threads cut to ASME B1.20.1. (NFPA 14.4.4.1.1)
 2. Steel pipe with wall thickness less than schedule thirty (30) for pipe eight (8) inches or more in diameter and wall thickness less than schedule forty (40) for pipe less than eight (8) inches in diameter shall only be permitted to be joined by threaded fittings where the threaded assembly is investigated for suitability in automatic sprinkler installations and listed for this service. (NFPA 14.4.4.1.2)
 3. Joint compound or tape shall be applied only to male threads. (NFPA 14.4.4.1.3)
- C. Welded pipe and fittings: (NFPA 14.4.2)
 1. Fittings: (NFPA 14.4.4.2.3)
 - a. Welded fittings used to join pipe shall be listed fabricated or manufactured fittings. (NFPA 14.4.4.2.3.1)
 - 1) Listed, shaped, and contoured nipples meet the definition of fabricated fittings. (NFPA 14.A.4.4.2.3.1)
 - b. Fittings shall be joined in conformance with a qualified welding procedure as set forth in this section and shall be an acceptable product, provided that materials and wall thickness are compatible with other sections of this specification. (NFPA 14.4.4.2.3.2)
 - c. Fittings shall not be required where pipe ends are butt welded. (NFPA 14.4.4.2.3.3)
 - d. When the pipe size in a run of piping is reduced, a reducing fitting designed for that purpose shall be used. (NFPA 14.4.4.2.3.4)
 2. Welding requirements: (NFPA 14.4.4.2.4)
 - a. Welds between pipe and welding outlet fittings shall be permitted to be attached by full penetration welds, partial penetration groove welds, or fillet welds. The minimum throat thickness shall be not less than the thickness of the pipe, the thickness of the welding fitting, or three-sixteenths (3/16) inch, whichever is least. (NFPA 14.4.4.2.4.1)
 - b. Circumferential butt joints shall be cut, beveled, and fit so that full penetration is achievable. Full penetration welding shall not be required. (NFPA 14.4.4.2.4.2)
 - c. Where slip-on flanges are welded to pipe with a single fillet weld, the weld shall be on the hub side of the flange and the minimum throat weld thickness shall not be less than one-and-one-quarter (1.25) times the pipe wall thickness or the hub thickness, whichever is less. (NFPA 14.4.4.2.4.3)
 - d. Face welds on the internal face of the flange shall be permitted as a water seal in addition to a hub weld. (NFPA 14.4.4.2.4.4)

- e. Tabs for longitudinal earthquake bracing shall have minimum throat weld thickness not less than one-and-one-quarter (1.25) times the pipe wall thickness and welded on both sides of the longest dimension. (NFPA 14.4.4.2.4.5)
- f. When welding is performed, the following shall apply: (NFPA 14.4.4.2.4.6)
 - 1) Holes in piping for outlets shall be cut to the full inside diameter of fittings prior to welding in place of the fittings.
 - 2) Discs shall be retrieved.
 - 3) Openings cut into piping shall be smooth bore, and all internal slag and welding residue shall be removed.
 - 4) Fittings shall not penetrate the internal diameter of the piping.
 - 5) Steel plates shall not be welded to the ends of piping or fittings.
 - 6) Fittings shall not be modified.
 - 7) Nuts, clips, eye rods, angle brackets, or other fasteners shall not be welded to pipe or fittings, except as specifically permitted.
 - 8) Completed welds shall be free from cracks, incomplete fusion, surface porosity greater than one-sixteenth (1/16) inch diameter and undercut deeper than twenty-five (25) percent of the wall thickness or one-thirty-seconds (1/32) inch, whichever is less.
 - 9) Completed circumferential but weld reinforcement shall not exceed three-thirty-seconds (3/32) inch.
- 3. Qualifications: (NFPA 14.4.4.2.5)
 - a. A welding procedure shall be prepared and qualified by the contractor or fabricator before any welding is done. (NFPA 14.4.4.2.5.1)
 - b. Qualification of the welding procedure to be used and the performance of all welders and welding operators shall be required and shall meet or exceed the requirements of AWS B2.1, or ASME Boiler and Pressure Vessel Code, Section IX, or other applicable qualification standard as required by the authority having jurisdiction. (NFPA 14.4.4.2.5.2)
 - 1) Successful procedure qualification of complete joint penetration groove welds shall qualify partial joint penetration (groove/fillet) welds and fillet welds in accordance with the provisions of NFPA 14. (NFPA 14.4.4.2.5.3)
 - c. Welding procedures qualified under standards recognized by previous editions of NFPA 14 shall be permitted to be continued in use. (NFPA 14.4.4.2.5.4)
 - d. Contractors or fabricators shall be responsible for all welding they produce. (NFPA 14.4.4.2.5.5)
 - e. Each contractor or fabricator shall have available to the authority having jurisdiction an established written quality assurance procedure ensures compliance. (NFPA 14.4.4.2.5.6)
- 4. Records: (NFPA 14.4.4.2.6)
 - a. Welders or welding machine operators shall, upon completion of each welded pipe, place their identification mark or label onto each piece adjacent to a weld. (NFPA 14.4.4.2.6.1)
 - b. Contractors or fabricators shall maintain certified records, which shall be available to the authority having jurisdiction, or the procedures used, and the welders or welding machine operators employed by them, along with their welding identification. (NFPA 14.4.4.2.6.2)

- c. Records shall show the date and the results of the procedure and performance qualifications. (NFPA 14.4.4.2.6.3)
- D. Groove joints: (NFPA 14.4.4.3)
 - 1. Pipe joined with grooved fittings shall be joined by a listed combination of fittings, gaskets, and grooves. (NFPA 14.4.4.3.1)
 - 2. Grooves cut or rolled on pipe shall be dimensionally compatible with the fittings. (NFPA 14.4.4.3.2)
 - 3. Grooved fittings, including gaskets used on dry pipe, preaction, and deluge systems, shall be listed for dry pipe service. (NFPA 14.4.4.3.3)
- E. Brazed joints: (NFPA 14.4.4.4)
 - 1. Joints for the connection of copper tube shall be brazed. (NFPA 14.4.4.4.1)
 - 2. Brazing fluxes shall not be of a highly corrosive type and shall be in accordance with AWS A5.8. (NFPA 14.4.4.4.2)
- F. End treatment: (NFPA 14.4.4.6)
 - 1. After cutting, pipe ends shall have burrs and fins removed. (NFPA 14.4.4.6.1)
 - 2. Pipe used with listed fittings and its end treatment shall be in accordance with the fitting manufacturer's installation instructions and the fitting's listing. (NFPA 14.4.4.6.2)

3.3 VALVE INSTALLATION

- A. Connections to water supply: (NFPA 14.6.3.1)
 - 1. Connections to each automatic water supply shall be provided with an approved indicating-type valve and check valve close to the supply. (NFPA 14.6.3.1.1)
- B. Valve supervision: (NFPA 14.6.3.7)
 - 1. System water supply valves, isolation control valves, and other valves in feed mains shall be supervised in an approved manner in the open position by one of the following methods: (NFPA 14.6.3.7.1)
 - a. A central station, proprietary, or remote station signaling service.
 - b. A local signaling service that initiates an audible signal at a constantly attended location.
 - c. Locking of valves in the open position.
 - d. Sealing of valves and an approved weekly recorded inspection where valves are located within fenced enclosures under the control of the owner.
 - 2. Underground gate valves with roadway boxes shall not be required to be supervised. (NFPA 14.6.3.7.2)
 - 3. Bypass valves shall be supervised in the closed position by one of the following methods: (NFPA 14.6.3.7.3)
 - a. A central station, proprietary, or remote station signaling service.
 - b. A local signaling service that initiates an audible signal at a constantly attended location.
- C. Signs for room identification, valves, and hose connections: (NFPA 14.6.3.8)
 - 1. All main and sectional system control valves, including water supply control valves, shall have a sign indicating the portion of the system that is controlled by the valve. (NFPA 14.6.3.8.1)
 - 2. All control, drain, and test connection valves shall be provided with signs indicating their purpose. (NFPA 14.6.3.8.2)
 - 3. Where a main or sectional system control valve is in a closed room or concealed space, the locations of the valve shall be indicated by a sign in an approved location on the outside of the door or near the opening to the concealed space. (NFPA 14.6.3.8.4)

4. Where hose connections are not located in exit stairways, signs shall be provided in accordance with NFPA 170 to identify the location of the hose connection in an approved manner. (NFPA 14.6.3.8.5)
 - a. Valve cabinets, where provided, shall be marked to indicate the contents. (NFPA 14.6.3.8.5.1)
 - b. The letter shall be red with a white background and shall be two-and-one-half (2.5) inches in height. (NFPA 14.6.3.8.5.2)

3.4 HOSE STATION AND CONNECTION INSTALLATION

- A. Hose connections and hose stations shall be unobstructed and shall be located not less than three (3) feet or more than five (5) feet above the floor. (NFPA 14.7.3.1.1)
 1. This dimension shall be measured from the floor to the center of the hose valve. (NFPA 14.7.3.1.1.1)
- B. The hose connection shall not be obstructed by any closed or open stairwell door(s) or other objects on the landing. (NFPA 14.7.3.1.2)

3.5 FIRE DEPARTMENT CONNECTION INSTALLATION

- A. Shutoff valves shall not be installed between the fire department connection and the system. (NFPA 14.6.4.1)
- B. A listed check valve shall be installed in each fire department connection, including the connection in manual dry systems, and located as near as practicable to the point where it joins the system. (NFPA 14.6.4.2)
- C. The fire department connection shall be installed as follows: (NFPA 14.6.4.3)
 1. Fire department connections shall not be connected on the suction side of fire pumps. (NFPA 14.6.4.3.1)
- D. In areas subject to freezing, a listed automatic drip valve that is arranged to allow drainage without causing water damage shall be installed in the piping between the check valve and the fire department connection. (NFPA 14.6.4.4)
- E. Location and identification: (NFPA 14.6.4.5)
 1. Fire department connections shall be visible and recognizable from the street or nearest point of fire department apparatus accessibility or on the street side of buildings. (NFPA 14.6.4.5.1)
 - a. Fire department connections shall be located and arranged so that hose lines can be attached to the inlets without interference from nearby objects, including buildings, fences, posts, landscaping, vehicles, or other fire department connections. (NFPA 14.6.4.5.1.1)
 2. Where a fire department connections services multiple buildings, structures, or locations, a sign shall be provided indicating the buildings, structures, or locations served. (NFPA 14.6.4.5.3)
 3. Fire department connections shall be located not more than one hundred (100) feet from the nearest fire hydrant connected to an approved water supply. (NFPA 14.6.4.5.4)
 - a. The location of the fire department connection shall be permitted to exceed one hundred (100) feet subject to the approval of the authority having jurisdiction. (NFPA 14.6.4.5.4.1)
- F. Fire department connections shall be located not less than eighteen (18) inches nor more than forty-eight (48) inches above the level of the adjoining ground, sidewalk, or grad surface. (NFPA 14.6.4.6)
- G. Fire department connection piping shall be supported in accordance with NFPA 13. (NFPA 14.6.4.7)

3.6 SYSTEM SIGNAGE INSTALLATION

- A. Signs shall be secured to a device or the building wall with corrosion-resistant chains or fasteners. (NFPA 14.6.6)
- B. Where a fire pump is provided, a sign shall be in the vicinity of the pump indicating the minimum pressure and flow required at the pump discharge flange to meet the system demand. (NFPA 14.6.7)
- C. Hydraulic design information sign: (NFPA 14.6.8)
 - 1. The installation contractor shall provide a sign identifying the basis of the system design. (NFPA 14.6.8.1)
 - 2. The sign shall indicate the following: (NFPA 14.6.8.3)
 - a. Location of the two (2) hydraulically most remote hose connections.
 - b. Design flow rate for the two (2) hydraulically most remote hose connections.
 - c. Design residual inlet and outlet pressures for the two (2) hydraulically most remote hose connections.
 - d. Design static pressure and the design system demand at the system control valve, or at the pump discharge flange where a pump is installed, and at each fire department connection.

3.7 SYSTEM ATTACHMENTS

- A. Gauges: (NFPA 14.5.5)
 - 1. Pressure-regulating device: (NFPA 14.5.5.2)
 - a. A valved outlet for a pressure gauge shall be installed on the upstream side of every pressure-regulating device. (NFPA 14.5.5.2.1)
 - b. Pressure gauges shall be installed on the upstream and the downstream sides of every pressure-regulating device installed in accordance with section 7.2.4(6) of NFPA 14. (NFPA 14.5.5.2.2)
- B. Waterflow and supervisory alarms: (NFPA 14.5.6)
 - 1. A test connection for testing the waterflow device shall be provided. (NFPA 14.5.6.4)
 - 2. Alarm and supervisory devices shall be installed in accordance with NFPA 72. (NFPA 14.5.6.5)

3.8 SYSTEM ACCEPTANCE TESTS

- A. General: (NFPA 14.11.1)
 - 1. All new systems shall be tested prior to the occupancy of the building. (NFPA 14.11.1.1)
 - 2. The installing contractor shall complete and sign the appropriate contractor's material and test certificate as shown in Figure 11.1.3(a) and Figure 11.1.3(b) of NFPA 14. (NFPA 14.11.1.3)
- B. Flushing of piping: (NFPA 14.11.2)
 - 1. Underground piping supplying the system shall be flushed in accordance with NFPA 24. (NFPA 14.11.2.1)
 - 2. Piping between the fire department connection and the check valve in the inlet pipe shall be flushed with a sufficient volume of water to remove any construction debris and trash accumulated in the piping prior to the completion of the system and prior to the installation of the fire department connection. (NFPA 14.11.2.2)
- C. Hose threads: (NFPA 14.11.3)
 - 1. All hose connection and fire department connections threads shall be tested to verify their compatibility with threads used by the local fire department. (NFPA 14.11.3.1)

2. The test shall consist of threading coupling samples, caps, or plugs onto the installed devices. (NFPA 14.11.3.2)
- D. Hydrostatic tests: (NFPA 14.11.4)
 1. All new systems, including yard piping and fire department connections, shall be tested hydrostatically at not less than two hundred (200) psi of pressure for two (2) hours, or at fifty (50) psi in excess of the maximum pressure where the maximum pressure is in excess of one-hundred-fifty (150) psi. (NFPA 14.11.4.1)
 2. The hydrostatic test pressure shall be measured at the low elevation point of the individual system or zone being tested. (NFPA 14.11.4.2)
 3. Underground pipe shall be tested in accordance with NFPA 24. (NFPA 14.11.4.4)
 4. Where cold weather prevents testing with water, an interim air test shall be permitted to be conducted prior to the standard hydrostatic test. (NFPA 14.11.4.5)
 - a. An air pressure leakage test at forty (40) psi shall be conducted for twenty-four (24) hours. (NFPA 14.11.4.5.1)
 - b. Any leakage that results in a loss of pressure more than one-and-one-half (1.5) psi during a continuous twenty-four (24) hour period shall be corrected. (NFPA 14.11.4.5.2)
 5. Piping between the fire department connection and the check valve in the inlet pipe shall be tested hydrostatically in the same manner as the balance of the system. (NFPA 14.11.4.6)
 6. Existing systems: (NFPA 14.11.4.7)
 - a. Modifications that cannot be isolated, such as new valves, or the point of connection for new piping, shall not require testing more than system static pressure. (NFPA 14.11.4.7.2)
 7. During testing, care shall be taken to ensure that no portion of the piping is subject to freezing during cold weather. (NFPA 14.11.4.8)
 8. Additives, corrosive chemicals such as sodium silicate or derivatives of sodium silicate, brine, or other chemicals shall not be used while hydrostatically testing systems or for stopping leaks. (NFPA 14.11.4.10)
- E. Flow tests: (NFPA 14.11.5)
 - 1.
 2. Backflow prevention assemblies: (NFPA 14.11.5.3)
 - a. The backflow prevention assembly shall be forward flow tested to ensure proper operation. (NFPA 14.11.5.3.1)
 - b. The minimum flow rate shall be the system demand. (NFPA 14.11.5.3.2)
 3. The filling arrangement for suction tanks shall be verified by shutting down all supplies to the tank, draining the tank to below the designated low water level, and then opening the supply valve to ensure operation of its automatic features. (NFPA 14.11.5.4)
 4. Pressure-regulating devices: (NFPA 14.11.5.5)
 - a. Each pressure-regulating device shall be tested to verify that the installation is correct, that the device is operating, and that the inlet and outlet pressures and flow at the device are in accordance with the design. (NFPA 14.11.5.5.1)
 - b. Static and residual inlet pressure and static and residual outlet pressure shall be recorded on the contractor's test certificate. (NFPA 14.11.5.5.2)
 5. Main drain flow test: (NFPA 14.11.5.6)
 - a. The main drain valve shall be opened and shall remain open until the system pressure stabilizes. (NFPA 14.11.5.6.1)
 - b. The static and residual pressure shall be recorded on the contractor's test certificate. (NFPA 14.11.5.6.2)

- c. Main drain flow tests are not required for manual systems that do not have a permanently attached water supply. (NFPA 14.11.5.6.3)
- 6. Testing of automatic dry and semiautomatic systems: (NFPA 14.11.5.7)
 - a. Automatic dry and semiautomatic systems shall be tested by initiating a flow of water from the hydraulically most remote hose connection. (NFPA 14.11.5.7.1)
 - b. The system shall deliver a minimum of two-hundred-fifty (250) gpm at the hose connection within three (3) minutes of opening the hose valve if the system capacity exceeds seven-hundred-fifty (750) gallons. (NFPA 14.11.5.7.2)
 - c. Each remote-control activation device for operating a semiautomatic system shall be tested in accordance with the manufacturer's specifications and instructions. (NFPA 14.11.5.7.3)
 - d. In addition to the standard hydrostatic test, an air pressure leakage test at forty (40) psi shall be conducted for twenty-four (24) hours. Any leakage that results in a loss of pressure in excess of one-and-one-half (1.5) psi shall be corrected. (NFPA 14.11.5.7.4)
 - e. These tests shall be conducted in addition to all the tests required for automatic and manual systems. (NFPA 14.11.5.7.5)
- F. Manual valve test: (NFPA 14.11.6)
 - 1. Each valve intended to be manually opened or closed shall be operated by turning the handwheel crank or wrench for its full range and returning it to its normal position. (NFPA 14.11.6.1)
 - 2. Hose valve caps shall be tightened sufficiently to avoid leakage during the test and removed after the test to drain water and relieve pressure. (NFPA 14.11.6.2)
- G. Each alarm and supervisory device provided shall be tested in accordance with NFPA 72. (NFPA 14.11.7)
- H. The installation of signs required by this standard shall be verified. (NFPA 14.11.10)

END OF SECTION

**SECTION 21 20 00
STATIONARY FIRE PUMPS**

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Centrifugal pumps.
 - 2. Electric drives for pumps.
 - 3. Electric drive controllers and accessories.
 - 4. Pump accessories.
 - 5. Pressure maintenance (jockey) pumps.

1.2 REFERENCES

- A. American National Standard Institute (ANSI):
 - 1. ANSI C62.1 – IEEE Standard for Gapped Silicon-Carbide Surge Arresters for AC Power Circuits.
 - 2. ANSI C62.11 – IEEE Standard for Metal-Oxide Surge Arresters for AC Power Circuits.
 - 3. ANSI C62.41 – IEEE Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
 - 4. ANSI 508 – Standard for Industrial Control Equipment.
 - 5. ANSI 1449 – Standard for Surge Protective Devices.
- B. International Building Code with North Carolina Amendments:
 - 1. North Carolina Fire Prevention Code.
 - 2. North Carolina Plumbing Code.
- C. National Electrical Manufacturers Association (NEMA):
 - 1. NEMA MG-1 – Motors and Generators.
- D. National Fire Protection Association (NFPA):
 - 1. NFPA 13 – Standard for the Installation of Sprinkler Systems.
 - 2. NFPA 20 – Standard for the Installation of Stationary Pumps for Fire Protection.
 - 3. NFPA 25 – Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.
 - 4. NFPA 70 – National Electrical Code.
 - 5. NFPA 70E – Standard for Electrical Safety in the Workplace.
 - 6. NFPA 72 – National Fire Alarm and Signaling Code.

1.3 SUBMITTALS

- A. Refer to specification section 21 01 05 for submittal requirements, definitions, and procedures.
- B. Submit manufacturer's data for the following:
 - 1. Centrifugal pumps.
 - 2. Electric drives for pumps.
 - 3. Electric drive controllers and accessories.
 - 4. Pump accessories.
 - 5. Pressure maintenance (jockey) pumps.
- C. Submit shop drawings in accordance with the following:
 - 1. Stationary fire pumps shall be selected based on the conditions under which they are to be installed and used.

2. The pump manufacturer or its authorized representative shall be given complete information concerning the liquid and power supply characteristics.
 3. A complete plan and detailed data describing pump, driver, controller, power supply, fittings, suction and discharge connections, and liquid supply connections shall be prepared for approval.
 4. Plans shall be drawn to an indicated scale on sheets of a uniform size, and shall indicate, as a minimum, the items from the following list that pertain to the design of the systems:
 - a. Name of owner and occupant.
 - b. Location, including street address.
 - c. Point of compass.
 - d. Name and address of installing contractor.
 - e. Pump make and model number.
 - f. Pump rating, in gpm at psi and with rpm.
 - g. Suction main size, length, location, weight, type of material, and point of connection to water supply, as well as size and type of valves, valve indicators, regulators, meters, and valve pits, and depth to top of pipe below grade.
 - h. Water supply capacity information including the following:
 - 1) Location and elevation of static and residual test gauge with relation to the riser reference point.
 - 2) Flow location.
 - 3) Static pressure, in psi.
 - 4) Residual pressure, in psi.
 - 5) Flow, in gpm.
 - 6) Date.
 - 7) Time.
 - 8) Name of person who conducted the test or supplied the information.
 - 9) Other sources of water supply, with pressure or elevation.
 - i. Pump driver details including manufacturer, horsepower, voltage, or fuel system details.
 - j. Controller manufacturer, type, and rating.
 - k. Suction and discharge pipe, fittings, and valve types.
 - l. Test connection piping and valves.
 - m. Flow meter details.
 - n. Jockey pump and controller arrangement, including sensing line details.
 5. Each pump, driver, controlling equipment, power supply and arrangement, and liquid supply shall be approved by the authority having jurisdiction for the specific field conditions encountered.
- D. Submittals shall be prepared by a qualified design professional currently employed by the contractor as follows:
1. Plans shall be prepared under the direct supervision of either a licensed professional engineer registered in the state of North Carolina or a NICET level III technician certified in water-based suppression systems.
 2. The design professional shall be on good standing with the associated accreditation board and shall have paid all required board fees, performed all necessary renewal procedures, and paid any required state taxes or licensing fees associated with maintaining accreditation.
 3. The design professional shall also affix their individual certification mark, indicating registration/certification number and their name as it is recorded with the associated accreditation board, and shall provide a unique signature to each sheet of the submittal.

1.4 OPERATION AND MAINTENANCE MANUALS

- A. Refer to specification section 21 01 05 for submittal requirements, definitions, and procedures.
- B. Submit manufacturer's data, manufacturer's warranties, and operation and maintenance instructions for the following:
 - 1. Centrifugal pumps.
 - 2. Electric drives for pumps.
 - 3. Electric drive controllers and accessories.
 - 4. Pump accessories.
 - 5. Pressure maintenance (jockey) pumps.
- C. One (1) set of record drawings shall be provided to the building owner.
- D. One (1) copy of the completed test report shall be provided to the building owner.
- E. One (1) set of instruction manuals for all major components of the fire pump system shall be supplied by the manufacturer of each major component.
- F. The manual shall contain the following:
 - 1. A detailed explanation of the operation of the component.
 - 2. Instructions for routine maintenance.
 - 3. Detailed instructions concerning repairs.
 - 4. Parts list and parts identification.
 - 5. Schematic electrical drawings of controller, transfer switch, and fire pump control panels.
 - 6. List of recommended spare parts and lubricants.
- G. Any special tools and testing devices required for routine maintenance shall be available for inspection by the authority having jurisdiction at the time of the field acceptance test. One (1) of each tool and testing device shall be provided to the owner at project closeout.

1.5 GENERAL SYSTEM REQUIREMENTS

- A. Fire pump unit performance:
 - 1. The fire pump unit, consisting of a pump, driver, and controller, shall perform in compliance with NFPA 20 as an entire unit when installed or when components have been replaced.
 - 2. The complete fire pump unit shall be field acceptance tested for proper performance in accordance with NFPA 20.
- B. Certified shop test:
 - 1. Certified shop test curves showing head capacity and brake horsepower of the pump shall be furnished by the manufacturer to the purchaser.
 - 2. The purchaser shall furnish this data to the authority having jurisdiction.
- C. Liquid supplies:
 - 1. Reliability:
 - a. The adequacy and dependability of the water source are of primary importance and shall be fully determined, with due allowance for its reliability in the future.
 - b. Where a water flow test is used to determine the adequacy of the attached water supply, the test shall have been completed not more than twelve (12) months prior to the submission of working plans, unless otherwise permitted by the authority having jurisdiction.
 - 2. Head:
 - a. The head available from a water supply shall be figured based on a flow of one-hundred-fifty (150) percent of rated capacity of the fire pump.

- b. Where the water supply cannot provide a flow of one-hundred-fifty (150) percent of the rated flow of the pump, but the water supply can provide the greater of one-hundred (100) percent of the rated flow or the flow demand of the fire protection system(s), the head available from the water supply shall be permitted to be calculated based on the maximum flow available.
 - c. This head shall be as indicated by a flow test.
- D. Pumps, drivers, and controllers:
 - 1. Fire pumps shall be dedicated to and listed for fire protection service.
 - 2. A pump shall not be equipped with more than one driver.
 - 3. Each fire pump shall have its own dedicated driver unless otherwise permitted by NFPA 20.8.6.3.1.
 - 4. Each driver shall have its own dedicated controller.
 - 5. The driver shall be selected to provide the required power to operate the pump at rated speed and maximum pump load under any flow condition.
- E. Pressure-actuated controller pressure sensing lines:
 - 1. For all pump installations, including jockey pumps, each controller shall have its own individual pressure sensing line.
 - 2. The pressure sensing line connection for each pump, including jockey pumps, shall be made between that pump's discharge check valve and discharge isolation valve.
 - 3. The pressure sensing line shall be brass, rigid copper pipes type K, L, or M, or series 3000 stainless steel pipe or tube, and the fittings shall be of one-half (0.5) inch nominal size.
 - 4. Check valves or ground-face unions:
 - a. There shall be two (2) check valves installed in the pressure sensing line at least five (5) feet apart with a nominal 0.09375-inch hole drilled in the clapper to serve as dampening.
 - b. Where the water is clean, ground-face unions with noncorrosive diaphragms drilled with a nominal 0.09375-inch orifice shall be permitted in place of the check valves.
 - c. There shall be two (2) inspection test valves attached to the pressure sensing line that shall consist of a tee, a valve, a second tee with the branch plugged, and a second valve.
 - 5. There shall be no shutoff valve in the pressure sensing line.
 - 6. Pressure switch actuation at the low adjustment setting shall initiate the pump starting sequence if the pump is not already in operation.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL PUMPS

- A. Maximum pressure:
 - 1. The net pump shutoff (churn) pressure plus the maximum static suction pressure, adjusted for elevation, shall not exceed the pressure for which the system components are rated.
- B. Capacities:
 - 1. A centrifugal fire pump for fire protection shall be selected so that the greatest single demand for any fire protection system connected to the pump is less than or equal to one-hundred-fifty (150) percent of the rated capacity of the pump.
 - 2. Centrifugal fire pumps shall have one of the rated capacities in gpm as identified in Table 4.8.2 of NFPA 20 and shall be rated at net pressures of forty (40) psi or more.

C. General

1. Types:

- a. Centrifugal pumps shall be of the overhung impeller design and the impeller between bearings design.
- b. The overhung impeller design shall be close-coupled or separately coupled single- or two-stage end-suction-type or in-line-type pumps.
- c. The impeller between bearings design shall be separately coupled single-stage or multistage axial (horizontal) split-case-type or radial (vertical) split-case-type pumps.

2. Centrifugal pumps shall not be used where a static suction lift is required.

D. Factory and field performance:

1. Pumps shall furnish not less than one-hundred-fifty (150) percent of rated capacity at not less than sixty-five (65) percent of total rated head.
2. The shutoff head shall not exceed one-hundred-forty (140) percent of rated head for any type pump.

2.2 ELECTRIC DRIVES FOR PUMPS

A. General:

1. All electrical equipment and installation methods shall comply with NFPA 70.
2. All power supplies shall be located and arranged to protect against damage by fire from within the premises and exposing hazards.
3. All power supplies shall have the capacity to run the fire pump on a continuous basis.
4. All power supplies shall comply with the following voltage drop requirements:
 - a. Unless one of the following requirements is met, the voltage at the controller line terminals shall not drop more than fifteen (15) percent below normal (controller-rated voltage) under motor-starting conditions.
 - 1) This requirement shall not apply to emergency-run mechanical starting.
 - b. The voltage at the contactor(s) load terminals to which the motor is connected shall not drop more than five (5) percent below the voltage rating of the motor when the motor is operating at one-hundred-fifteen (115) percent of the full-load current rating of the motor.
 - 1) Wiring from the controller(s) to the pump motor shall be in rigid metal conduit, intermediate metal conduit, electrical metal tubing, liquid tight flexible metal conduit, or liquid tight flexible nonmetallic Type LFNC-B, listed Type MC cable with an impervious covering, or Type MI cable.
 - 2) Electrical connections at motor terminal boxes shall be made with a listed means of connection.
 - 3) Twist-on insulation-piercing type and soldered wire connectors shall not be permitted to be used for this purpose.
5. Phase converters shall not be used to supply power to a fire pump.
6. Interruption:
 - a. No ground fault interruption means shall be installed in any fire pump control or power circuit.
 - b. No arc fault interruption means shall be installed in any fire pump control or power circuit.

B. Motors:

1. General:

- a. All motors shall comply with NEMA MG-1, shall be marked as complying with NEMA Design B standards, and shall be specifically listed for fire pump service.

- b. Part-winding motors shall have a fifty-fifty (50-50) winding ratio for equal currents in both windings while running at nominal speed.
 - c. All motors shall be rated for continuous duty.
 - d. Electric motor-induced transients shall be coordinated with the electrical characteristics of the electric drive controller to prevent nuisance tripping of motor controller protective devices.
- 2. Current limits:
 - a. The motor capacity in horsepower shall be such that the maximum motor current in any phase under any condition of pump load and voltage unbalance shall not exceed the motor-rated full-load current multiplied by the service factor.
 - b. The following shall apply for the service factor:
 - 1) The maximum service factor at which a motor shall be used is 1.15.
 - c. These service factors shall be in accordance with NEMA MG-1.
 - d. General-purpose (open and drip proof) motors, totally enclosed fan cooled (TEFC) motors, and totally enclosed nonventilated (TENV) motors shall not have a service factor larger than 1.15.
- 3. Marking:
 - a. Marking of motor terminals shall be in accordance with NEMA MG-1, Part 2.
 - b. A motor terminal connecting diagram for multiple lead motors shall be furnished by the motor manufacturer.

2.3 ELECTRIC DRIVE CONTROLLERS AND ACCESSORIES

- A. General:
 - 1. Performance and testing:
 - a. All controllers and transfer switches shall be specifically listed for electric motor-driven fire pump service.
 - b. Marking:
 - 1) The controller and transfer switch shall be suitable for the available short-circuit current at the line terminals of the controller and transfer switch.
 - 2) The controller and transfer switch shall be marked "Suitable for use on a circuit capable of delivering not more than ___ amperes RMS symmetrical at ___ volts ac," or "___ amperes RMS symmetrical at ___ volts ac short-circuit current rating," or equivalent, where the blank spaces shown shall have appropriate values filled in for each installation.
 - c. All controllers shall be completely assembled, wired, and tested by the manufacturer before shipment from the factory.
 - 1) Controllers shipped in sections shall be completely assembled, wired, and tested by the manufacturer before shipment from the factory.
 - 2) Such controllers shall be reassembled in the field, and the proper assembly shall be verified by the manufacturer or designated representative.
 - d. All controllers and transfer switches shall be listed as suitable for use as service equipment where so used.
 - e. Additional marking:
 - 1) All controllers shall be marked "Electric Fire Pump Controller" and shall show plainly the name of the manufacturer, identifying designation, maximum operating pressure, enclosure type designation, and complete electrical rating.
 - f. It shall be the responsibility of the pump manufacturer or its designated representative to make necessary arrangements for the services of a

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- c. Complete instructions covering the operation of the controller shall be provided and conspicuously mounted on the controller.
 - d. The installation instructions of the manufacturer of the fire pump controller shall be followed.
- 8. Marking:
 - a. Each motor control device and each switch and circuit breaker shall be marked to plainly indicate the name of the manufacturer, the designated identifying number, and the electrical rating in volts, horsepower, amperes, frequency, phases, and so forth, as appropriate.
 - b. The markings shall be so located as to be visible after installation.
- C. Components:
 - 1. Voltage surge arrester:
 - a. A voltage surge arrester complying with ANSI C62.1 or ANSI C62.11 shall be installed from each phase to ground.
 - b. The surge arrester shall be rated to suppress voltage surges above line voltage.
 - c. The above requirements shall not apply where the controller can withstand without damage a ten (10) kV impulse in accordance with ANSI C62.41, or where the controller is listed to withstand surges and impulses in accordance with ANSI 1449.
 - 2. Isolating switch:
 - a. General:
 - 1) The isolating switch shall be a manually operable motor circuit switch or a molded case switch having a horsepower rating equal to or greater than the motor horsepower.
 - 2) A molded case switch having an ampere rating not less than one-hundred-fifteen (115) percent of the motor rated full-load current and suitable for interrupting the motor locked rotor current shall be permitted.
 - 3) A molded case isolating switch shall be permitted to have self-protecting instantaneous short-circuit overcurrent protection, provided that this switch does not trip unless the circuit breaker in the same controller trips.
 - b. The isolating switch shall be externally operable.
 - c. The ampere rating of the isolating switch shall be at least one-hundred-fifteen (115) percent of the full-load current rating of the motor.
 - d. Warning:
 - 1) The following warning shall appear on or immediately adjacent to the isolating switch, "WARNING – DO NOT OPEN OR CLOSE THIS SWITCH WHILE THE CIRCUIT BREAKER (DISCONNECTING MEANS) IS IN CLOSED POSITION."
 - 2) The above requirement shall not apply where the following requirements are met:
 - a) Where the isolating switch and the circuit breaker are so interlocked that the isolating switch can be neither opened nor closed while the circuit breaker is closed, the warning label shall be permitted to be replaced with an instruction label that directs the order of operation.
 - b) This label shall be permitted to be part of the electrical diagrams and instructions.
 - e. Operating handle:
 - 1) The isolating switch operating handle shall be provided with a spring latch that shall be so arranged that it requires the use of the other hand to hold the latch released to permit opening or closing of the switch.

- 2) The above requirements shall not apply where the isolating switch and the circuit breaker are so interlocked that the isolating switch can be neither opened nor closed with the circuit breaker is closed.
3. Circuit breaker (disconnecting means):
 - a. The motor branch circuit shall be protected by a circuit breaker that shall be connected directly to the load side of the isolating switch and shall have one pole for each ungrounded circuit conductor.
 - b. The circuit breaker shall have the following mechanical characteristics:
 - 1) It shall be externally operable.
 - 2) It shall trip free of the handle.
 - 3) A nameplate with the legend "Circuit Breaker – Disconnecting means" in letters not less than three-eighths (0.375) inch high shall be located on the outside of the controller enclosure adjacent to the means for operating the circuit breaker.
 - c. Electrical characteristics:
 - 1) The circuit breaker shall have the following characteristics:
 - a) A continuous current rating of not less than one-hundred-fifteen (115) percent of the rated full-load current of the motor.
 - b) Overcurrent-sensing elements of the nonthermal type.
 - c) Instantaneous short-circuit overcurrent protection.
 - d) An adequate interrupting rating to provide the suitability rating of the controller.
 - e) Capability of allowing normal and emergency starting and running of the motor without tripping.
 - f) An instantaneous trip setting of not more than twenty (20) times the full-load current.
 - g) The circuit breaker shall not trip when starting a motor from rest in the across-the-line (direct-on-line) mode, whether the controller is of the reduced inrush starting type.
 - h) The circuit breaker shall not trip when power is interrupted from a running pump, or if the pump is restarted in less than three (3) seconds after being shut down. If a control circuit preventing a restart within three (3) seconds is provided, this requirement shall not apply.
 - 2) Current limiters, where integral parts of the circuit breaker, shall be permitted to be used to obtain the required interrupting rating, provided all the following requirements are met:
 - a) The breaker shall accept current limits of only one rating.
 - b) The current limiters shall hold three hundred (300) percent of full-load motor current for a minimum of thirty (30) minutes.
 - c) The current limiters, where installed in the breaker, shall not open at locked rotor current.
 - d) A spare set of current limiters of correct rating shall be kept readily available in a compartment or rack within the controller enclosure.
4. The only other overcurrent protective device that shall be required and permitted between the isolating switch and the fire pump motor shall be located within the fire pump controller and shall possess the following characteristics:
 - a. For a squirrel-cage or wound-rotor induction motor, the device shall be of the time-delay type having tripping times as follows:
 - 1) Between eight (8) seconds and twenty (20) seconds at locked rotor current.
 - 2) Three (3) minutes at a minimum of three hundred (300) percent of motor full-load current.

- b. For a direct-current motor, the device shall be as follows:
 - 1) Of the instantaneous type.
 - 2) Calibrated and set at a minimum of four hundred (400) percent of motor full-load current.
 - c. There shall be visual means or marking clearly indicated on the device that proper settings have been made.
 - d. It shall be possible to reset the device for operation immediately after tripping, with the tripping characteristics thereafter remaining unchanged.
 - e. Tripping shall be accomplished by opening the circuit breaker, which shall be of the external manual reset type.
- 5. Motor starting circuitry:
 - a. The motor contactor shall be horsepower rated and shall be of the magnetic type with a contact in each ungrounded connector.
 - 1) Running contactors shall be sized for both the locked rotor currents and the continuous running currents encountered.
 - 2) Starting contactors shall be sized for both the locked rotor current and the acceleration (starting) encountered.
 - b. Timed acceleration:
 - 1) For electrical operation of reduced-voltage controllers, timed automatic acceleration of the motor shall be provided.
 - 2) The period of motor acceleration shall not exceed ten (10) seconds.
 - c. Starting resistors shall be designed to permit one five (5) second starting operation every eighty (80) seconds for a period of not less than one (1) hour.
 - d. Starting reactors and autotransformers:
 - 1) Starting reactors and autotransformers shall comply with the requirements of ANSI 508, Table 92.1.
 - e. Soft start units:
 - 1) Soft start units shall be horsepower rated or specifically designed for the service.
 - 2) The bypass contactor shall comply with the requirements for motor contactors.
 - 3) Soft start units shall comply with the duty cycle requirements of starting reactors and autotransformers.
 - f. Single-phase sensors in controller:
 - 1) Sensors shall be permitted to prevent a three-phase motor from starting under single-phase conditions.
 - 2) Such sensors shall not cause disconnection of the motor if it is running at the time of single-phase occurrence.
 - 3) Such sensors shall be monitored to provide a local visible signal in the event of malfunction of the sensors.
 - g. No ground fault protection (tripping) shall be allowed.
 - h. A ground fault alarm should be permitted.
- 6. Signal devices on controller:
 - a. Power available visible indicator:
 - 1) A visible indicator shall monitor the availability of power in all phases at the line terminals of the motor contactor or of the bypass contactor, if provided.
 - 2) If the visible indicator is a pilot lamp, it shall be accessible for replacement.
 - 3) When power is supplied from multiple power sources, monitoring of each power source for phase loss shall be permitted at any point electrically upstream of the line terminals of the contactor, provided all sources are monitored.

- b. Phase reversal:
 - 1) Phase reversal of the power source to which the line terminals of the motor contactor are connected shall be indicated by a visible indicator.
 - 2) When power is supplied from multiple power sources, monitoring of each power source for phase reversal shall be permitted at any point electrically upstream of the line terminals of the contactor, provided all sources are monitored.
 - 7. Fire pump alarm and signal devices remote from controller:
 - a. Where the pump room is not constantly attended, the audible or visible signals powered by a source not exceeding one-hundred-twenty-five (125) volts shall be provided at a point of constant attendance.
 - b. Those fire pump alarms and signals shall indicate the following:
 - 1) The signal shall actuate whenever the controller has operated into a motor-running condition.
 - a) This signal shall be energized by a separate reliable supervised power source or from the pump motor power, reduced to not more than one-hundred-twenty-five (125) volts.
 - 2) Loss of phase:
 - a) The fire pump alarm shall actuate whenever any phase at the line terminals of the motor contactor is lost.
 - b) All phases shall be monitored. Such monitoring shall detect loss of phase whenever the motor is running or at rest.
 - c) When power is supplied from multiple power sources, monitoring of each power source for phase loss shall be permitted at any point electrically upstream of the line terminals of the contactor, provided all sources are monitored.
 - 3) The fire pump alarm shall actuate whenever the three-phase power at the line terminals of the motor contactor is reversed.
 - a) The fire pump alarm circuit shall be energized by a separate reliable supervised power source or from the pump motor power, reduced to not more than one-hundred-twenty-five (125) volts.
 - 4) Controller connected to alternate source:
 - a) Where two (2) sources of power are supplied, this signal shall indicate whenever the alternate source is the source supplying power to the controller.
 - b) This signal shall be energized by a separate reliable supervised power source, reduced to not more than one-hundred-twenty-five (125) volts.
 - 8. Controllers shall be equipped with contacts (open or closed) to operate alarm signal devices and when a controller is equipped with a transfer switch.
- D. Starting and control:
- 1. Automatic and nonautomatic:
 - a. An automatic controller shall be self-acting to start, run, and protect a motor.
 - b. An automatic controller shall be arranged to start the driver upon actuation of a pressure switch or non-pressure switch.
 - c. An automatic controller shall be operable also as a nonautomatic controller.
 - d. A nonautomatic controller shall be actuated by manually initiated electrical means and by manually initiated means.
 - 2. Automatic controller:
 - a. Water pressure control:

- 1) Pressure-actuated switches
 - a) There shall be provided a pressure-actuated switch or electronic pressure sensor having adjustable high- and low-calibrated setpoints as part of the controller.
- 2) There shall be no pressure snubber or restrictive orifice employed within the pressure switch or pressure responsive means.
- 3) There shall be no valve or other restrictions within the controller ahead of the pressure switch or pressure responsive means.
- 4) This switch shall be responsive to water pressure in the fire protection system.
- 5) The pressure sensing element of the switch shall withstand a momentary surge pressure of four-hundred (400) psi or one-hundred-thirty-three (133) percent of fire pump controller rated operating pressure, whichever is higher, without losing its accuracy.
- 6) Suitable provision shall be made for relieving pressure to the pressure-actuated switch to allow testing of the operation of the controller and the pumping unit.
- 7) Water pressure control shall be in accordance with the following:
 - a) Pressure switch actuation at the low adjustment setting shall initiate the pump starting sequence (if pump is not already in operation).
 - b) A pressure recording device shall record the pressure in each fire pump controller pressure-sensing line at the input to the controller.
 - c) The pressure recorder shall be listed as part of the controller or shall be a separately listed unit installed to sense the pressure at the input of the controller.
 - d) The recorder shall operate for at least seven (7) days without being reset or rewound.
 - e) The pressure sensing element of the recorder shall withstand a momentary surge pressure of at least four-hundred (400) psi or one-hundred-thirty-three (133) percent of fire pump controller operating pressure, whichever is greater, without losing its accuracy.
- b. External circuits connected to controllers:
 - 1) External control circuits that extend outside the fire pump room shall be arranged so that failure of any external circuit (open, ground-fault, or short circuit) shall not prevent operation of pump(s) from all other internal or external means.
 - 2) Breakage, disconnecting, shorting of the wires, ground fault, or loss of power to these circuits shall be permitted to cause continuous running of the fire pump but shall not prevent the controller(s) from starting the fire pump(s) due to causes other than these external circuits.
 - 3) All control conductors within the fire pump room that are not fault tolerant shall be protected from mechanical injury.
3. Nonautomatic controller.
 - a. Manual electric control at controller:
 - 1) There shall be a manually operated switch on the control panel so arranged that, when the motor is started manually, its operation cannot be affected by the pressure-actuated switch.
 - 2) The arrangement shall also provide that the unit will remain in operation until manually shut down.
 - b. Emergency-run mechanical control at controller:

- 1) The controller shall be equipped with an emergency-run handle or lever that operates to mechanically close the motor-circuit switching mechanism.
 - a) This handle or lever shall provide for nonautomatic continuous running operation of the motor(s) independent of any electric control circuits, magnets, or equivalent devices and independent of the pressure-activated control switch.
 - b) Means shall be incorporated for mechanically latching or holding the handle or lever for manual operation in the actuated position.
 - c) The mechanical latching shall be designed to be automatic or manual.
- 2) The handle or lever shall be arranged to move in one direction only from the off position to the final position.
- 3) The motor starter shall return automatically to the off position in case the operator releases the starter handle or lever in any position but the full running position.
- 4) The operation handle shall be marked or labeled as to function and operation.
4. Shutdown shall be accomplished by one of the following methods:
 - a. Manual shutdown shall be accomplished by operation of a pushbutton on the outside of the controller enclosure that, in the case of automatic controllers, shall return the controller to the fully automatic position.
 - b. Where provided, automatic shutdown after automatic start shall comply with the following:
 - 1) Automatic shutdown shall be permitted only where the controller is arranged for automatic shutdown after all starting and running causes have returned to normal.
 - 2) A running period timer set for at least ten (10) minutes running time shall be permitted to commence at initial operation.
 - 3) Automatic shutdown shall not be permitted where the pump constitutes the sole supply of a fire sprinkler or standpipe system or where the authority having jurisdiction has required manual shutdown.

2.4 PUMP ACCESSORIES

- A. Nameplate:
 1. Pumps shall be provided with a nameplate.
 2. The name plate shall be made of and attached using corrosion resistant material.
- B. Pressure gauges:
 1. Discharge:
 - a. A pressure gauge having a dial not less than three-and-one-half (3.5) inches in diameter shall be connected near the discharge casting with a nominal one-quarter (0.25) inch gauge valve.
 - b. The dial shall indicate pressure to at least twice the rated working pressure of the pump but not less than two-hundred (200) psi.
 - c. The face of the dial shall read in psi with the manufacturer's standard graduations.
 2. Suction:
 - a. A pressure gauge having a dial not less than three-and-one-half (3.5) inches in diameter shall be connected to the suction pipe with a nominal one-quarter (0.25) inch gauge valve.
 - 1) Where the minimum pump suction pressure is below twenty (20) psi under any flow condition, the suction gauge shall be a compound pressure and vacuum gauge.

- b. The face of the dial shall read in psi for the suction range.
 - c. The gauge shall have a pressure range two (2) times the rated maximum suction pressure of the pump.
- C. Suction pipe and fittings:
 - 1. Components:
 - a. The suction components shall consist of all pipe, valves, and fittings from the pump suction flange to the connection to the public or private water service main, storage tank, or reservoir, and so forth, that feeds water to the pump.
 - 2. Suction size:
 - a. The size of the suction pipe for a single pump or the suction header pipe for multiple pumps shall be such that, with all pumps operating at maximum flow, the gauge pressure at the pump suction flanges shall be zero (0) psi or higher.
 - b. This requirement shall not apply where the supply is a suction tank with its base at or above the same elevation as the pump, and the gauge pressure at the pump suction flange shall be permitted to drop to negative three (3) psi with the lowest water level after the maximum system demand and duration have been supplied.
 - c. The size of that portion of the suction pipe located within ten (10) pipe diameters upstream of the pump suction flange shall not be less than that shown in Table 4.26(a) of NFPA 20.
 - 3. Pumps with bypass:
 - a. Where the suction supply pressure is of sufficient pressure to be of material value without the pump, the pump shall be installed with a bypass.
 - b. The size of the bypass shall be at least as large as the pipe size required for discharge pipe as shown in Table 4.26(1) of NFPA 20.
 - 4. Valves:
 - a. A listed outside screw and yoke (OS&Y) gate valve shall be installed in the suction pipe.
 - b. No control valve other than a listed OS&Y valve and those required by backflow prevention devices shall be installed in the suction pipe within fifty (50) feet of the pump suction flange.
 - 5. Installation:
 - a. Suction pipes shall be laid carefully to avoid air leaks and air pockets, either of which can seriously affect the operation of the pump.
 - b. Elbows and tees:
 - 1) Elbows and tees with a centerline plane parallel to a horizontal split-case pump shaft shall not be permitted.
 - 2) This requirement shall not apply to elbows and tees with a centerline plane parallel to a horizontal split-case pump shaft where the distance between the flanges of the pump suction intake and the elbow and tee is greater than ten (10) times the suction pipe diameter.
 - 3) Elbows and tees with a centerline plan perpendicular to the horizontal split-case pump shaft shall be permitted at any location in the pump suction intake.
 - c. Where the suction pipe and pump suction flange are not of the same size, they shall connect an eccentric tapered reducer or increaser installed in such a way as to avoid air pockets.
 - d. Where the pump and its suction supply are on separate foundations with rigid interconnecting pipe, the pipe shall be provided with strain relief.
 - 6. Devices in suction piping:

- a. No device or assembly that will stop, restrict the starting of, or restrict the discharge of a fire pump or pump driver shall be installed in the suction piping.
 - b. The following devices shall be permitted in the suction piping where the following requirements are met:
 - 1) Check valves and backflow prevention devices and assemblies shall be permitted where required by other NFPA standards or the authority having jurisdiction.
 - 2) Where the authority having jurisdiction requires positive pressure to be maintained on the suction piping, a pressure sensing line for a low suction pressure control, specifically listed for fire pump service, shall be permitted to be connected to the suction piping.
 - 3) Devices shall be permitted to be installed in the suction supply piping or stored water supply and arranged to activate a signal if the pump suction pressure or water level falls below a predetermined minimum.
 - 4) Suction strainers shall be permitted to be installed in the suction piping where required by NFPA 20.
 - 5) Other devices specifically permitted or required by NFPA 20 shall be permitted.
- D. Discharge pipe and fittings:
 - 1. The discharge components shall consist of pipe, valves, and fittings extending from the pump discharge flange to the system side of the discharge valve.
 - 2. The pressure rating of the discharge components shall be adequate for the maximum total discharge head with the pump operating at shutoff and rated speed but shall not be less than the rating of the fire protection systems.
 - 3. Steel pipes with flanges, screwed joints, or mechanical grooved joints shall be used aboveground.
 - 4. All pump discharge pipes shall be hydrostatically tested in accordance with NFPA 13.
 - 5. The size of the pump discharge and fittings shall not be less than shown in Table 4.26(a) of NFPA 20.
 - 6. A listed check valve or backflow preventer shall be installed in the pump discharge assembly.
 - 7. A listed indicating gate or butterfly valve shall be installed on the fire protection system side of the pump discharge check valve.
 - 8. No pressure regulating devices shall be installed in the discharge pipe except as permitted by NFPA 20.
- E. Valve supervision:
 - 1. Where provided, the suction valve, discharge valve, bypass valves, and isolation valves on the backflow prevention device or assembly shall be supervised open by one of the following methods:
 - a. Central station, proprietary, or remote station signaling service.
 - b. Local signaling service that will cause the sounding of an audible signal at a constantly attended point.
 - c. Locking valves open.
 - d. Sealing of valves and approved weekly recorded inspection where valves are located within fenced enclosures under the control of the owner.
 - 2. Control valves located in the pipeline to the hose valve header shall be supervised closed by one of the methods for supervised open valves.
- F. Water flow test devices:
 - 1. General:

- a. A fire pump installation shall be arranged to allow the test of the pump at its rated condition as well as the suction supply at the maximum flow available from the fire pump.
 - b. Where water usage or discharge is not permitted for the duration of the field acceptance test, the outlet shall be used to test the pump and suction supply and determine that the system is operating in accordance with the design.
 - c. The flow shall continue until the flow has stabilized.
 - d. Where a test header is installed, it shall be installed on an exterior wall or in another location outside the pump room that allows for water discharge during testing.
2. Meters and testing devices:
- a. Metering devices or fixed nozzles for pump testing shall be listed.
 - b. Metering devices or fixed nozzles shall be capable of water flow of not less than one-hundred-seventy-five (175) percent of rated pump capacity.
 - c. All the meter system piping shall be permitted to be sized hydraulically but shall not be smaller than as specified by the meter manufacturer.
 - d. If the meter system piping is not sized hydraulically, then all the meter system piping shall be sized as specified by the meter manufacturer but not less than the meter device sizes shown in Table 4.26(a) of NFPA 20.
 - e. For non-hydraulically sized piping, the minimum size meter for a given pump capacity shall be permitted to be used where the meter system piping does not exceed one-hundred (100) feet equivalent length.
 - f. The primary element shall be suitable for the pipe size and pump rating.
 - g. The readout instrument shall be sized for the pump rated capacity.
 - h. When discharging back into a tank, the discharge nozzle(s) or pipe shall be located at a point as far from the pump suction as is necessary to prevent the pump from drafting air introduced by the discharge of test water into the tank.
 - i. Where a metering device is installed in a loop arrangement for fire pump flow testing, an alternate means of measuring flow shall be provided.
 - 1) The alternate means of measuring flow shall be located downstream of and in series with the flow meter.
 - 2) The alternate means of measuring flow shall function for the range of flows necessary to conduct a full flow test.
 - 3) An appropriately sized test header shall be an acceptable alternate means of measuring flow.
3. Hose valves:
- a. General:
 - 1) Hoses valves shall be listed.
 - 2) The number and size of hose valves used for pump testing shall be as specified in Table 4.26(a) of NFPA 20.
 - 3) Where outlets are being utilized to test the fire pump, one of the following methods shall be used:
 - a) Hose valves mounted on a hose valve header.
 - b) Wall hydrants, yard hydrants, or standpipe outlets of sufficient number and size to allow testing of the pump.
 - b. Thread types shall comply with one of the following:
 - 1) Hose valve(s) shall have the NH standard external thread for the valve size specified, as stipulated in NFPA 1963.
 - 2) Where local fire department connections do not conform to NFPA 1963 and the connection is to be utilized as a wall hydrant, the authority having jurisdiction shall designate the threads to be used.

- c. Location:
 - 1) A listed indicating butterfly or gate valve shall be in the pipeline to the hose valve header.
 - 2) A drain valve or automatic ball drip shall be in the pipeline at a low point between the valve and the header.
 - 3) The butterfly or gate valve shall be at a point in the line close to the pump.
- d. The pipe size shall be in accordance with one of the following two methods:
 - 1) Where the pipe between the hose valve header and the connection to the pump discharge pipe is over fifteen (15) feet in length, the next larger pipe size shall be used.
 - 2) This pipe is permitted to be sized by hydraulic calculations based on a total flow of one-hundred-fifty (150) percent of rated pump capacity, including the following:
 - a) This calculation shall include friction loss for the total length of pipe plus equivalent lengths of fittings, control valve, and hose valves, plus elevation loss, from the pump discharge flange to the hose valve outlets.
 - b) The installation shall be proven by a test flowing the maximum water available.

2.5 PRESSURE MAINTENANCE (JOCKEY) PUMPS

- A. Pressure maintenance pumps shall not be required to be listed. Pressure maintenance pumps shall be approved.
 - 1. The pressure maintenance pump shall be sized to replenish the fire protection system pressure due to allowable leakage and normal drops in pressure.
- B. Pressure maintenance pumps shall have rated capacities no less than any normal leakage rate.
- C. Pressure maintenance pumps shall have discharge pressures sufficient to maintain the desired fire protection system pressure.
- D. Piping and components for pressure maintenance pumps:
 - 1. Steel pipe shall be used for suction and discharge piping on pressure maintenance pumps, which includes package prefabricated systems.
 - 2. Valves and components for the pressure maintenance pump shall not be required to be listed.
 - 3. An isolation valve shall be installed on the suction side of the pressure maintenance pump to isolate the pump for repair.
 - 4. A check valve and isolation valve shall be installed on the discharge pipe.
 - 5. Indicating valves shall be installed in such places as needed to make the pump, check valve, and miscellaneous fittings accessible for repair.
 - 6. The pressure sensing line for the pressure maintenance pump shall be sized in accordance with the requirements for pressure actuated controller pressure sensing lines.
 - 7. The isolation valves serving the pressure maintenance pump shall not be required to be supervised.
- E. The fire pump shall not be used as a pressure maintenance pump.
- F. The controller for a pressure maintenance pump shall be listed but shall not be required to be listed for fire pump service.
- G. The pressure maintenance pump shall not be required to have secondary or standby power.

PART 3 - EXECUTION

3.1 SYSTEM FLUSHING AND HYDROSTATIC TEST

- A. Flushing:
 - 1. Suction piping shall be flushed at a flow rate not less than indicated in Table 14.1.1.1 of NFPA 20 or at the hydraulically calculated water demand rate of the system, whichever is greater.
 - 2. Flushing shall occur prior to hydrostatic test.
 - 3. Where the maximum flow available from the water supply cannot provide the flow provided in Table 14.1.1.1 of NFPA 20, the flushing flow rate shall be the greater of one hundred (100) percent of the rated flow of the connected fire pump or the maximum flow demand of the fire protection system(s).
 - a. This reduced flushing flow capacity shall constitute an acceptable test, provided that the flow rate exceeds the fire protection system design and flow rate.
 - 4. Flushing is to be performed, witnessed, and signed off before connection to the suction piping is completed.
- B. Hydrostatic test:
 - 1. Suction and discharge piping shall be hydrostatically tested at not less than two hundred (200) psi or at fifty (50) psi more than the maximum pressure to be maintained in the system, whichever is greater.
 - 2. This pressure shall be maintained for two (2) hours.
 - 3. The installing contractor shall furnish a certificate for flushing and hydrostatic test prior to the start of the fire pump field acceptance tests.
 - 4. These certificates shall be as shown in Figure A.14.1.3(a) and Figure A.14.1.3(b) of NFPA 20.

3.2 FIELD ACCEPTANCE TESTS

- A. The pump manufacturer, the controller manufacturer, and the transfer switch manufacturer, or their factory-authorized representatives shall be present for the field acceptance tests.
- B. The date, time, and location of the field acceptance tests shall be coordinated with the authority having jurisdiction.
- C. All electrical wiring to the fire pump motor(s), including control inter-wiring, normal power supply, alternate power supply where provided, and jockey pump, shall be completed and checked by the electrical contractor prior to the initial startup and acceptance tests.
- D. Certified pump curve:
 - 1. A copy of the manufacturer's certified pump test characteristic curve shall be available for comparison of the results of the field acceptance tests.
 - 2. At all flow conditions, the fire pump as installed shall equal the performance as indicated on the manufacturer's certified shop test characteristic curve within the accuracy limits of the test equipment.
- E. The actual unadjusted fire pump discharge flows and pressures installed shall meet or exceed the fire protection system's demand.
- F. Field acceptance test procedures:
 - 1. The fire pump operation shall be in a manner as prescribed in NFPA 20.A.14.2.6 and as required by the manufacturer.
 - 2. Test equipment:

- a. Calibrated test equipment shall be provided to determine net pump pressures, rate of flow through the pump, volts and amperes for electric motor-driven pumps, and speed.
 - b. Calibrated test gauges shall be used and bear a label with the latest date of calibration.
 - 1) Gauges shall be calibrated a minimum of annually.
 - 2) Calibration of test gauges shall be maintained at an accuracy level of $\pm$ one (1) percent.
 - c. Requirements for personal protective equipment and procedures in accordance with NFPA 70E shall be followed when working near energized electrical or rotating equipment.
 3. Fire pump flow testing:
 - a. The fire pump shall perform at minimum, rated, and peak loads without objectionable overheating of any component.
 - b. Vibrations of the fire pump assembly shall not be of a magnitude to pose potential damage to any fire pump component.
 - c. The minimum, rated, and peak loads of the fire pump shall be determined by controlling the quantity of water discharged through approved test devices.
 - d. Where the maximum flow available from the water supply cannot provide a flow of one-hundred-fifty (150) percent of the rated flow of the pump, the fire pump shall be operated at the greater of one hundred (100) percent of rated flow or the maximum flow demand of the fire protection system(s) maximum allowable discharge to determine its acceptance.
 - 1) This reduced capacity shall constitute an acceptable test, provided that the pump discharge exceeds the fire protection system design and flow rate.
 4. Measurement procedure:
 - a. The quantity of water discharging from the fire pump assembly shall be determined and stabilized.
 - b. Immediately thereafter, the operating conditions of the fire pump and driver shall be measured.
 - c. Electric motor-driven units:
 - 1) For electric motors operating at rated voltage and frequency, the ampere demand on each phase shall not exceed the product of the full-load ampere rating times the allowable service factor as stamped on the motor nameplate.
 - 2) The voltage at the motor contactor output lugs shall not vary more than five (5) percent below or ten (10) percent above rated voltage during the test.
 5. The fire pump unit shall be started and brought up to rated speed without interruption under the conditions of a discharge equal to peak load.
 6. For electric motors, a test shall be performed to ensure that there is not a phase reversal condition in either the normal power supply configuration or from the alternate power supply.
- G. Controller acceptance tests:
1. Fire pump controllers shall be tested in accordance with the manufacturer's recommended test procedure.
 2. As a minimum, no fewer than six (6) automatic and six (6) manual operations shall be performed during the acceptance test.
 3. An electric-driven fire pump shall be operated for a period of at least five (5) minutes at full speed during each of the fire pump flow test operations.
 4. The automatic operation sequence of the controller shall start the pump from all provided starting features.

5. This sequence shall include pressure switches or remote starting signals.
 6. The selection, size, and setting of all overcurrent protective devices, including fire pump controller circuit breaker, shall be confirmed to be in accordance with NFPA 20.
 7. The fire pump shall be started once from each power service and run for a minimum of five (5) minutes.
 - a. Manual emergency operation shall be accomplished by manual actuation of the emergency handle to the fully latched position in a continuous motion. The handle shall be latched for the duration of this test run.
- H. Alternate power supply:
1. On installations with an alternate source of power and an automatic transfer switch, loss of primary source shall be simulated, and transfer shall occur while the pump is operating at peak load.
 2. Transfer from normal to alternate source and retransfer from alternate to normal source shall not cause opening of overcurrent protection devices in either line.
 3. At least half of the manual and automatic operations of controller acceptance tests shall be performed with the fire pump connected to the alternate source.
 4. If the alternate power source is a generator set required by NFPA 20.9.3.2, installation acceptance shall be in accordance with NFPA 110.
- I. Both local and remote signals and fire pump alarm conditions shall be simulated to demonstrate satisfactory operation.
- J. The fire pump shall be in operation for not less than one (1) hour total time during all the foregoing tests.

3.3 CENTRIFUGAL PUMP INSTALLATION

- A. Fittings:
1. Where necessary, the following fittings for the pump shall be provided by the pump manufacturer or an authorized representative:
 - a. Automatic air release valve.
 - b. Circulation relief valve.
 - c. Pressure gauges.
 2. Where necessary, the following fittings shall be provided:
 - a. Eccentric tapered reducer at suction inlet.
 - b. Hose valve manifold with hose valves.
 - c. Flow measuring device.
 3. Automatic air release:
 - a. Pumps that are automatically controlled shall be provided with a listed float-operated air release valve having a nominal one-half (0.5) inch minimum diameter discharged to atmosphere.
 - b. This requirement shall not apply to overhung impeller type pumps with top centerline discharge or that are vertically mounted to naturally vent the air.
- B. Foundation and setting:
1. Overhung impeller and impeller between bearings design pumps and driver shall be mounted on a common grouted base plate.
 2. Pumps of the overhung impeller close coupled inline type shall be permitted to be mounted on a base attached to the pump mounting base plate.
 3. The base plate shall be securely attached to a solid foundation in such a way that shaft alignment of the pump and driver is ensured.

4. The foundation shall be sufficiently substantial to form a permanent and rigid support for the base plate.
5. The base plate, with pump and driver mounted on it, shall be set level on the foundation.
- C. Connection to driver and alignment
 1. Coupling type:
 - a. Separately coupled-type pumps with electric motor drivers shall be connected by a flexible coupling or flexible connecting shaft.
 - b. All coupling types shall be listed for this service.
- D. Pump and drivers on separately coupled-type pumps shall be aligned in accordance with the coupling and pump manufacturers' specifications and the *Hydraulic Institute Standards for Centrifugal, Rotary, and Reciprocating Pumps*.

3.4 ELECTRIC DRIVE INSTALLATION

- A. Normal power:
 1. An electric motor-driven fire pump shall be provided with a normal source of power as a continually available source.
 2. The normal source of power and its routing shall be arranged in accordance with one of the following:
 - a. Service connection dedicated to the fire pump installation.
 - b. On-site power production facility connection dedicated to the fire pump installation.
 - c. Dedicated feeder connection derived directly from the dedicated service to the fire pump installation.
 - d. As a feeder connection where all the following conditions are met:
 - 1) The protected facility is part of a multi-building campus-style arrangement.
 - 2) A backup source of power is provided from a source independent of the normal source of power.
 - 3) It is impractical to supply normal power through previously listed means.
 - 4) The arrangement is acceptable to the authority having jurisdiction.
 - 5) The overcurrent protection device(s) in each disconnecting means is selectively coordinated with any other supply side overcurrent protection device(s).
 - e. Dedicated transformer connection directly from the service meeting the requirements of NFPA 70.
 3. For fire pump installations not using the arrangement of section 21 20 00.2.2.B.2.d, for the normal source of power, no more than one (1) disconnecting means and associated overcurrent protection device shall be installed in the power supply to the fire pump controller.
 - a. Where the disconnecting means is installed, the disconnecting means shall meet the following:
 - 1) They shall be identified as being suitable for use as service equipment.
 - 2) They shall be lockable in the closed position.
 - 3) They shall be located remote from other buildings by disconnecting means.
 - 4) They shall be located remote from other fire pump sources disconnecting means.
 - 5) They shall be marked "Fire Pump Disconnecting Means" in letters that are no less than one (1) inch in height and that can be seen without opening enclosure doors or covers.

- b. Where the disconnecting means is installed, a placard shall be placed adjacent to the fire pump controller stating the location of this disconnecting means and the location of any key needed to unlock the disconnect.
 - c. Where the disconnecting means is installed, the disconnect shall be supervised in the closed position by one of the following methods:
 - 1) Central station, proprietary, or remote station signal device.
 - 2) Local signaling service that will cause the sounding of an audible signal at a constantly attended location.
 - 3) Locking the disconnecting means in the closed position.
 - 4) Sealing of disconnecting means and approved weekly recorded inspections where the disconnecting means are located within fenced enclosures or in buildings under the control of the owner.
 - d. Where the overcurrent protection is installed, the overcurrent protection device shall be rated to carry indefinitely the sum of the locked rotor current of the largest pump motor and the full-load current of all the other pump motors and accessory equipment.
 - 1) Alternatively, compliance with the previous paragraph shall be based on an assembly listed for fire pump service complying with the following:
 - a) The overcurrent protection device shall not open within two (2) minutes at six hundred (600) percent full-load current.
 - b) The overcurrent protection device shall not open with a restart transient of twenty-four (24) times the full-load current.
 - c) The overcurrent protection device shall not open within ten (10) minutes at three hundred (300) percent full load current.
 - d) Trip point for circuit breakers is not field adjustable.
- B. Alternate power:
 - 1. Where provided, an alternate supply shall be arranged so that the power to the fire pump is not disrupted when overhead lines are de-energized for fire department connections.
- C. On-site standby generator systems:
 - 1. Power sources:
 - a. On-site standby generator systems shall comply with the voltage drop requirements of NFPA 20, and shall meet the requirements of Level 1, Type 10, Class X systems of NFPA 110.
 - b. The generator shall run and continue to produce rated nameplate power without shutdown or derate for alarms and warnings or failed engine sensors, except for overspeed shutdown.
 - c. The generator fuel supply capacity shall be sufficient to provide eight (8) hours of fire pump operation at one hundred (100) percent of the rated pump capacity in addition to the supply required for other demands.
 - 2. Automatic sequencing of the fire pumps shall be permitted in accordance with the sequencing of pumps requirements for electric drive controllers.
 - 3. Transfer of power to the fire pump controller between the normal supply and one alternate supply shall take place within the pump room.
 - 4. Protective devices installed in the on-site power source circuits at the generator shall allow instantaneous pickup of the full pump room load and shall comply with NFPA 70.
- D. Where fire pump wiring to or from a fire pump controller is routed through a junction box, the following requirements shall be met:
 - 1. The junction box shall be securely mounted.

2. Mounting and installation of a junction box shall not violate the enclosure type rating of the fire pump controller(s).
 3. Mounting and installation of a junction box shall not violate the integrity of the fire pump controller(s) and shall not affect the short circuit rating of the controller(s).
 4. As a minimum, Type 2, drip proof enclosure (junction box) shall be used. The enclosure shall be listed to match the fire pump controller enclosure type rating.
 5. Terminals, junction blocks, and splices, where used, shall be listed.
 6. A fire pump controller of fire pump power transfer switch, where provided, shall not be used as a junction box to supply other equipment, including a pressure maintenance (jockey) pump(s).
- E. Listed electrical circuit protective system to controller wiring:
1. Where single conductors (individual conductors) are used, they shall be terminated in a separate junction box.
 - a. The junction box shall be installed ahead of the fire pump controller, a minimum of twelve (12) inches beyond the fire-rated wall of floor bounding the fire zone.
 - b. Single conductors (individual conductors) shall not enter the fire pump enclosure separately.
 2. Where required by the manufacturer of a listed electrical circuit protective system, by NFPA 70, or by the listing, the raceway between a junction box and the fire pump controller shall be sealed at the junction box end as required and in accordance with the instructions of the manufacturer.
 3. Standard wiring between the junction box and the controller shall be considered acceptable.
- F. Raceway terminations:
1. Listed conduit hubs shall be used to terminate raceway (conduit) to the fire pump controller.
 2. The type rating of the conduit hub(s) shall be at least equal to that of the fire pump controller.
 3. The installation instructions of the manufacturer of the fire pump controller shall be followed.
 4. Alterations to the fire pump controller, other than conduit entry as allowed by NFPA 70, shall be approved by the authority having jurisdiction.
 5. Where the raceway (conduit) between the controller and motor is not capable of conducting ground fault current sufficient to trip the circuit breaker when a ground fault occurs, a separate equipment grounding conductor shall be installed between the controller and motor.

3.5 ELECTRIC DRIVE CONTROLLER INSTALLATION

- A. Location:
1. Controllers shall be located as close as is practical to the motors they control and shall be within sight of the motors.
 2. Controllers shall be located or protected so that they will not be damaged by water escaping from pumps or pump connections.
 3. The current-carrying parts of controllers shall be not less than twelve (12) inches above the floor level.
 4. Working clearances around controllers shall comply with NFPA 70.
- B. Power transfer for alternate power supply:
1. General:

- a. Manual transfer switches shall not be used to transfer power between the normal supply and the alternate supply to the fire pump controller.
- b. No remote device(s) shall be installed that will prevent automatic operation of the transfer switch.
- 2. Fire pump controller and transfer switch arrangements:
 - a. Individually listed fire pump controller and power transfer switch:
 - 1) A fire pump controller, a power transfer switch and a fire pump controller shall be provided.
 - 2) The transfer switch overcurrent protection for both the normal and alternate sources shall comply with NFPA 20.
 - 3) The transfer switch overcurrent protection shall be selected or set to indefinitely carry the locked rotor current of the fire pump motor where the alternate source is supplied by a second utility.
 - 4) An isolating switch ahead of the alternate source input terminals of the transfer switch shall meet the following requirements:
 - a) The isolating switch shall be lockable in the on position.
 - b) A placard shall be externally installed on the isolating switch stating, "Fire Pump Isolating Switch," with letters at least one (1) inch in height.
 - c) A placard shall be placed adjacent to the fire pump controller stating the location of the isolating switch and the location of the key (if the isolating switch is locked).
 - d) The isolating switch shall be supervised to indicate when it is not closed, by one of the following methods:
 - (1) Central station, proprietary, or remote station signal service.
 - (2) Local signaling service that will cause the sounding of an audible signal at a constantly attended point.
 - (3) Locking the isolating switch closed.
 - (4) Sealing of isolating switches and approved weekly recorded inspections where isolating switches are located within fenced enclosures or in buildings under the control of the owner.
 - e) This supervision shall operate an audible and visible signal on the transfer switch and permit monitoring at a remote point where required.
 - b. Each fire pump shall have its own dedicated transfer switch(es) where a transfer switch(es) is required.

END OF SECTION

SECTION 22 01 00

PLUMBING GENERAL REQUIREMENTS

PART 1-GENERAL

1.1 STIPULATIONS

- A. General provisions of the contract documents including general and supplementary conditions apply to all work in this division.
- B. The general conditions shall be carefully examined before proposals for any work are submitted. Division twenty-two shall not be interpreted as waiving or overruling any requirements expressed in the general conditions unless division twenty-two specifications contain statements more definitive or more restrictive.
- C. Nothing contained herein shall be so construed as to relieve the contractor from performing their work per the true intent and meaning of the contract drawings and specifications. The contractor will be held responsible for providing all materials and equipment and shall provide all labor necessary for the complete, prompt, and satisfactory execution of the work. The contractor is also responsible for the proper coordination of their work with all other trades.
- D. The contractor shall bear all expenses incidental to the satisfactory completion of the work contained in the contract drawings and specifications.

1.2 DEFINITIONS

- A. Where words and phrases used throughout the contract documents are not specifically defined below or in the reference standards, they shall be interpreted by the meanings given to them in the latest edition of the Merriam-Webster dictionary.
- B. Words and phrases used throughout the contract documents shall be interpreted as indicated below:
 - 1. Contractor: The person or organization awarded the contract for construction services. In the case of a construction project administered as a multiple-prime contract, the term shall be further defined as the contractor holding a prime contract for plumbing construction work.
 - 2. Others: A person or organization other than the contractor, owner, or professional.
 - 3. Owner: The person or organization that awards the construction contract, or their designated representative.
 - 4. Professional: The engineer of record.
 - 5. Provide: To furnish and install materials, equipment, or systems.
 - 6. Submittals: Industry standards, manufacturer's data, manufacturer's warranties, operation and maintenance instructions, shop drawings, and test reports.
 - 7. Work: All labor, materials, equipment, and services necessary and reasonably incidental to the proper completion and proper operation of the plumbing systems.

1.3 REFERENCES

- A. The contractor shall comply with all laws, ordinances, and regulations of all authorities having jurisdiction, including those of all applicable city, county, state, federal, and public utility entities. The contractor shall obtain all licenses, permits, etc. and shall pay all associated connection fees, tapping fees, inspection fees, etc. These costs shall be included in the contract price.
- B. The publications listed below form a part of this specification. All publications shall be the latest edition as adopted by the authority having jurisdiction at the date of bid advertisement.

The minimum standard of work under this contract shall be in accordance with the following model building codes or standards:

1. ASTM International:
 - a. ASTM C33 – Standard Specification for Concrete Aggregates.
 - b. ASTM C94 – Standard Specification for Ready-Mixed Concrete.
 - c. ASTM C150 – Standard Specification for Portland Cement.
 - d. ASTM C618 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
 - e. ASTM C989 – Standard Specification for Slag Cement for Use in Concrete and Mortars.
 - f. ASTM D1557 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³).
 - g. ASTM D1556 – Standard Test Method for Density and Unit Weight of Soil in Place by the Sand Cone Method.
2. International Building Code (IBC) with North Carolina Amendments:
 - a. North Carolina Building Code.
 - b. North Carolina Energy Conservation Code.
 - c. North Carolina Fire Prevention Code.
 - d. North Carolina Fuel Gas Code.
 - e. North Carolina Mechanical Code.
 - f. North Carolina Plumbing Code.
3. National Fire Protection Association:
 - a. NFPA 70 – National Electric Code.

1.4 SCOPE

- A. Domestic water systems: The domestic water systems shall be extended to all equipment and accessories, including those provided by others as determined in the construction contract. For systems with piping outside of the building, the systems shall be extended from a point five (5) feet beyond the exterior face of the building. Final installation at the point of utility connection shall be done by the contractor.
- B. Sanitary waste systems: The sanitary waste systems shall be extended to all equipment and accessories including those provided by others as determined in the construction contract. For systems with piping outside of the building, the systems shall be extended from a point five (5) feet beyond the exterior face of the building. Final installation at the point of utility connection shall be done by the contractor.
- C. Storm drainage systems: The storm drainage systems shall be extended to all equipment and accessories, including those provided by others as determined in the construction contract.
- D. Propane gas systems: The natural gas systems shall be extended to all equipment and accessories, including those provided by others as determined in the construction contract. For systems with piping outside of the building, the systems shall be extended from a point twelve (12) inches above the finish floor inside the building. Final installation at the point of utility connection shall be done by the contractor.

1.5 RELATED WORK

- A. All work related to providing complete plumbing systems and equipment shall be the responsibility of the contractor. The following related work shall be provided as indicated in other specification divisions:
 1. General contractor:
 - a. The contractor shall furnish access panels to the general contractor for installation.
 - b. The contractor shall furnish roof drains to the general contractor for installation.
The contractor shall make final connections to roof drains.

- c. The contractor shall make all final connections to the owner of the supplied equipment. The contractor shall be responsible for coordination of plumbing services with the equipment.
 - d. The contractor shall furnish and/or install casework mounted fixtures and equipment where not furnished and/or installed by others. Where fixtures and equipment are furnished by others, the contractor shall install these items in accordance with the contract drawings and specifications. Rough-in plumbing work shall be in accordance with rough-in drawings provided by others. The contractor shall make the final connections to all fixtures and equipment. The contractor shall be responsible for coordination of plumbing services with the fixtures and equipment.
 - e. The general contractor shall perform cutting and patching of exterior walls and roofs when necessary for the installation of the work.
 - f. Final painting of existing walls, floors, and ceilings where the surfaces are being refinished and remodeled under the general contract. The general contractor shall perform all required painting of piping provided by the contractor.
- 2. Electrical contractor:
 - a. Verification of the proper rotation of three-phase equipment, and any modifications required to correct improper rotation.
 - b. Installation of all combination starters/disconnects and overload protectors.
 - c. Installation of all line side junction boxes and/or receptacles servicing low voltage control transformers.
- 3. HVAC contractor:
 - a. Condensate drain piping associated with HVAC equipment.

1.6 QUALITY ASSURANCE

- A. The contractor shall become thoroughly familiarized with all specifications and drawings for the project such that they clearly understand their responsibility in relationship to the work to be performed. The contractor shall plan and perform their work to permit the use of the building as soon as possible.
- B. The contractor shall coordinate their work with that of the other trades. Where interference with other trades occurs, the contractor shall present their solution to the professional. The professional shall make the final decision regarding changes to be made in the work.
- C. The contractor is responsible for the proper installation of all materials and equipment required for a complete installation within the intent and meaning of the contract documents.
- D. The contractor shall expressly and completely follow the manufacturer's instructions required for validation of the manufacturer's warranty, including but not limited to service, maintenance, and adjustment of the equipment.
- E. The contractor shall guarantee all work, materials, and equipment furnished against defects, leaks, performance, and nonoperation for a period of one (1) year after the date of the owner's final acceptance, or as indicated in the general conditions. Defects shall be interpreted as defective materials or equipment or unsatisfactory installation and are not intended to apply to ordinary wear and tear. The contractor shall pay for any repairs or replacements caused by these defects within the period covered by the guarantee, including all incidental work required to fix the deficiency.

1.7 MATERIALS

- A. Each length of pipe and each pipe fitting, trap, fixture, material, and device utilized in all plumbing systems shall bear the identification of the manufacturer and the applicable standard to which it was manufactured.

- B. All plumbing products and materials shall comply with the referenced standards, specifications, and performance criteria of the contract documents. Where required, plumbing products and materials shall either be tested by an approved third-party testing agency or certified by an approved third-party certification agency.
- C. All piping materials exposed within plenums shall comply with the provisions of the North Carolina Mechanical Code.
- D. Equipment efficiencies shall be in accordance with the North Carolina Energy Conservation Code.
- E. Solders with lead content exceeding two-tenths (0.2) percent are prohibited. Brass and bronze materials with lead content of two (2) percent or greater are prohibited.
- F. Provide products requiring electrical connections listed and classified by Underwriters Laboratories Inc. (UL), as suitable for the purpose specified and indicated.

1.8 FIELD MEASUREMENTS

- A. The contractor is responsible for verifying the location of all existing underground utilities near their work. When it has been indicated that these utilities are to remain in place, the contractor shall provide adequate means of support and protection during excavation operations.
- B. Before ordering any equipment and material or performing any work, the contractor shall verify all measurements and dimensions at the job site. The contractor is responsible for the correctness of this information.
- C. Any difference identified by the contractor shall be submitted to the professional for consideration before proceeding with the work.
- D. No extra compensation will be considered based on differences between actual dimensions or measurements and those indicated on the drawings.

1.9 PROTECTION OF UTILITIES

- A. All existing service utilities shall remain active during construction. Any service underground, aboveground, interior, or exterior that is damaged, broken, or otherwise rendered inoperative during construction due to activities on the part of the contractor shall be properly repaired by the contractor at their own expense. The method used in repairing, replacing, or maintaining the services shall be submitted to the professional for review and approval.
- B. Ashes, cinders or rags; flammable, poisonous or explosive liquids or gases; oil, grease or any other insoluble material capable of obstructing, damaging or overloading the building drainage or sewer system, or capable of interfering with the normal operation of the sewage treatment process or private disposal system, shall not be deposited into such systems.

1.10 INTERRUPTION OF UTILITIES

- A. The contractor shall schedule their work to avoid interruption of any utility services.
- B. Existing utilities serving occupied facilities shall not be interrupted, except when such interruptions have been authorized by the owner. Interruptions may occur only after acceptable temporary utility services have been provided. The contractor shall provide a minimum of ten (10) working days' notice to them and receive written notice to proceed before interrupting any utility.

1.11 STRUCTURAL SAFETY

- A. The work shall be installed with due regard to preservation of the strength of structural members and prevention of damage to wall and other surfaces through fixture usage.
- B. In the process of installing or repairing any part of a plumbing system, the finished floors, walls, ceilings, tile work, or any other part of the building or premises that must be changed or replaced shall be left in a safe structural condition in accordance with the North Carolina Building Code.

- C. The cutting, notching, and boring of holes in structural steel framing members shall be as prescribed by the structural engineer.
- D. Flanges and lips of load-bearing cold-formed steel framing members shall not be cut or notched. Holes in webs of load-bearing cold-formed steel framing members shall be permitted along the centerline of the web of the framing member and shall not exceed the dimensional limitations, penetration spacing, or minimum hole edge distance as prescribed by the structural engineer. Cutting, notching, and boring holes of steel floor or roof decking shall be as prescribed by the structural engineer.
- E. Flanges and lips of nonstructural cold-formed steel wall studs shall not be cut or notched. Holes in webs of nonstructural cold-formed steel wall studs shall be permitted along the centerline of the web of the framing member, shall not exceed one-and-one-half (1-1/2) inches in width or four (4) inches in length, and the holes shall not be spaced less than twenty-four (24) inches center to center from another hole or less than ten (10) inches from the bearing end.
- F. Truss members and components shall not be cut, drilled, notched, spliced, or otherwise altered in any way without written concurrence and approval of the structural engineer. Alterations resulting in the addition of loads to any member shall not be permitted without verification that the truss can support such additional loading.
- G. Trenches installed parallel to footings shall not extend below the forty-five (45) degree bearing plane of any footing or foundation wall.

1.12 RODENTPROOFING

- A. All strainer plates on drain inlets shall be designed and installed so that all openings are not greater than one-half (1/2) inch in least dimension.
- B. Where openings have been made in walls, floors, or ceilings for the passage of pipes, such openings shall be closed and protected by the installation of approved metal collars or other approved materials that are securely fastened to the adjoining structure.
- C. Annular spaces around pipes, electric cables, conduits, or other openings in the foundation or exterior walls shall be protected against the passage of rodents by closing such openings with cement mortar, concrete masonry, silicone caulking, or noncorrosive metal.

1.13 PROTECTION OF WORK

- A. Plumbing systems shall not be in an elevator shaft or in an elevator equipment room. Floor drains, sumps, and sump pumps shall be permitted at the base of an elevator shaft when intended for the specific purpose of dewatering and are installed in accordance with the contract documents.
- B. Pipes passing through or under walls shall be protected from breakage.
- C. Piping shall be installed to prevent strains and stresses that exceed the structural strength of the pipe. Where necessary, provisions shall be made to protect piping from damage resulting from expansion, contraction, and structural settlement.
- D. Any pipe that passes within twelve (12) inches under a footing or through a foundation wall shall be provided with a relieving arch, or a pipe sleeve pipe shall be built into the foundation wall. The sleeve shall be two (2) pipe sizes greater than the pipe passing through the wall. Piping shall not be run under pier footings.
- E. The top of water pipes, installed below grade outside the building, shall be below the frost line or a minimum of twelve (12) inches below finished grade, whichever is greater. Water pipes installed in a wall exposed to the exterior shall be installed on the heated side of the wall insulation. Water piping installed in an unconditioned space shall have insulation with a minimum R-factor of six-and-one-half (6.5) determined at seventy-five (75) degrees Fahrenheit in accordance with ASTM C177.
- F. No traps of soil or waste pipe shall be installed or permitted outside of a building, or concealed in outside walls, or in any place where they may be subjected to freezing temperatures, unless

adequate provision is made to protect them from freezing. Waste and soil piping leaving the building shall have a minimum cover of three (3) inches.

- G. In concealed locations where piping, other than cast iron or galvanized steel, is installed through holes or notches in studs, joists, rafters, or similar members less than one-and-one-half (1-1/2) inches from the nearest edge of the member, the pipe shall be protected by steel shield plates. Such shield plates shall have a thickness of not less than sixteen (16) gauge. Such plates shall cover the area of the pipe where the member is notched or bored and shall extend a minimum of two (2) inches above sole plates and below top plates.
- H. Components of plumbing systems installed along alleyways, driveways, parking garages, or other locations exposed to damage shall be recessed into the wall or otherwise protected in an approved manner.
- I. At their own expense, the contractor shall protect their work, materials, or equipment that is subject to damage during the project duration. All openings into any piping, ducts, or equipment shall be securely covered, or otherwise protected, to prevent injury due to carelessly or maliciously dropped tools or materials, grit, dirt, or any foreign material. The contractor is responsible for all damage until their work is fully and finally accepted.
- J. The use of plumbing fixtures prior to final acceptance by the owner is prohibited.

1.14 CHASES AND OPENINGS

- A. All chases and openings required for the installation of the work shall be coordinated with the work of other trades. The contractor shall provide the other trades with sufficient time for coordination of all chases and openings. The contractor shall be responsible for cutting and patching all openings in floors, walls, and ceilings necessary for their work.
- B. The contractor shall provide all sleeves, hangers, and anchors required for installation of the work in chases and openings.
- C. Pipes passing through concrete or cinder walls and floors or other corrosive material shall be protected against external corrosion by a protective sheathing or wrapping or other means that will withstand any reaction from the lime and acid of concrete, cinder, or other corrosive material. Sheathing or wrapping shall allow for movement including expansion and contraction of piping. Minimum wall thickness of material shall be twenty-five-one-thousandths (0.025) inch.
- D. Annular spaces between sleeves and pipes shall be filled in an approved manner. Annular spaces between sleeves and pipes in fire-resistance-rated assemblies shall be fire stopped in accordance with specification section 22 05 32.
- E. Joints at the roof and around vent pipes shall be made water-tight by lead, copper, galvanized steel, aluminum, plastic, or other approved flashings or flashing material. Exterior wall openings shall be made watertight.

1.15 MISCELLANEOUS STEEL AND ACCESSORIES

- A. The contractor shall provide all necessary steel angles, channels, pipes, rods, nuts, bolts, etc. as shown on plans, as specified, or as may be required for the complete and proper installation of plumbing fixtures, systems, and equipment. All material and workmanship shall be of the best quality and shall be installed in accordance with the best practices of the trade.

1.16 CROSS CONNECTION CONTROL

- A. The contractor shall coordinate water service requirements in accordance with the local water utility regulations, including required permits, backflow preventers, meters, piping, valves, bypasses, supports, and other accessories.
- B. Where these services are provided by others, the contractor shall verify that they are complete and have been inspected prior to making final connection(s).

1.17 CLEANUP

- A. The contractor shall provide containers for collection of waste materials, debris, and rubbish. Waste materials, debris, and rubbish shall be removed from the job site and legally disposed of at a landfill area in accordance with all applicable regulations. Burning or burying waste materials, debris, or rubbish on project site is not permitted.
- B. The contractor shall maintain buildings, grounds, and public properties free from accumulations of waste materials, debris, and rubbish. At reasonable intervals during the progress of work, and when directed by the owner, the site and public properties shall be cleaned, and waste materials, debris, and rubbish disposed of in an appropriate manner.
- C. At the completion of the project, the contractor shall remove waste materials, rubbish, tools, equipment, machinery, surplus materials, etc., and clean all sight-exposed plumbing fixtures and equipment; remove grease, dust, dirt, stains, labels, fingerprints, and other foreign materials from sight-exposed plumbing fixtures and equipment; broom clean paved and concrete surfaces; rake clean other ground surfaces; repair, patch, and touch-up marred surfaces to the specified finish or to match adjacent surfaces.

1.18 PROJECT CLOSEOUT DOCUMENTATION

- A. Changes from the contract documents necessary to coordinate the work with other trades, to conform to the building conditions, or to conform to the rules and regulations of authorities having jurisdiction shall be made only after obtaining written permission from the professional.
- B. The contractor shall keep a record of construction changes and deviations from the original contract documents. All changes shall be recorded on a separate set of prints, which shall be kept at the job site specifically for that purpose. The record shall be made immediately after the work is completed. Documentation shall include:
 - 1. Location and elevation of new utility lines.
 - 2. Changes in pipe size and routing location.
 - 3. Valve locations.
 - 4. Equipment locations.
 - 5. Actual capacities and values of equipment provided as indicated in equipment schedules or specifications.
- C. The marked-up record set of construction documents shall be delivered to the professional before final acceptance of the work.
- D. The contractor shall deliver operation and maintenance manuals per section 22 01 05 to the professional before instruction of the owner and after final acceptance of the work.

1.19 INSTRUCTION OF THE OWNER

- A. After acceptance of the project, the contractor shall provide the services of personnel thoroughly familiar with the completed installation to instruct the owner in the proper operation and maintenance of all equipment and appurtenances provided.
- B. The contractor shall provide the owner with ten (10) business days' notice before the instruction session(s).

PART 2 - PRODUCTS

2.1 ACCESS PANELS

- A. The contractor shall furnish access doors to the general contractor for installation in ceilings, walls, partitions, and floors for access to valves, traps, fittings, and all appurtenances.
- B. Access panels shall be of sufficient size to permit removal or access to equipment, except that the minimum size shall be twelve (12) by sixteen (16) inches.

- C. Access door locations shall be as determined by field conditions for optimum access to equipment and shall be reviewed by the professional before final installation. Access door locations shall be subject to the following:
 - 1. Bottom of access doors shall not be lower than the top of the partition base, or a minimum of six (6) inches above floor.
 - 2. The tops and/or sides of access panels shall be a minimum of six (6) inches from the ceiling or opening of from the edge of a wall.
- D. Access doors shall be suitable for installation in the finish material of the ceilings, walls, partitions, and floors.
- E. Frame and panel access doors in restrooms, kitchens, and as indicated shall be stainless steel.
- F. Access doors with Underwriters' Laboratories (UL) listing shall be provided in fire-rated construction assemblies. Access doors shall be "B-Label" and shall have a UL rating for both door and frame matching that of the wall in which it is installed. Maximum size shall be twenty (20) inches by twenty (20) inches or four hundred (400) square inches in area. The frame shall be sixteen (16) gauge minimum steel, panel shall be twenty (20) gauge minimum steel.
- G. Access doors without UL label shall be provided in all non-fire-rated construction assemblies. Frames shall be sixteen (16) gauge minimum steel, panel shall be fourteen (14) gauge minimum steel.
- H. Access doors shall be provided with a baked-on enamel finish (prime coat), continuous type hinge on one side, flush-face type lock with key operation, and self-latching cylinder locks.
- I. Door shall open one-hundred-seventy-five (175) degrees minimum.
- J. All access doors shall be keyed alike.

2.2 CONCRETE

- A. Concrete shall be as follows:
 - 1. Cementitious materials: Use the following cementitious materials of the same type, brand, and source throughout:
 - a. Portland cement: ASTM C150, Type I; supplement with the following:
 - 1) Fly ash: ASTM C618, Class F.
 - 2) Ground granulated blast-furnace slag: ASTM C989, Grade 100 or 120.
 - 2. Normal-weight aggregates: ASTM C33; uniformly graded, with maximum coarse-aggregate size of one (1) inch.
 - 3. Water: ASTM C94; potable.
- B. Reinforcing shall conform to ASTM A615, Grade 60. Concrete exposed to freezing and thawing, salts, sulfates, and corrosion shall comply with the NC Building Code.
- C. All concrete shall be of minimum three thousand (3,000) pounds per square inch (psi) strength in twenty-eight (28) days.

PART 3-EXECUTION

3.1 GENERAL

- A. The contract documents are diagrammatic and are indicative of the work to be performed. It is not intended that they show every pipe, fitting, offset, change in direction, or appurtenance required for a complete installation.
- B. All materials used shall be installed in strict accordance with the standards under which the materials are accepted and approved. In the absence of such installation procedures, the manufacturer's installation instructions shall be followed.

3.2 EXCAVATION, BACKFILLING, COMPACTION, AND RESURFACING

- A. General:
 - 1. The contractor shall notify "ONE CALL" prior to any work.

2. The contractor shall perform all excavation, backfilling, compaction, and necessary finishing for all piping, equipment, and accessories. Piping installation shall be in accordance with local water, sewer, and gas utility regulations and applicable state and local codes.
 3. The contractor shall provide all bracing, sheathing, and shoring necessary to perform and protect their excavations. The contractor shall provide safety rails, lights, signs, etc. as necessary or required for safety, or as required to conform to governing codes and laws.
 4. The contractor shall provide, maintain, and operate pumping equipment of sufficient capacity to ensure that all their excavations and trenches are kept free of water.
 5. The contractor shall protect existing structures, utilities, sidewalks, pavements, and other facilities not indicated for removal from damage caused by settlement, lateral movement, undermining, washout, and other hazards from excavation operations.
 6. Existing utility lines shown on the contract documents do not indicate the exact location of the lines. The location and depth of all utilities shall be marked and recorded prior to any excavation. Should uncharted or incorrectly charted piping or other utilities be uncovered during excavation, the contractor shall contact the professional immediately for directions before proceeding further with work in this area.
 7. All surfaces of streets, walkways, seeded areas, or finished grade areas disturbed by the excavation shall be restored to their original condition and/or as indicated in the contract documents.
 8. The presence of explosives on the project site or the use of explosives in the execution of the work under this contract is prohibited.
 9. Buried piping shall be supported throughout its entire length.
- B. Trenching and bedding:
1. All plumbing excavation is unclassified.
 2. If trench excavation operations are performed when the atmospheric temperature is less than thirty-five (35) degrees Fahrenheit, the contractor shall provide cold weather protection as required to protect excavated trench bottoms from freezing. Piping shall not be placed in a trench containing water or on a subgrade containing frost.
 3. Take up and relay pipe that is not laid true to required alignment or grade. Pipe that has had its joints disturbed after installation shall be taken up and relayed. Deviation from the required lines and grades will not be permitted unless approved by the professional.
 4. Trenches shall be dug to uniform width not less than twelve (12) inches and not more than sixteen (16) inches wider than the bell diameter of the piping. Trench sides shall be vertical. Carry depth of trenches for piping as required to establish required slopes and invert elevations. Beyond building perimeter, keep bottom of trenches sufficiently below finished grade to protect against frost. The bottom of trenches shall be accurately graded to provide uniform and smooth flow throughout.
 5. Where trenches are excavated such that the bottom of the trench forms the bed for the pipe, solid and continuous load-bearing support shall be provided between joints. Bell holes, hub holes, and coupling holes shall be provided at points where piping is joined. Such pipe shall not be supported on blocks to grade.
 6. Where trenches are excavated below the installation level of the pipe such that the bottom of the trench does not form the bed for the pipe, the trench shall be backfilled to the installation level of the bottom of the pipe with sand or fine gravel placed in layers of six (6) inches maximum depth and such backfill shall be compacted after each placement.
 7. Where rock is encountered in trenching, the rock shall be removed to a minimum of three (3) inches below the installation level of the bottom of the pipe, and the trench shall be backfilled to the installation level of the bottom of the pipe with sand tamped in place to provide uniform load-bearing support for the pipe between joints. The pipe, including joints, shall not rest on rock at any point.

8. If soft materials of poor load-bearing quality are found at the bottom of the trench, stabilization shall be achieved by over-excavating a minimum of two (2) pipe diameters and backfilling to the installation level of the bottom of the pipe with fine gravel, crushed stone, or a concrete foundation. The concrete foundation shall be bedded with sand tamped into place to provide uniform load-bearing support for the pipe between joints.
 9. All underground piping shall be laid on first class granular bedding. The bedding shall be a minimum depth of six (6) inches or one-fourth (1/4) the pipe diameter, whichever is greater. The bedding shall provide uniform longitudinal support to the pipe and shall be laid to provide the grade and line as shown on the drawings or as directed by the professional. Hand-tamp the embedment materials under the haunches and around the pipe to the spring-line of the pipe to a compaction density of ninety-five (95) percent. Final embedment for ferrous pipe materials shall extend from the spring-line of the pipe to a depth of six (6) inches minimum above the top of the pipe. Final embedment for nonmetallic pipe shall extend from the spring-line of the pipe to a depth of eighteen (18) inches minimum above the top of the pipe.
- C. Backfilling:
1. Backfilling shall not be undertaken until all tests and inspections have been made.
 2. When the type of backfill material is not indicated on the plans or is not specified, the excavated material may be used, provided such material consists of loam, clay, sand, gravel, or other material that is suited for backfilling. From one (1) foot above the top of the pipe to subgrade, material containing stones greater than three (3) inches in their greatest dimension may not be used.
 3. Backfill shall be free from discarded construction material and debris. Loose earth free from rocks, broken concrete and frozen chunks shall be placed in the trench in six (6) inch layers and tamped in place until the crown of the pipe is covered by twelve (12) inches of tamped earth. The backfill under and beside the pipe shall be compacted for pipe support. Backfill shall be brought up evenly on both sides of the pipe so that the pipe remains aligned.
 4. Backfill trenches to a depth of twelve (12) inches above the top of the outside barrel of the pipe. Continue thereafter with the backfill in twelve (12) inch lifts.
- D. Compaction:
1. Compaction shall be accomplished by approved equipment suited to the soil being compacted. Material shall be moistened or aerated as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used.
 2. Compacting of this backfill by puddling or jetting will not be permitted. Use mechanical tampers to compact backfill materials in trench refill operations to produce a density of backfill at the bottom of each layer of not less than ninety-five (95) percent of the maximum density obtained at optimum moisture content, in accordance with ASTM D1557, method D and ASTM D1556, sand cone method.
 3. The use of specialty equipment for compaction of backfill is prohibited.
- E. Resurfacing:
1. All trench backfill shall be brought to subgrade, ready for base material or topsoil. After the initial aggregate backfill layer has been placed, refill the remainder of the trench using backfill materials as follows:
 - a. Lawns: Successive six (6) inch layers of clean earth backfill material shall be deposited after initial aggregate backfill. This backfill shall consist of excavated material free from large clods of earth and stone. If stones greater than three (3) inches are encountered, remove stones from the site and haul in clean earth backfill. The entire trench shall be uniformly tamped after each successive layer is

deposited. Replace topsoil to its original depth and crown to such height as required.

- b. Walks and parking areas: Clean earth backfill compacted in six (6) inch layers to a depth of eight (8) inches below the adjacent existing surfaces. Refill the remaining eight (8) inches with compacted stone and replace walk or paving as required.
- c. Paved areas: When working within the right-of-way limits of all state highways, backfilling must be in accordance with the requirements of the State Department of Transportation. Trenches located within the areas described above shall be backfilled with aggregate material from the top of the pipe bedding to the bottom elevation of the pavement structure and must be spread and compacted in layers not to exceed four (4) inches when using a mechanical damper. The contractor is to understand that payment for special backfilling material shall not be made unless specifically provided in the form of a proposal.

3.3 CONCRETE

- A. All concrete shall be mixed by machine.
- B. No wet or moistened mixture containing cement shall remain unplaced for a period exceeding thirty (30) minutes and shall not be used after its initial set. Tempering after initial set is prohibited.
- C. Exposed surfaces shall be protected from drying for at least seven (7) days.
- D. All forms shall be built true and rigid. Form removal shall not injure the concrete.
- E. All concrete is to be finished with a hard, smooth troweled finish and is to be faced smooth with rounded corners.

3.4 INSPECTION AND TESTING

- A. General:
 - 1. New plumbing systems and parts of existing systems, which have been altered, extended, or repaired, shall be tested to disclose leaks and defects.
 - 2. The contractor shall notify the professional a minimum of five (5) working days prior to testing to coordinate the testing and inspection procedures.
 - 3. The contractor shall provide all equipment, material, labor, etc. required for testing the plumbing systems.
 - 4. All new, altered, extended, or replaced plumbing systems shall be left uncovered and unconcealed until it has been inspected, tested, and accepted by the professional. Where such work has been concealed before it has been inspected, tested, and accepted, it shall be uncovered by the contractor at their own expense as directed by the professional.
 - 5. If the professional determines that the plumbing systems do not pass the prescribed tests, the contractor shall be required to make the necessary repairs at their own expense. The contractor shall inspect and retest the systems. Repairing, inspection, and testing shall be continued until all systems pass as determined by the professional.
- B. Test gauges:
 - 1. Tests requiring a pressure of ten (10) psi or less shall utilize a testing gauge having increments of one-tenth (0.1) psi or less.
 - 2. Tests requiring a pressure of greater than ten (10) psi but less than or equal to one hundred (100) psi shall utilize a testing gauge having increments of one (1) psi or less.
 - 3. Tests requiring a pressure of greater than one hundred (100) psi shall utilize a testing gauge having increments of two (2) psi or less.

END OF SECTION

SECTION 22 01 05

PLUMBING SUBMITTAL REQUIREMENTS

PART 1- GENERAL

1.1 STIPULATIONS

- A. General provisions of the contract documents including general and supplementary conditions apply to all work in this division.
- B. Submittals shall be made in separate packages containing all the required documentation indicated in each specification section. Only one (1) submittal package shall be made for each specification section. Partial submissions will not be addressed.
- C. Failure of the contractor to provide a complete submittal package may result in delay in processing time. All such delays to the project resulting from the contractor's failure to provide submittals in a timely fashion will be the responsibility of the contractor.

1.2 DEFINITIONS

- A. Industry standard: Printed copies of the current standards recognized in the industry. Current means the latest issue as of the date of these specifications; within the text of these specifications the date suffix frequently shown with identification numbers has been omitted.
- B. Manufacturer's data: Product manufacturer's standard printed product information, including promotional brochures, product specifications, installation instructions and diagrams, statements of compliance with standard performance charts or curves, and similar information concerning the standard portions of manufacturer's products.
- C. Manufacturer's warranty: Manufacturer's standard printed commitment about a specific product and normal application, stating that certain acts of restitution will be performed for the purchaser or owner by the manufacturer, when and if the product fails within certain operational conditions and time limits.
- D. Operation and maintenance instructions: The written instructions by the manufacturer, fabricator, or installer of equipment or systems, detailing the procedures to be followed by the owner in operation, control, and shutdown of each operating item of the equipment.
- E. Shop drawings: Project shop drawings and other data prepared specifically for fulfillment of the project requirements. Shop drawings include fabrication, layout, setting, installation, coordination, and similar drawings and diagrams, and include performance data associate therewith, including weights, capacities, speeds, outputs, consumption, efficiencies, voltages, amperages, cycles, phases, noise levels, operating ranges, and similar information.
- F. Test reports: Specific reports prepared by independent testing laboratories and others, showing the results of specified testing on either the material or equipment provided or on identical material or equipment.

1.3 SUBSTITUTIONS

- A. Submittals are not opportunities for gaining acceptance of substitutions. Where three or more manufacturers are specified by name or by catalog reference, the contractor shall select for use any of those so specified.
- B. Should the contractor desire to substitute another manufacturer's equipment for one specified by name, the contractor shall apply in writing at least ten (10) business days prior to bid date for such permission. The contractor shall provide supporting data for the professional's consideration. No substitution shall be made for any material, article, or process under the contract unless approved by the professional.

- C. Any time that is required by the professional for a request to review submittals for substitute equipment after the award of bids will be billed to the contractor at the professional's current hourly billing rate. The professional's review time will be billed to the contractor whether the proposed substitution is accepted or rejected.

1.4 SUBMITTAL FORM AND PROCEDURES

- A. Submittals shall be assembled as single-file electronic submittals. Transmittals shall be included within the file as the first page.
- B. Submittals shall be made in separate packages containing all the required documentation indicated in each specification section. A separate submittal package shall be made for each specification section.
- C. Submittals shall be complete and clearly identified and cross-referenced to the appropriate specification section defining the submitted item.
- D. After checking and verifying all field measurements, the contractor shall submit copies of all submittals to the professional for review. The data shown on the submittals shall be complete with respect to dimensions, design criteria, materials of construction, and the like to enable the professional to review the information as required.
- E. The contractor shall stamp the submittals and verify by signature that the submittals have been checked for compliance with the contract documents and appropriate means have been taken to ensure that the material or equipment will fit into the space available.
- F. At the time of each submission, the contractor shall in writing call the professional's attention to any deviations that the submittal may have from the requirements of the contract documents.
- G. The submittals shall be clearly marked indicating which specific options are being considered and with all related information.
- H. The professional's review of submittals is for general conformance with design concept only. Corrections or comments made on the submittals during review do not relieve the contractor from compliance with requirements of the contract documents.
- I. The contractor is responsible for all quantities, dimensions, and coordination of the work of all trades. The contractor is responsible for selecting fabrication processes and techniques of construction and for performing all work in a safe and satisfactory manner.
- J. No work requiring a submittal shall be commenced until the submittal has been reviewed by the professional.
- K. A copy of each approved submittal shall be kept in good order by the contractor and shall be made available at the site.

1.5 OPERATION AND MAINTENANCE MANUALS

- A. Submit after final inspection for review by the professional.
- B. The contents of the submittal shall be prepared as follows:
 - 1. Table of contents.
 - 2. A directory listing names, addresses, and telephone number of professional, contractor, subcontractors, and equipment suppliers.
 - 3. Project documents and certificates:
 - a. Certificates of compliance.
 - b. Photocopies of warranties and bonds.
 - c. Material safety data sheets (MSDS).
 - 4. Operation and maintenance instructions subdivided by specification section. For each item, identify the following:
 - a. Significant design criteria.
 - b. List of equipment.
 - c. Parts list for each component.
 - d. Maintenance instructions for equipment and systems.

- e. Maintenance instructions for finishes including recommended cleaning methods and materials and operating instructions.
 - f. Special precautions identifying detrimental agents.
 - g. Special requirements of other sections of this specification noted to be included in the operation and maintenance manual.
- C. Submit five (5) copies for review by the owner ten (10) business days prior to owner training.

END OF SECTION

SECTION 22 05 29

HANGERS AND SUPPORTS FOR PLUMBING SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Pipe hangers and supports.
 - 2. Flashing.
 - 3. Sleeves.
 - 4. Mechanical sleeve seals.

1.2 REFERENCES

- A. Manufacturers Standardization Society:
 - 1. MSS SP 58 – Pipe Hangers and Supports – Materials, Design, Manufacture, Selection, Application, and Installation.

1.3 SUBMITTALS

- A. Refer to specification section 22 01 05 for submittal requirements, definitions, and procedures.
- B. Submit manufacturer's data for the following:
 - 1. Pipe hangers and supports.
 - 2. Flashing.
 - 3. Sleeves.
 - 4. Mechanical sleeve seals.
- C. Submit shop drawings indicating the following:
 - 1. Details of pipe hanger and support methods.
 - 2. Hanger layout with critical dimensions, sizes, and pipe hanger and support locations and types.

1.4 OPERATION AND MAINTENANCE MANUALS

- A. Refer to specification section 22 01 05 for submittal requirements, definitions, and procedures.
- B. Submit manufacturer's data, manufacturer's warranties, and operation and maintenance instructions for the following:
 - 1. Pipe hangers and supports.
 - 2. Flashing.
 - 3. Sleeves.
 - 4. Mechanical sleeve seals.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

- A. Conform to applicable portions of MSS SP 58.
- B. Provide copper or copper-plated supports for copper piping.
- C. Design hangers for pipe movement without disengagement of supported pipe.
- D. Obtain permission from the professional before using powder-actuated anchors.
- E. Suspended supports:
 - 1. Two (2) inches or less: Carbon steel, adjustable swivel, split ring.
 - 2. Two (2) to four (4) inches: Carbon steel, adjustable, clevis.

- 3. Six (6) inches or more: Adjustable steel yoke, cast iron pipe roll, and double hanger.
 - 4. Trapeze hangers: Steel channels with welded supports or spacers and hanger rods.
- F. Wall supports:
 - 1. Three (3) inches or less: Cast iron hooks.
 - 2. Four (4) inches to six (6) inches: Welded steel bracket and wrought steel clamps.
 - 3. Six (6) inches or more: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast-iron pipe roll.
- G. Floor supports:
 - 1. Four (4) inches or less: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 - 2. Six (6) inches or more: Adjustable cast iron pipe roll and stand, steel screws, and concrete pier or steel support.
- H. Vertical supports: Steel riser clamp.
- I. Hanger rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.
- J. Hangers, anchors, and supports shall support the piping and the contents of the piping. Hangers and strapping material shall be approved material that will not promote galvanic action.

2.2 FLASHING

- A. Metal flashing: twenty-six (26) gauge galvanized steel.
- B. Metal counterflashing: twenty-two (22) gauge galvanized steel.
- C. Lead flashing:
 - 1. Waterproofing: five (5) lb./ft² sheet lead.
 - 2. Soundproofing: one (1) lb./ft² sheet lead.
- D. Flexible flashing: forty-seven (47) mil sheet butyl; compatible with roofing.
- E. Caps: Twenty-two (22) gauge steel.

2.3 SLEEVES

- A. Non-fire-rated floors: Eighteen (18) gauge galvanized steel.
- B. Non-fire-rated beams, walls, footings, and potentially wet floors: Steel pipe or eighteen (18) gauge galvanized steel.
- C. Sealant: Acrylic.

2.4 MECHANICAL SLEEVE SEALS

- A. Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

PART 3 - EXECUTION

3.1 PIPE HANGER AND SUPPORT INSTALLATION:

- A. Conform to applicable portions of MSS SP 58.
- B. Hangers and anchors shall be attached to the building construction in an approved manner.
- C. Piping bundles for manifold systems shall be supported at changes in direction in accordance with the manufacturer's installation instructions. Hot and cold-water piping shall not be grouped in the same bundle.
- D. Bases of stacks shall be supported by the building structure, virgin or compacted earth, or other material suitable to support the weight of the piping.

- E. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- F. Use hangers with one-and-one-half (1-1/2) inch minimum vertical adjustment.
- G. Provide clearance in hangers and from structure and other equipment for installation of insulation. Refer to specification section 22 07 00.
- H. Install hangers with minimum one-half (1/2) inch space between finished covering and adjacent work.
- I. Place hangers within twelve (12) inches of each horizontal elbow.
- J. Where piping is installed in parallel and at same elevation, provide trapeze hangers.
- K. Support horizontal cast iron pipe adjacent to each hub.
- L. Support vertical piping independently of connected horizontal piping.
- M. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
- N. Piping shall be supported in accordance with the following:

PIPING MATERIAL	MAXIMUM HORIZONTAL SPACING (ft)	MAXIMUM VERTICAL SPACING (ft)	HANGER ROD DIAMETER (in)
Cast Iron Pipe	5 ^[1]	15	5/8
Copper or Copper-Alloy Pipe	12	10	1/2
Copper or Copper-Alloy Tubing (less than 1-1/2")	6	10	1/2
Copper or Copper-Alloy Tubing (more than 1-1/4")	10	10	1/2

1. The maximum horizontal spacing of cast iron pipe hangers shall be increased to ten (10) feet where ten (10) foot lengths of pipe are installed.

3.2 FLASHING INSTALLATION:

- A. Provide flexible flashing and metal counterflashing where piping penetrates weather or waterproofed walls or floors.
- B. For pipes through outside walls, turn flanges back into wall and caulk, metal counter-flash, and seal.
- C. Flash floor drains in floors with topping over finished areas with lead, ten (10) inches clear on sides with minimum thirty-six (36) by thirty-six (36) inch sheet size. Fasten flashing to drain clamp device.
- D. Seal all drains watertight to adjacent materials.

3.3 SLEEVE INSTALLATION:

- A. Verify openings are ready to receive sleeves.
- B. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of sealant material.
- C. Install backing or damming materials to arrest liquid material leakage.
- D. Exterior watertight entries: Seal with mechanical sleeve seals.
- E. Set sleeves in position in forms. Provide reinforcing around sleeves.
- F. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- G. Extend sleeves through floors two (2) inches above finished floor level. Caulk sleeves.

- H. Where piping penetrates floor, ceiling, or wall, close off space between pipe and adjacent work with stuffing insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- I. Install escutcheons at finished surfaces.

END OF SECTION

SECTION 22 05 32

FIRESTOPPING FOR PLUMBING SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Firestopping related to plumbing work.
 - 2. Firestopping accessories.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM E84 – Test Method for Surface Burning Characteristics of Building Materials.
 - 2. ASTM E814 – Test Method of Fire Tests of Through Penetration Firestops.
- B. FM Global:
 - 1. FM Approval Guide – A Guide to Equipment, Materials and Services Approved by Factory Mutual Research for Property Conservation.
- C. Underwriters Laboratories, Inc.:
 - 1. UL 723 – Standard for Test for Surface Burning Characteristics of Building Materials.
 - 2. UL 1479 – Fire Tests of Through-Penetration Firestops.

1.3 DEFINITIONS

- A. Firestopping (through-penetration protection system): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.4 SYSTEM DESCRIPTION

- A. Firestopping materials: ASTM E814, UL 1479; to achieve fire ratings as noted on drawings for adjacent construction, but not less than a one-hour fire rating.
- B. Surface burning: ASTM E84, UL 723; with maximum flame spread index/smoke developed rating of 25/50 (plenum-rated).
- C. Firestop interruptions to fire rated assemblies, materials, and components.

1.5 SUBMITTALS

- A. Refer to specification section 22 01 05 for submittal requirements, definitions, and procedures.
- B. Submit manufacturer's data for the following:
 - 1. Firestopping related to plumbing work.
 - 2. Firestopping accessories.
- C. Submit schedule(s) of opening locations and sizes, penetrating items, and required listed installation details to seal openings to maintain fire-resistance rating of adjacent assembly.
- D. For conditions not covered by UL or FM listed designs, submit judgments by a professional engineer registered in the state of North Carolina suitable for presentation to authority having jurisdiction for acceptance as meeting code requirements.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply firestopping materials when temperature of substrate material and ambient air is below sixty (60) degrees Fahrenheit.

- B. Maintain this minimum temperature before, during, and for at least three (3) days after installation of firestopping materials.
- C. Provide ventilation in areas to receive solvent cured materials.

PART 2 - PRODUCTS

2.1 FIRESTOPPING

- A. Product description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
 - 1. Silicone firestopping elastomeric firestopping: single component silicone elastomeric compound and compatible silicone sealant.
 - 2. Foam firestopping compounds: single component foam compound.
 - 3. Fiber stuffing and sealant firestopping: composite of mineral or ceramic fiber stuffing insulation with silicone elastomer for smoke stopping.
 - 4. Mechanical firestopping device with fillers: mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
 - 5. Intumescent firestopping: intumescent putty compound which expands on exposure to surface heat gain.

2.2 FIRESTOPPING ACCESSORIES

- A. Primer: type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.
- B. Dam material: selected firestopping methods must only employ permanent damming materials.
- C. Installation accessories: provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.
- D. General:
 - 1. Furnish UL listed or FM approved products.
 - 2. Select products with rating not less than rating of wall or floor being penetrated.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.
- B. Remove incompatible materials affecting bond.
- C. Install backing or damming materials to arrest liquid material leakage.

3.2 INSTALLATION

- A. Install material at fire-rated construction perimeters and openings containing penetrating sleeves, piping and other items, requiring firestopping.
- B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating to uniform density and texture.
- D. Compress fibered material to maximum forty (40) percent of its uncompressed size.
- E. Place intumescent coating in sufficient coats to achieve rating required.
- F. Damming materials shall remain.

END OF SECTION

SECTION 22 05 53

IDENTIFICATION FOR PLUMBING SYSTEMS

PART 1- GENERAL

1.1 SUMMARY:

- A. Section includes:
 - 1. Pipe identification.
 - 2. Valve tags.
 - 3. Ceiling tacks.
 - 4. Nameplates.
 - 5. Labels.

1.2 REFERENCES:

- A. ASME International:
 - 1. ASME A13.1 – Scheme for the Identification of Piping Systems.

1.3 SUBMITTALS:

- A. Refer to specification section 22 01 05 for submittal requirements, definitions, and procedures.
- B. Submit manufacturer's data for the following:
 - 1. Pipe identification.
 - 2. Valve tags.
 - 3. Ceiling tacks.
 - 4. Nameplates.
 - 5. Labels.
- C. Submit shop drawings indicating the following:
 - 1. Wording, symbols, letter size, and color coding for all identification.
 - 2. Valve chart and schedule including valve tag number, location, function, and valve manufacturer's name and model number.

1.4 OPERATION AND MAINTENANCE MANUALS:

- A. Refer to specification section 22 01 05 for submittal requirements, definitions, and procedures.
- B. Submit manufacturer's data, manufacturer's warranties, and operation and maintenance instructions for the following:
 - 1. Pipe identification.
 - 2. Valve tags.
 - 3. Ceiling tacks.
 - 4. Nameplates.
 - 5. Labels.

PART 2- PRODUCTS

2.1 PIPE IDENTIFICATION:

- A. Font and symbols conforming to ASME A13.1.
- B. Colors shall match owner's standard.
- C. With clean cut symbols and letters of following size:
 - 1. Outside diameter two (2) inches or less: one-half (1/2) inch.
 - 2. Outside diameter two-and-one-half (2-1/2) to six (6) inches: one (1) inch.
 - 3. Outside diameter six (6) inches or more: one-and-one-half (1-1/2) inches.

- D. Plastic pipe markers:
 - 1. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener.
- E. Plastic underground pipe tape:
 - 1. Bright colored continuously printed plastic ribbon tape manufactured for direct burial service, minimum six (6) inches wide by four (4) mil.

2.2 VALVE TAGS:

- A. Font size conforming to ASME A13.1.
- B. Colors shall match owner's standard.
- C. Metal:
 - 1. Brass with stamped letters, minimum one-and-one-half (1-1/2) inches diameter with finished edges.
- D. Tag chart:
 - 1. Typewritten list of applied tags and locations in anodized aluminum frame with polycarbonate cover.

2.3 CEILING TACKS:

- A. Font size conforming to ASME A13.1.
- B. Colors shall match owner's standard.
- C. Three-quarters (3/4) inch steel.
- D. Adhesive attachment is prohibited.

2.4 NAMEPLATES:

- A. Font size conforming to ASME A13.1.
- B. Colors shall match owner's standard.
- C. Laminated three (3) layer plastic with engraved letters on contrasting background color.
- D. Adhesive attachment is prohibited

2.5 LABELS:

- A. Font size conforming to ASME A13.1.
- B. Colors shall match owner's standard.
- C. Laminated Mylar adhesive backed with printed identification.
- D. Two (2) by three-quarters (3/4) inches.

PART 3- EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS:

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Install identifying devices after completion of coverings and painting.

3.2 PIPE IDENTIFICATION INSTALLATION:

- A. Identify all piping with plastic pipe markers.
- B. Identify service, flow direction, and pressure.
- C. Install in clear view and align with axis of piping.
- D. Locate identification as follows:
 - 1. On every straight run, including risers and drops.
 - 2. Every twenty (20) feet on straight runs.
 - 3. Adjacent to each valve and tee.
 - 4. At each side of wall and floor penetrations.
 - 5. At the underside of roof penetrations.

- 6. Not less than once in each room.
- E. Install underground plastic pipe markers six (6) inches below finished grade, directly above buried pipe.

3.3 VALVE TAG INSTALLATION:

- A. Identify valves in main and branch piping with valve tags.
- B. Install valve tags using corrosion resistant chain.
- C. Number tags consecutively by location.

3.4 CEILING TACK INSTALLATION:

- A. Provide ceiling tacks to locate valves above T-bar type panel ceilings.
- B. Locate in corner of ceiling panel closest to equipment.

3.5 NAMEPLATE INSTALLATION:

- A. Install plastic nameplates with corrosive-resistant mechanical fasteners.
- B. Identify all equipment with plastic nameplates.
- C. Identify all disconnects provided by the contractor with nameplates.

3.6 LABEL INSTALLATION:

- A. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer.
- B. Identify in-line specialties and other small devices with labels.

END OF SECTION

SECTION 22 07 00

INSULATION FOR PLUMBING SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY:

- A. Section includes:
 - 1. Pipe insulation.
 - 2. Pipe insulation jackets.
 - 3. Pipe insulation shields and inserts.

1.2 REFERENCES:

- A. ASTM International:
 - 1. ASTM C534 – Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
 - 2. ASTM C547 – Standard Specification for Mineral Fiber Pipe Insulation.

1.3 SUBMITTALS:

- A. Refer to specification section 22 01 05 for submittal requirements, definitions, and procedures.
- B. Submit manufacturer's data for the following:
 - 1. Pipe insulation.
 - 2. Pipe insulation jackets.
 - 3. Pipe insulation shields and inserts.

1.4 OPERATION AND MAINTENANCE MANUALS:

- A. Refer to specification section 22 01 05 for submittal requirements, definitions, and procedures.
- B. Submit manufacturer's data, manufacturer's warranties, and operation and maintenance instructions for the following:
 - 1. Pipe insulation.
 - 2. Pipe insulation jackets.
 - 3. Pipe insulation shields and inserts.

1.5 ENVIRONMENTAL REQUIREMENTS:

- A. Do not install insulation and related products when ambient temperatures and conditions do not meet manufacturer's requirements.
- B. Maintain required temperature and humidity before, during, and after installation for at least twenty-four (24) hours.

PART 2 - PRODUCTS

2.1 PIPE INSULATION:

- A. Mineral fiber: ASTM C547; rigid molded, noncombustible.
 - 1. K-factor: Twenty-seven-one-hundredths (0.27) at seventy-five (75) degrees Fahrenheit.
 - 2. Maximum service temperature: Eight-hundred (800) degrees Fahrenheit.
 - 3. Vapor retarder jacket: Kraft paper with glass fiber yarn and bonded to aluminized film, secured with self-sealing longitudinal laps and butt strips or with outward clinch expanding staples and vapor retarder mastic.

2.2 PIPE INSULATION JACKETS:

- A. Polyvinyl chloride (PVC) plastic:
 - 1. One-piece molded type fitting covers and sheet material.
 - 2. Ten (10) mil with pressure sensitive color matching vinyl tape.

2.3 PIPE INSULATION SHIELDS AND INSERTS:

- A. Shields:
 - 1. Twenty-two (22) gauge galvanized steel.
- B. Inserts:
 - 1. Cork or other high density insulating material, not less than six (6) inches long.

PART 3 - EXECUTION**3.1 GENERAL INSTALLATION REQUIREMENTS:**

- A. Verify piping and equipment has been tested before applying insulation materials.
- B. Verify surfaces are clean and dry, with foreign material removed.
- C. Neatly finish insulation at supports, protrusions, and interruptions.
- D. Locate insulation and cover seams in least visible locations.
- E. Insulate complete systems conveying fluids below ambient temperature, including fittings, valves, unions, flanges, strainers, flexible connections, etc. Provide vapor barrier jackets for mineral fiber insulation.
- F. Insulate complete systems conveying fluids above ambient temperature, including fittings, valves, unions, flanges, strainers, flexible connections, etc. Insulate flanges and unions with removable sections and jackets.

3.2 PIPING INSULATION INSTALLATION:

- A. Continue insulation vapor barrier through penetrations.
- B. For exposed piping, finish with PVC jacket and fitting covers.
- C. Insulate piping systems in accordance with the following:

PIPING SYSTEM	PIPE SIZE RANGE	INSULATION SIZE
Domestic Cold-Water Supply	1/2" to 1-1/2"	1/2"
Domestic Cold-Water Supply	2" to 4"	1"
Domestic Hot Water Supply & Return	1/2" to 1-1/2"	1"
Horizontal Roof Drainage	All	1"

3.3 PIPE INSULATION SHIELD AND INSERT INSTALLATION:

- A. Provide shields on piping or equipment two-and-one-half (2-1/2) inches diameter or smaller between insulation and pipe hangers.
- B. Install inserts on piping three (3) inches diameter or larger. Install between support shield and piping and under finish jacket.

END OF SECTION

SECTION 22 11 00

DOMESTIC WATER SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY:

- A. Section includes:
 - 1. Piping.
 - 2. Valves.
 - 3. Strainers.
 - 4. Water hammer arresters.
 - 5. Pressure gauges.
 - 6. Thermometers.
 - 7. Hydrants.
 - 8. Recessed valve boxes.
 - 9. Thermal expansion tanks.
 - 10. Inline circulator pumps.

1.2 REFERENCES:

- A. American Society of Mechanical Engineers (ASME):
 - 1. ASME A112.18.1 – Plumbing Supply Fittings.
 - 2. ASME B16.18 – Cast Copper Alloy Solder Joint Pressure Fittings.
 - 3. ASME B16.22 – Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - 4. ASME B40.1 – Pressure Gauges and Gauge Attachments.
- B. ASSE International:
 - 1. ASSE 1010 – Performance Requirements for Water Hammer Arresters.
 - 2. ASSE 1011 – Performance Requirements for Hose Connection Vacuum Breakers.
 - 3. ASSE 1019 – Performance Requirements for Wall Hydrant with Backflow Protection and Freeze Resistance.
 - 4. ASSE 1052 – Performance Requirements for Hose Connection Backflow Preventers.
- C. ASTM International:
 - 1. ASTM B32 – Standard Specification for Solder Metal.
 - 2. ASTM B75 – Standard Specification for Seamless Copper Tube.
 - 3. ASTM B88 – Standard Specification for Seamless Copper Water Tube.
 - 4. ASTM B251 – Standard Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube.
 - 5. ASTM B447 – Standard Specification for Welded Copper Tube.
 - 6. ASTM B813 – Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube.
 - 7. ASTM B828 – Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings.
 - 8. ASTM D2846 - Standard Specification for Chlorinated Polyvinyl Chloride (CPVC) Plastic Hot- and Cold-Water Distribution Systems.
 - 9. ASTM E1 – Standard Specification for Liquid-in-Glass Thermometers.
 - 10. ASTM F439 – Standard Specification for Socket-Type Chlorinated Polyvinyl Chloride (CPVC) Plastic Pipe Fittings, Schedule 80.
 - 11. ASTM F447 – Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
 - 12. ASTM F493 – Standard Specification for Solvent Cements for Chlorinated Polyvinyl Chloride (CPVC) Plastic Pipe and Fittings.

- D. American Welding Society (AWS):
 - 1. AWS A5.8 – Specification for Filler Metals for Brazing and Braze Welding.
- E. Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS):
 - 1. MSS SP 71 – Gray Iron Swing Check Valves, Flanged and Threaded Ends.
 - 2. MSS SP 80 – Bronze Gate, Globe, Angle, and Check Valves.
 - 3. MSS SP 110 – Ball Valves Threaded, Socket Welding, Solder Joint, Grooved, and Flared Ends.
- F. NSF International:
 - 1. NSF 61 – Drinking Water System Components – Health Effects.
- G. Plumbing and Drainage Institute (PDI):
 - 1. PDI WH-201 – Water Hammer Arresters.

1.3 SUBMITTALS:

- A. Refer to specification section 22 01 05 for submittal requirements, definitions, and procedures.
- B. Submit manufacturer's data for the following:
 - 1. Piping.
 - 2. Valves.
 - 3. Strainers.
 - 4. Water hammer arresters.
 - 5. Pressure gauges.
 - 6. Thermometers.
 - 7. Hydrants.
 - 8. Recessed valve boxes.
 - 9. Thermal expansion tanks.
 - 10. Inline circulator pumps.

1.4 OPERATION AND MAINTENANCE MANUALS:

- A. Refer to specification section 22 01 05 for submittal requirements, definitions, and procedures.
- B. Submit manufacturer's data, manufacturer's product warranties, and operation and maintenance instructions for the following:
 - 1. Piping.
 - 2. Valves.
 - 3. Strainers.
 - 4. Water hammer arresters.
 - 5. Pressure gauges.
 - 6. Thermometers.
 - 7. Hydrants.
 - 8. Recessed valve boxes.
 - 9. Thermal expansion tanks.
 - 10. Inline circulator pumps.

PART 2 - PRODUCTS

2.1 PIPING:

- A. Copper or copper-alloy tubing: ASTM B75, ASTM B88, ASTM B251, ASTM B447.
 - 1. Pipe:
 - a. Aboveground: Type L.
 - b. Underground: Type K.
 - 2. Fittings:
 - a. Soldered: ASME B16.18, ASME B16.22.
 - 3. Joints:
 - a. Soldered: ASTM B828

- 1) Flux: ASTM B813.
- 2) Solder: ASTM B32.
- B. Chlorinated polyvinyl chloride (CPVC) plastic pipe: ASTM D2846.
 1. Fittings:
 - a. Socketed:
 - 1) Schedule 80: ASTM F439.
 2. Joints:
 - a. Socketed:
 - 1) Primer: Use approved primer.
 - 2) Solvent cement: ASTM F493.
- C. The water service pipe shall conform to NSF 61. All water service pipe or tubing, installed underground and outside of the structure, shall have a minimum working pressure rating of one-hundred-sixty (160) psi at seventy-three-and-four-tenths (73.4) degrees Fahrenheit. Where the water pressure exceeds one-hundred-sixty (160) psi, piping material shall have a minimum rated working pressure equal to the highest available pressure.
- D. Pipe fittings shall be approved for installation with the piping material installed. All pipe fittings utilized in water supply systems shall also comply with NSF 61. The fittings shall not have ledges, shoulders, or reductions capable of retarding or obstructing flow in the piping.

2.2 VALVES:

- A. Ball:
 1. Two (2) inches or less: MSS SP 110; 600 psi CWP; two-piece cast brass body; replaceable Teflon seats; full port; blowout proof stems; chrome-plated brass ball; threaded, soldered, or compression ends; locking lever handle operated.
 2. Provide extended stems for valves in insulated piping.
- B. Swing check:
 1. Two (2) inches or less: MSS SP 80; class 125; 200 psi CWP; cast bronze body and cap; soldered or threaded ends; Y-pattern swing type nitrile rubber disc.
 2. Two-and-one-half (2-1/2) inches or more: MSS SP 71; class 125; 200 psi CWP; cast iron body, bronze mounted, and bolted bonnet; flanged or threaded ends; swing type nitrile rubber disc; non-asbestos gasket.
- C. Spring-loaded check:
 1. Two (2) inches or less: MSS SP 80; class 125; 200 psi CWP; cast bronze body and cap; soldered or threaded ends; inline spring lift check; silent closing nitrile rubber disc; integral seat.
 2. Two-and-one-half (2-1/2) inches or more: MSS SP 71; class 125; 200 psi CWP; cast iron body, bronze mounted, and bolted bonnet; flanged or threaded ends; wafer style; center guided bronze disc; stainless steel springs and screws.
- D. Automatic flow control:
 1. Construction: Class 125; bronze body; union on inlet and outlet; temperature and pressure test plug on inlet and outlet; combination blow-down drain.
 2. Calibration: Control flow within five (5) percent of selected rating; over operating pressure range of ten (10) times minimum pressure required for control; maximum minimum pressure five (5) psi.
- E. All valves shall be of an approved type and compatible with the type of piping material installed in the system. Ball valves, gate valves, globe valves, and plug valves intended to supply drinking water shall meet the requirements of NSF 61.

2.3 STRAINERS:

- A. Two (2) inches or less: Class 150; 300 psi CWP; bronze body; Y-pattern with 1/32-inch stainless steel perforated screen; soldered or threaded ends.

- B. Two-and-one-half (2-1/2) inches to four (4) inches: Class 125; 200 psi CWP; cast iron body, bronze fitted; Y-pattern with 1/16-inch stainless steel perforated screen; flanged or threaded ends.

2.4 WATER HAMMER ARRESTERS:

- A. ASSE 1010; 150 psi CWP; copper construction, piston type sized in accordance with PDI WH-201. Refer to plumbing fixture schedule on sheet P001 for additional information.

2.5 PRESSURE GAUGES:

- A. Gauge: ASME B40.1; with bourdon tube; rotary brass movement; brass socket; front calibration adjustment; black scale on white background.
 - 1. Case: Cast aluminum.
 - 2. Bourdon tube: Brass.
 - 3. Dial size: 4-inch diameter.
 - 4. Mid-scale accuracy: Two (2) percent.
 - 5. Scale: Psi.
 - 6. Pressure gauge taps:
 - a. Needle valve: Brass, 1/4-inch NPT for 300 psi.
 - b. Pulsation damper: Pressure snubber, brass with 1/4-inch NPT connections.

2.6 THERMOMETERS:

- A. Thermometer: ASTM E1; adjustable angle; red appearing mercury; lens front tube; cast aluminum case with enamel finish; cast aluminum adjustable joint with positive locking device.
 - 1. Size: 7-inch scale.
 - 2. Window: Clear Lexan plastic.
 - 3. Stem: Brass, 3/4-inch NPT, 3-1/2-inch long.
 - 4. Accuracy: Two (2) percent.
 - 5. Calibration: Degrees Fahrenheit.

2.7 HYDRANTS:

- A. Interior hydrant: ASSE 1011; bronze or brass with integral mounting flange; replaceable hexagonal disc; hose thread spout; chrome-plated in public spaces, brass in all other spaces, with metallic hand wheel; integral vacuum breaker.
- B. Exterior wall hydrant: ASSE 1019, ASSE 1052; non-freeze; self-draining type with polished bronze wall plate hose thread spout; lock shield and removable key; and integral vacuum breaker.
- C. Roof hydrant: ASSE 1052; non-freeze; self-draining type with bronze handle and spout assembly; hose-thread spout; through-roof mounting assembly; integral vacuum breaker.

2.8 RECESSED VALVE BOXES:

- A. Powder-coated metal preformed rough-in box with quarter-turn brass arrester valve(s) and slip-in finishing cover.

2.9 THERMAL EXPANSION TANKS:

- A. Construction: Welded steel, tested and stamped in accordance with ASME Section VIII; supplied with National Board Form U-1, rated for working pressure of one-hundred-fifty (150) psig, with flexible diaphragm sealed into tank, and steel legs or saddles.
- B. Accessories: Pressure gauge and air-charging fitting, tank drain; pre-charge to forty (40) psig.
- C. Size: As specified in the thermal expansion tank schedule on drawings.

2.10 INLINE CIRCULATOR PUMPS:

- A. Casing: Bronze rated for 125 psig working pressure with bronze or stainless-steel rotor assembly.
- B. Impeller: Bronze.
- C. Shaft: Alloy steel with integral thrust collar and two, oil lubricated bronze sleeve bearings.
- D. Seal: Carbon rotating against stationary ceramic seat.
- E. Drive: Flexible coupling.
- F. Performance: As specified in drawings.
- G. Electrical Characteristics: As specified in drawings.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION:

- A. Piping shall be neatly arranged – straight, parallel, or at right angles to walls – and cut accurately to established measurements.
- B. Group piping whenever practical at common elevations.
- C. Pipes shall be worked into place without springing or forcing.
- D. Sufficient headroom shall be provided to enable the clearing of light fixtures, ductwork, sprinklers, aisles, passageways, windows, doors, and other openings.
- E. Pipes shall not interfere with access to maintain equipment.
- F. Pipes shall be clean, free of cuttings and foreign matter inside, and exposed ends shall be covered during site storage and installation. Split, bent, flattened, or otherwise damaged pipe or tubing shall not be used.
- G. Sufficient clearance shall be provided from walls, ceilings, and floors to permit the welding, soldering, or connecting of joints and valves. No less than six (6) inches of clearance shall be provided.
- H. Installation of pipe inside electrical equipment rooms, telecommunications or data rooms, elevator machine rooms, elevator hoist ways, and stairwells is prohibited.
- I. Piping systems shall not interfere with the proper operation and maintenance of safety or relief valves.
- J. Means of draining the entire facility's water distribution system shall be provided. A hose thread hydrant with vacuum breaker shall be placed at each low point in the system for this purpose. Constant grades to the low points shall be maintained for proper drainage. Piping shall be free of air pockets due to changes in elevations.
- K. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- L. Install unions downstream of valves and at equipment or apparatus connections.
- M. Provide access doors where unions, adapters, or flanges are not accessible. Refer to section 22 01 00.
- N. Sleeve pipes passing through partitions, walls, and floors. Refer to section 22 05 29.
- O. Install firestopping at fire-rated construction perimeters and openings containing penetrating sleeves and piping. Refer to section 22 05 32.
- P. The water service pipe and the building sewer shall be separated by five (5) feet of undisturbed or compacted earth.
 - 1. Exceptions:
 - a. The required separation distance shall not apply where the bottom of the water service pipe within five (5) feet of the sewer is a minimum of twelve (12) inches above the top of the highest point of the sewer and the pipe materials conform to Table 702.3 of the North Carolina Plumbing Code.
 - b. Water service pipe is permitted to be in the same trench with a building sewer, provided such sewer is constructed of materials listed in Table 702.2 of the North Carolina Plumbing Code.

- c. The required separation distance shall not apply where a water service pipe crosses a sewer pipe, provided the water service pipe is sleeved at least five (5) feet horizontally from the sewer pipe centerline on both sides of such crossing with pipe materials listed in Table 605.3, 702.2, or 702.3 of the North Carolina Plumbing Code.
- Q. Potable water service pipes shall not be in, under, or above cesspools, septic tanks, septic tank drainage fields, or seepage pits.
- R. The installation of a water service or water distribution pipe shall be prohibited in soil and ground water contaminated with solvents, fuels, organic compounds, or other detrimental materials causing permeation, corrosion, degradation, or structural failure of the piping material. Where detrimental conditions are suspected, a chemical analysis of the soil and ground water conditions shall be required to ascertain the acceptability of the water service or water distribution piping material for the specific installation. Where detrimental conditions exist, approved alternative materials or routing shall be required.
- S. Joints between copper or copper-alloy tubing or fittings shall comply with the following:
 - 1. Soldered joints: Soldered joints shall be made in accordance with the methods of ASTM B828. All cut tube ends shall be reamed to the full inside diameter of the tube end. All joint surfaces shall be cleaned. A flux conforming to ASTM B813 shall be applied. The joint shall be soldered with a solder conforming to ASTM B32. The joining of water supply piping shall be made with lead-free solders and fluxes. "Lead-free" shall mean a chemical composition equal to or less than 0.2-percent lead.
- T. Joints between chlorinated polyvinyl chloride (CPVC) plastic pipe or fittings shall comply with the following:
 - 1. Solvent cementing: Joint surfaces shall be clean and free of moisture, and an approved primer shall be applied. Solvent cement, orange in color and conforming to ASTM F493, shall be applied to all joint surfaces. The joint shall be made while the cement is wet, and in accordance with ASTM D2846 or ASTM F493. Solvent cement joints shall be permitted above or below ground.
 - a. Exception: A primer is not required where all the following conditions apply:
 - 1) The solvent cement used is third party certified as conforming to ASTM F493.
 - 2) The solvent cement used is yellow in color.
 - 3) The solvent cement is used only for joining one-half (1/2) inch through two (2) inch diameter CPVC pipe and fittings.
 - 4) The CPVC pipe and fittings are manufactured in accordance with ASTM D2846.

3.2 VALVE INSTALLATION:

- A. Provide temporary protective coating on cast iron and steel valves.
- B. Install valves with stems upright or horizontal, not inverted.
- C. Provide spring-loaded check valves on discharge of pumps.
- D. Full open valves shall be installed in the following locations:
 - 1. A full open valve shall be located either outside the building within five (5) feet of the foundation wall in a readily accessible valve box, in the crawlspace within three (3) feet of the crawlspace access door or within the building in a location where it may be accessed without the use of a ladder or a tool.
 - 2. On the base of every water riser pipe.
 - 3. On the water supply pipe to every water heater.
- E. Shutoff valves shall be installed in the following locations:
 - 1. On the fixture supply to each plumbing fixture other than bathtubs and showers.
 - 2. On the water supply to each appliance or mechanical equipment.

3. Each supply branch line serving more than one fixture shall have a shutoff valve installed to isolate all fixtures and all pieces of equipment supplied by the branch line. The shutoff valve shall be labeled and located as close to the connection to the supply main and riser as practical.
- F. Access shall be provided to all full open valves and shutoff valves.
- G. Service valves shall be identified. All other valves installed in locations that are not adjacent to the fixture or appliance shall be identified, indicating the fixture or appliance served. Refer to specification section 22 05 53.

3.3 STRAINER INSTALLATION:

- A. Access shall be provided to all strainers.
- B. Strainers shall be installed with blow-downs perpendicular to the floor or access panels.

3.4 BACKFLOW PREVENTER INSTALLATION:

- A. Backflow preventer applications shall conform to Table 608.1 of the North Carolina Plumbing Code.
- B. The supply lines and fittings for every plumbing fixture shall be installed to prevent backflow. Plumbing fixture fittings shall provide backflow protection in accordance with ASME A112.18.1.
- C. All devices, appurtenances, appliances, and apparatus intended to serve some special function, such as sterilization, distillation, processing, cooling, or storage of ice or foods, and that connect to the water supply system, shall be provided with protection against backflow and contamination of the water supply system. Water pumps, filters, softeners, tanks, and all other appliances and devices that handle or treat potable water shall be protected against contamination.
- D. Access shall be provided to backflow preventers as specified by the installation instructions of the approved manufacturer.
 1. Backflow preventers shall not be in areas subject to freezing except where they can be removed by means of unions or are protected from freezing by heat, insulation, or both.
 - a. The termination of the piping from the relief port or air gap fitting of a backflow preventer shall discharge to an approved indirect waste receptor or to the outdoors where it will not cause damage or create a nuisance.
- E. All potable water openings and outlets shall be protected against backflow in accordance with the following:
 1. Openings and outlets shall be protected by an air gap between the opening and the fixture flood level rim as specified in Table 608.15.1 of the North Carolina Plumbing Code. Openings and outlets for hose connections shall be protected by means other than an air gap.
 2. The critical level of each vacuum breaker shall be set at a minimum of six (6) inches above the flood level rim of the fixture or device. Vacuum breakers shall not be installed under exhaust hoods or similar locations that will contain toxic fumes or vapors. Pipe applied vacuum breakers shall be installed not less than six (6) inches above the flood level rim of the fixture, receptor, or device served.
 - a. Approved deck-mounted or equipment mounted vacuum breakers and faucets with integral vacuum atmospheric or spillproof vacuum breakers shall be installed in accordance with the manufacturer's instructions and the requirements for labeling with the critical level not less than one (1) inch above the flood level rim.
 - b. Sillcocks, hose bibs, wall hydrants, and other openings with a hose connection shall be protected by an atmospheric or pressure type vacuum breaker or a permanently attached hose connection vacuum breaker.
 - 1) Exceptions:

- a) This section shall not apply to water heater and boiler drains valves that are provided with hose connection threads and that are intended only for tank and vessel draining.
 - b) This section shall not apply to water supply valves intended for connection of clothes washing machines where backflow prevention is otherwise provided or is integral with the machine.
- 3. The water supply connection to coffee machines and noncarbonated beverage dispensers shall be protected against backflow by a backflow preventer conforming to ASSE 1022 or by an air gap.

3.5 WATER HAMMER ARRESTER INSTALLATION:

- A. A water hammer arrester shall be installed where quick-closing valves and metallic piping are used.
- B. Install water hammer arresters complete with accessible isolation valve on hot and cold-water supply piping as indicated on drawings.

3.6 PRESSURE GAUGE INSTALLATION:

- A. Install one pressure gauge for each pump, locate taps before strainers and on suction and discharge of pump.
- B. Install gauge taps in piping.
- C. Install pressure gauges with pulsation dampers. Provide needle valve to isolate each gauge.
- D. Provide instruments with scale ranges selected per service with largest appropriate scale.
- E. Install gauges in locations where they are easily read from normal operating level. Install vertical to forty-five (45) degrees off vertical.
- F. Adjust gauges to final angle, clean windows and lenses, and calibrate to zero.

3.7 THERMOMETER INSTALLATION:

- A. Install thermometers in piping systems in sockets in short couplings. Allow clearance from insulation.
- B. Provide instruments with scale ranges selected per service with largest appropriate scale.
- C. Install thermometers in locations where they are easily read from normal operating level. Install vertical to forty-five degrees off vertical.
- D. Adjust thermometers to final angle, clean windows and lenses, and calibrate to zero.

3.8 HYDRANT INSTALLATION:

- A. Install at mounting heights indicated in plumbing fixture schedule on sheet P0.001.
- B. Coordinate installation of exterior hydrants with the general contractor so that the hydrant occupies space within a single course of masonry units.
- C. Coordinate installation of roof hydrants with general contractor prior to installation.

3.9 RECESSED VALVE BOX INSTALLATION:

- A. Coordinate mounting height with equipment served.
- B. Each recessed valve box shall be supported by the wall structure on both sides of the box.

3.10 THERMAL EXPANSION TANK INSTALLATION:

- A. Install as indicated in expansion tank schedule on drawings and in accordance with water heater detail on drawings.

3.11 INLINE CIRCULATION PUMP INSTALLATION:

- A. Provide pumps to operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within twenty-five (25) percent of midpoint of published maximum efficiency curve.

- B. Provide line sized shut-off valve and strainer on pump suction, and line sized spring-loaded check valve, balancing valve, and shut-off valve on pump discharge.
- C. Lubricate pumps before start-up.

3.12 INSPECTION AND TESTING:

- A. Refer to specification section 22 01 00 for general inspection and testing requirements and performance requirements of test gauges.
- B. Upon completion of a section of or the entire water supply system, the system, or portion completed, shall be tested and proved tight under a water pressure of not less than the working pressure of the system; or an air test of not less than one hundred (100) psi. This pressure shall be held for at least fifteen (15) minutes. The water utilized for tests shall be obtained from a potable source of supply.

3.13 STERILIZATION OF THE DOMESTIC WATER SYSTEM:

- A. Permitted new or repaired potable water systems shall be purged of deleterious matter prior to neutralization.
- B. After the system has been tested and approved, the entire new system, including valves and accessories, shall be chlorinated. Disinfecting shall be in accordance with AWWA C651.
- C. Chlorine may be applied in any of the following forms:
 - 1. Liquid chlorine gas-water mixture.
 - a. Chlorine gas-water mixture shall be applied by a solution feed chlorinating device.
 - 2. Calcium hypochlorite and water mixture.
 - a. A solution consisting of five (5) percent powder to ninety-five (95) percent water by weight shall be prepared. The calcium hypochlorite and water mixture shall first be made into a paste, then thinned into slurry, and injected or pumped into the system.
- D. The system or any part thereof shall be filled with a water-chlorine solution containing a chlorine concentration and shall stand in the system for a duration from either of the following:
 - 1. Chlorine concentration of at least fifty (50) parts per million and a duration of twenty-four (24) hours.
 - 2. Chlorine concentration of at least two hundred (200) parts per million and a duration of three (3) hours.
- E. During the chlorination process all valves and accessories shall be independently and manually operated at least twice.
- F. After the chlorination process, the chlorine shall be flushed from the system until the system water is equal in chemical and bacteriological composition to those of the permanent source of water supply. Spent chlorinated water shall be disposed of in an environmentally responsible procedure.
- G. Water supply shall not be placed into service until bacteriological test results are found to be satisfactory and the water meets Environmental Protection Agency quality standards for drinking water.
- H. The contractor shall submit samples of the system water to a competent laboratory for analysis. Laboratory tests of the water shall be paid for by the contractor. The water test report shall be submitted to the professional for review and approval.
- I. After acceptance by the professional, the water test report shall be submitted by the contractor to the owner and authority having jurisdiction prior to sending a request for final acceptance and occupancy permit.

END OF SECTION

SECTION 22 13 00

SANITARY WASTE AND VENT SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY:

- A. Section includes:
 - 1. Underground sanitary waste and vent piping.
 - 2. Aboveground sanitary waste and vent piping.
 - 3. Valves.
 - 4. Floor drains.
 - 5. Floor sinks.
 - 6. Trench drains.
 - 7. Cleanouts.
 - 8. Grease interceptors.
 - 9. Oil interceptors.
 - 10. Lint interceptors.

1.2 REFERENCES:

- A. ASME International:
 - 1. ASME A112.6.3 – Floor and Trench Drains.
 - 2. ASME A112.6.7 – Sanitary Floor Sinks.
- B. ASSE International:
 - 1. ASSE 1051 – Performance Requirements for Individual and Branch Type Air Admittance Valves for Sanitary Drainage Systems.

1.3 SUBMITTALS:

- A. Refer to specification section 22 01 05 for submittal requirements, definitions, and procedures.
- B. Submit manufacturer's data for the following:
 - 1. Underground sanitary waste and vent piping.
 - 2. Aboveground sanitary waste and vent piping.
 - 3. Valves.
 - 4. Floor drains.
 - 5. Floor sinks.
 - 6. Trench drains.
 - 7. Cleanouts.
 - 8. Grease interceptors.
 - 9. Oil interceptors.
 - 10. Lint interceptors.

1.4 OPERATION AND MAINTENANCE MANUALS:

- A. Refer to specification section 22 01 05 for submittal requirements, definitions, and procedures.
- B. Submit manufacturer's data, manufacturer's warranties, and operation and maintenance instructions for the following:
 - 1. Underground sanitary waste and vent piping.
 - 2. Aboveground sanitary waste and vent piping.
 - 3. Valves.
 - 4. Floor drains.

5. Floor sinks.
6. Trench drains.
7. Cleanouts.
8. Grease interceptors.
9. Oil interceptors.
10. Lint interceptors.

PART 2 - PRODUCTS

2.1 UNDERGROUND SANITARY WASTE AND VENT PIPING:

- A. Polyvinyl chloride (PVC) plastic pipe: ASTM D2665.
 1. Fittings:
 - a. Socketed: ASTM D2665.
 2. Joints:
 - a. Socketed:
 - 1) Primer: ASTM F656.
 - 2) Solvent cement: ASTM D2564.
- B. Pipe fittings shall not have ledges, shoulders, or reductions capable of retarding or obstructing flow in the piping. Threaded drainage pipe fittings shall be of the recessed drainage type.

2.2 ABOVEGROUND SANITARY WASTE AND VENT PIPING:

- A. Polyvinyl chloride (PVC) plastic pipe: ASTM D2665.
 1. Fittings:
 - a. Socketed: ASTM D2665.
 2. Joints:
 - a. Socketed:
 - 1) Primer: ASTM F656.
 - 2) Solvent cement: ASTM D2564.
- B. Lead bends and traps shall not be less than one-eighth (1/8) inch wall thickness.
- C. Pipe fittings shall not have ledges, shoulders, or reductions capable of retarding or obstructing flow in the piping. Threaded drainage pipe fittings shall be of the recessed drainage type.

2.3 VALVES:

- A. Air admittance valves:
 1. Individual and branch type air admittance valves shall conform to ASSE 1051.

2.4 FLOOR DRAINS:

- A. Floor drain (FD1): ASME A112.6.3; lacquered cast iron two-piece body with double drainage flange, weep holes, reversible clamping collar, and square adjustable nickel-bronze strainer with removable perforated sediment bucket.
- B. Floor drain (FD2): ASME A112.6.3; lacquered cast iron two-piece body with double drainage flange, weep holes, reversible clamping collar, and adjustable recessed round nickel-bronze strainer with removable perforated sediment bucket.

2.5 FLOOR SINKS:

- A. Floor sink (FS1): ASME A112.6.7; twelve (12) inches by twelve (12) inches by six (6) inches, sixteen (16) gauge, type 304 stainless steel, light-duty body with loose set half-grate and anti-splash stainless steel interior dome strainer.

2.6 TRENCH DRAINS

- A. Trench drain (TD1): ASME A112.6.3; pre-sloped trench drain system with twelve- (12) inches wide by forty-eight- (48) inches long ductile iron frame, ultraviolet-stabilized polypropylene channels with bottom or end outlet(s). The system shall be frame-anchored with traffic-rated, ductile iron vandal-resistant grate. System to include frame connectors, grate lockdowns, and construction covers.

2.7 CLEANOUTS:

- A. Cleanout plugs shall be brass. Brass cleanout plugs shall be utilized with metallic drain, waste, and vent piping only, and shall conform to ASTM A74. Cleanouts with plate-style access covers shall be fitted with corrosion-resistant fasteners.
- B. Exterior surfaced areas: Round or square access frame and non-skid cover.
- C. Exterior unsurfaced areas: Line type with round cover with gasket.
- D. Interior finished floor areas: Body with anchor flange, reversible clamping collar, threaded top assembly, and round scored cover with gasket in service areas and round or square depressed cover with gasket to accept floor finish in finished floor areas.
- E. Interior finished wall areas: Line type with round cover with gasket, and round stainless-steel access cover secured with machine screw.
- F. Interior unfinished accessible areas: Caulked or threaded type.

2.8 GREASE INTERCEPTORS:

- A. Elliptical fiberglass (FRP) grease interceptor construction, as supplied by Green Turtle Americas Ltd. or Green Turtle Technologies Ltd., with inlet piping and baffle penetration designed to introduce wastewater in a tangential laminar flow pattern.
 - 1. Include accessways, tanks, and piping and baffle openings to retain grease and to permit tangential laminar wastewater flow.
 - 2. Factory installed schedule forty PVC cement welded type socket ports, or straight pipe, fitted into interceptor walls for each pipe connection.
 - 3. Accessway extension collar:
 - a. Fiberglass risers, as required.
 - b. Accessway frames and covers: Round cover with non-slipcover finish, gasketed and non-vented top design with "Proceptor" lettering cast into cover.
 - 1) Cast Iron: AASHTO M306 traffic-load rated. Twenty-four (24) inches diameter cover with one-quarter (0.25) inch gasket. Two closed pick holes. Bolted option. Weight 249 lbs. ASTM A48 CL35B.
 - c. Watertight flexible caulking: Sikaflex 255 or Sikaflex 221 or approved alternate to provide watertight seal at extension collar joints.
 - 4. Capacity: Refer to interceptor schedule on plans.
- B. Fiberglass accessway extensions: Fiberglass wound pipe.
 - 1. Length: From top of underground tank to underside of access frame at grade.
 - 2. Extension sections: One-quarter (0.25) inch minimum thickness and twenty-four (24) inch as a single continuous piece, without joints unless approved by the manufacturer.
 - a. Sealant: Watertight flexible caulking, Sikaflex 255 or Sikaflex 221 or approved alternate to provide watertight seal at extension collar joining to tank on bottom and access frame at top.

2.9 OIL INTERCEPTORS:

- A. Elliptical fiberglass (FRP) grease interceptor construction, as supplied by Green Turtle Americas Ltd. or Green Turtle Technologies Ltd., with inlet piping and baffle penetration designed to introduce wastewater in a tangential laminar flow pattern.

1. Include accessways, tanks, and piping and baffle openings to retain grease and to permit tangential laminar wastewater flow.
 2. Factory installed schedule forty PVC cement welded type socket ports, or straight pipe, fitted into interceptor walls for each pipe connection.
 3. Accessway extension collar:
 - a. Fiberglass risers, as required.
 - b. Accessway frames and covers: Round cover with non-slipcover finish, gasketed and non-vented top design with "Proceptor" lettering cast into cover.
 - 1) Cast Iron: AASHTO M306 traffic-load rated. Twenty-four (24) inches diameter cover with one-quarter (0.25) inch gasket. Two closed pick holes. Bolted option. Weight 249 lbs. ASTM A48 CL35B.
 - c. Watertight flexible caulking: Sikaflex 255 or Sikaflex 221 or approved alternate to provide watertight seal at extension collar joints.
 4. Capacity: Refer to interceptor schedule on plans.
- B. Fiberglass accessway extensions: Fiberglass wound pipe.
1. Length: From top of underground tank to underside of access frame at grade.
 2. Extension sections: One-quarter (0.25) inch minimum thickness and twenty-four (24) inch as a single continuous piece, without joints unless approved by the manufacturer.
 - a. Sealant: Watertight flexible caulking, Sikaflex 255 or Sikaflex 221 or approved alternate to provide watertight seal at extension collar joining to tank on bottom and access frame at top.

2.10 LINT INTERCEPTORS:

- A. Polyethylene. Interceptor shall have removable, corrosion-resistant filter basket. The interceptor shall be equipped with high and low outlet options, with a movable sewer gas trap to be located on either outlet. The interceptor shall be furnished for below-grade installation. The cover shall be water and gas tight with a minimum 2,000 pounds load capacity. The interceptor shall be certified to IAPMO IGC 167-2011ae2.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION:

- A. Fittings shall be installed to guide sewage and waste in the direction of flow. The change in direction shall be made by fittings installed in accordance with the North Carolina Plumbing Code.
- B. Heel inlet quarter bends shall be an acceptable means of connection, except where the quarter bend serves a water closet. A low heel inlet shall not be used as a wet vented connection. Side inlet quarter bends shall be an acceptable means of connection for drainage, wet venting, and stack venting arrangements.
- C. The water service pipe and the building sewer shall be separated by five (5) feet of undisturbed or compacted earth.
 1. Exceptions:
 - a. The required separation distance shall not apply where the bottom of the water service pipe within five (5) feet of the sewer is a minimum of twelve (12) inches above the top of the highest point of the sewer and the pipe materials conform to Table 702.3 of the North Carolina Plumbing Code.
 - b. Water service pipe is permitted to be in the same trench with a building sewer, provided such sewer is constructed of materials listed in Table 702.2 of the North Carolina Plumbing Code.
 - c. The required separation distance shall not apply where a water service pipe crosses a sewer pipe, provided the water service pipe is sleeved at least five (5) feet

horizontally from the sewer pipe centerline on both sides of such crossing with pipe materials listed in Table 605.3, 702.2, or 702.3 of the North Carolina Plumbing Code.

- D. Where a building sewer or drain is installed in unstable fill or unstable ground, it shall be of cast iron pipe, except that nonmetallic drains may be laid upon an approved continuous supporting system if installed in accordance with the manufacturer's installation instructions.
- E. Horizontal drainage piping shall be installed in uniform alignment at uniform slopes. The minimum slop of a horizontal drainage pipe shall be in accordance with the following:
 - 1. Pipes sized two-and-one-half (2-1/2) inches or less: one-quarter (1/4) inch per foot.
 - 2. Pipes sized (3) three to six (6) inches: one-eighth (1/8) inch per foot.
- F. The size of drainage piping shall not be reduced in size in the direction of flow.
- G. Horizontal branches shall connect to the bases of stacks at a point located not less than ten (10) times the diameter of the drainage stack downstream from the stack. Horizontal branches shall connect to horizontal stack offsets at a point located not less than ten (10) times the diameter of the drainage stack downstream of the upper stack.
- H. In the installation or removal of any part of a drainage system, dead ends shall be prohibited. Cleanout extensions and approved future fixture drainage piping shall not be considered as dead ends.
- I. Joints between polyvinyl chloride (PVC) plastic pipe or fittings shall comply with the following:
 - 1. Solvent cementing: Joint surfaces shall be clean and free of moisture. A purple primer or an ultraviolet purple primer that conforms to ASTM F656 shall be applied. When an ultraviolet primer is used, the installer shall provide an ultraviolet light to the inspector to be used during the inspection. Solvent cement, not purple in color and conforming to ASTM D2564 shall be applied to all joint surfaces. The joint shall be made while the cement is wet and shall be in accordance with ASTM D2855. Solvent cement joints shall be permitted above or below ground. Install underground piping in accordance with ASTM D2321.
- J. Outdoor vent extensions shall comply with the following:
 - 1. Every building in which plumbing is installed shall have at least one (1) stack the size of which is not less than one-half (1/2) of the required diameter of the building drain, and not less than two (2) inches in diameter. Such stack shall run undiminished in size and as directly as possible from the building drain through to the open air or to a vent header that extends to the open air.
 - 2. Vent stacks or stack vents shall extend outdoors and terminate in the open air.
 - 3. Every stack vent shall connect to the base of the drainage stack. The vent stack shall connect at or below the lowest horizontal branch. Where the vent stack connects to the building drain, the connection shall be located downstream of the drainage stack and within ten (10) times the diameter of the drainage stack.
- K. Vent terminals shall comply with the following:
 - 1. All open vent pipes that extend through a roof shall be terminated at least six (6) inches above the roof, except that where a roof is used by the public or tenants for any purpose, the vent extensions shall be run at least seven (7) feet above the roof.
 - 2. Where the ninety-seven-and-one-half (97.5) percent value for outside design temperature is zero (0) degrees Fahrenheit or less, every vent extension through a roof or wall shall be a minimum of three (3) inches in diameter. Any increase in the size of the vent shall be made inside the structure to a minimum of one (1) foot below the roof or inside the wall.
 - 3. The juncture of each vent pipe with the roof line shall be made water-tight by an approved flashing. Refer to specification section 22 01 00.
 - 4. Vent terminals shall not be used as a flagpole or to support flag poles, television aerials, or similar items, except when the piping has been anchored in an approved manner.

5. An open vent terminal from a drainage system shall not be located directly beneath any door, operable window, or other air intake opening of the building or of an adjacent building or property line, and any such vent terminal shall not be within ten (10) feet horizontally of such an opening unless it is at least two (2) feet above the top of such opening.
 6. Vent terminals extending through the wall shall terminate a minimum of ten (10) feet from the lot line and ten (10) feet above average ground level. Vent terminals shall not terminate under the overhang structure with soffit vents. Side wall vent terminals shall not terminate horizontally to prevent birds or rodents from entering or blocking the vent opening.
 7. In climates where the ninety-seven-and-one-half (97.5) percent value for outside design temperature is less than zero (0) degrees Fahrenheit, vent pipes installed on the exterior of the structure shall be protected against freezing by insulation, heat, or both.
- L. Vent connections shall comply with the following:
1. All individual, branch, and circuit vents shall connect to a vent stack, stack vent, air admittance valve, or extend to the open air.
 2. All vent and branch vent pipes shall be so graded and connected as to drain back to the drainage pipe by gravity.
 3. Every dry vent connecting to a horizontal drain shall connect above the centerline of the horizontal drainpipe.
 4. Every dry vent shall rise vertically to a minimum of six (6) inches above the flood level rim of the highest trap or trapped fixture being vented.
 - a. Exception: When vents for interceptors and isolated floor drains are not located near an adjacent wall, the vent must rise six (6) inches vertically before turning horizontally and continuing to the nearest wall. A cleanout the same size as the vent shall be provided.
 5. A connection between a vent pipe and a vent stack or stack vent shall be made at least six (6) inches above the flood level rim of the highest fixture served by the vent. Horizontal vent pipes forming branch vents, relief vents, or loop vents shall be at least six (6) inches above the flood level rim of the highest fixture served.
- M. Fixture vents shall comply with the following:
1. Each fixture trap shall have a protecting vent located so that the slope and the developed length in the fixture drain from the trap weir to the vent fitting are as indicated in Table 906.1 of the North Carolina Plumbing Code.
 2. The total fall in a fixture drain due to pipe slope shall not exceed the diameter of the fixture drain, nor shall the vent connection to a fixture drain, except for water closets, be below the weir of the trap.
 3. A vent shall not be installed within two (2) pipe diameters of the trap weir.
- N. Each trap and trapped fixture is permitted to be provided with an individual vent. The individual vent shall connect to the fixture drain of the trap or trapped fixture being vented.
- O. Common vents shall comply with the following:
1. An individual vent is permitted to vent two (2) traps or trapped fixtures as a common vent. The traps or trapped fixtures being commonly vented shall be located on the same floor level.
 2. Where the fixture drains being commonly vented connect at the same level, the vent connection shall be at the interconnection of the fixture drains or downstream of the interconnection.
 3. Where the fixture drains being commonly vented connect at difference levels, the vent shall connect as a vertical extension of the vertical drain. The vertical drainpipe connecting the two (2) fixtures shall be considered the vent for the lower fixture drain. The upper fixture shall not be a water closet or clothes washer.

- P. Wet venting shall comply with the following:
1. Any combination of fixtures located on the same floor level is permitted to be vented by a wet vent. The wet vent shall be considered the vent for the fixtures and shall extend from the connection of the dry vent along the direction of flow in the drainpipe to the most downstream fixture drain connection to the horizontal branch drain. A residential clothes washer drain line shall not be used as a wet vent.
 - a. Any combination of fixtures located on the same floor level is permitted to be vented by a vertical wet vent. The vertical wet vent shall be considered the vent for the fixtures and shall extend from the connection of the dry vent down to the lowest fixture drain connection. Each fixture shall connect independently to the vertical wet vent. Water closet drains shall connect at the same elevation. Other fixture drains shall connect above or at the same elevation as the water closet fixture drains. The dry vent connection to the vertical wet vent shall be an individual or common vent serving one (1) or two (2) fixtures.
 2. The dry vent connection to the wet vent shall be an individual vent or common vent. The dry vent shall be sized based on the largest required diameter of pipe within the wet vent system served by the dry vent.
- Q. Circuit venting shall comply with the following:
1. A maximum of eight (8) fixtures connected to a horizontal branch drain shall be permitted to be circuit vented. Each fixture drain shall connect horizontally to the horizontal branch being circuit vented. The horizontal branch drain shall be classified as a vent from the most downstream fixture drain to the most upstream fixture drain connection to the horizontal branch.
 - a. Circuit vented horizontal branch drains are permitted to be connected. Each group of a maximum of eight (8) fixtures shall be considered a separate circuit vent.
 2. The circuit vent connection shall be located between the two (2) most upstream fixture drains. The vent shall connect to the horizontal branch. The circuit vent pipe shall not receive the discharge of any waste pipe.
 3. The maximum slope of the vent section of the horizontal branch drain shall be one (1) inch per foot.
 4. A relief vent shall be provided for circuit vented horizontal branches receiving the discharge of four (4) or more water closets and connecting to a drainage stack that receives the discharge from upper horizontal branches.
 - a. The relief vent shall connect to the horizontal branch drain between the stack and the most downstream fixture drain of the circuit vent.
 - b. The relief vent is permitted to be a fixture drain or fixture branch for fixtures located within the same branch interval as the circuit vented horizontal branch. The maximum discharge to a relief vent shall be four (4) fixture units.
 5. Fixtures, other than the circuit vented fixtures are permitted to discharge to the horizontal branch drain. Such fixtures shall be located on the same floor as the circuit vented fixtures and shall be either individually or commonly vented.

3.2 VALVE INSTALLATION:

- A. Air admittance valves shall be installed in accordance with the following:
1. Air admittance valves shall be installed in accordance with the manufacturer's installation instructions and after the drainage and vent air or water test but before the drainage and vent final test.
 2. Individual, branch, and circuit vents shall be permitted to terminate with a connection to an air admittance valve. The air admittance valves shall vent only fixtures that are on the same floor level and connect to a horizontal branch drain.

- a. The horizontal branch drain shall connect to the drainage stack or building drain at a maximum of four (4) branch intervals from the top of the stack.
 - b. If the horizontal branch is located more than four (4) branch intervals from the top of the stack, the horizontal branch shall be provided with a relief vent that shall connect to a vent stack or stack vent or extend outdoors to the open air. The relief vent shall connect to the horizontal branch drain between the stack or building drain and the most downstream fixture drain connected to the horizontal branch drain.
3. The air admittance valve shall be located at a minimum of four (4) inches above the horizontal branch drain or fixture drain being vented. The air admittance valve shall be located within the maximum developed length permitted for the vent. The air admittance valve shall be installed a minimum of six (6) inches above insulation materials.
4. Access shall be provided to all air admittance valves. The valve shall be located within a ventilated space that allows air to enter the valve.
5. The air admittance valve shall be rated in accordance with the standard for the size of the vent to which the valve is connected.
6. Within each plumbing system, a minimum of one (1) stack vent or vent stack shall extend outdoors to the open air.
7. Air admittance valves shall not be installed in non-neutralized special waste systems. Air admittance valves shall not be in spaces utilized as supply or return air plenums. Air admittance valves without an engineered design shall not be utilized to vent sumps or tanks of any type.

3.3 FLOOR DRAIN INSTALLATION

- A. Coordinate the final location of all floor drains dedicated to serving equipment with the equipment provider prior to installation.
- B. Floor drains shall be installed with tops and strainers level with the floor slab.

3.4 FLOOR SINK INSTALLATION

- A. Coordinate the final location of all floor sinks dedicated to serving equipment with the equipment provider prior to installation.
- B. Floor sinks shall be installed with tops and strainers level with the floor slab.

3.5 CLEANOUT INSTALLATION:

- A. Plugs shall have raised square or countersunk square heads. Countersunk heads shall be installed where raised heads are a trip hazard.
- B. Cleanouts shall be in accordance with the following:
 1. All horizontal drains shall be provided with cleanouts located not more than one hundred (100) feet apart.
 2. One cleanout shall be required for every four (4) horizontal forty-five (45) degree changes located in series. A long sweep bend is equivalent to two (2) forty-five (45) degree bends.
 3. A cleanout shall be provided at the base of each waste or soil stack.
 4. There shall be a cleanout at the junction of the building drain and the building sewer. The cleanout shall be outside the building wall and shall be brought up to the finished ground level. An approved two-way cleanout is to be used at this location to serve as a required cleanout for both the building drain and building sewer.
 - a. The cleanout at the junction of the building drain and building sewer shall not be required if the cleanout on a three (3) inch or larger diameter waste stack is located within a developed length of not more than fifteen (15) feet from the building drain and building sewer connections and is extended to the outside of the building.

- C. Cleanout plugs shall not be covered with cement, plaster, or any other permanent finish material. Where it is necessary to conceal a cleanout or to terminate a cleanout in an area subject to vehicular traffic, the covering plate, access door, or cleanout shall be of an approved type designed and installed for this purpose.
- D. Every cleanout shall be installed to open to allow cleaning in the direction of flow of the drainage piping or at right angles thereto.
- E. Cleanout openings shall not be utilized for the installation of new fixtures, except where approved and where another cleanout of equal access and capacity is provided.
- F. Cleanouts shall be the same nominal size of the pipe they serve up to four (4) inches. For pipes larger than four (4) inches nominal size, the minimum size of the cleanout shall be four (4) inches.
- G. Cleanouts on six (6) inch and smaller pipes shall be provided with a clearance of not less than eighteen (18) inches for rodding. Cleanouts on eight (8) inch and larger pipes shall be provided with a clearance of not less than thirty-six (36) inches for rodding.
- H. Access shall be provided to all cleanouts.
- I. Each horizontal drainage pipe shall be provided with a clean out at the upstream end of the pipe.
 - 1. The following plumbing arrangements are acceptable in lieu of the upstream cleanout:
 - a. P-traps connected to the drainage piping with slip joints or ground joint connections.
 - b. P-traps into which floor drains, shower drains, or tub drains with removable strainers discharge.
 - c. P-traps into which straight through type waste and overflow discharge with the overflow connecting to the top of the tee.
 - d. P-traps into which residential washing machines discharge.
 - e. Test tees or cleanouts in a vertical pipe.
 - f. Cleanout near the junction of the building drain and the building sewer which may be rodded in both directions.
 - g. Water closets for the water closet fixture drain only.
 - h. Cast iron cleanout sizing shall be in accordance with ASTM A74 for hub and spigot fittings or CISPI 301 for hubless fittings.

3.6 INTERCEPTOR INSTALLATION

- A. Install interceptors in accordance with the information provided in the construction documents and all manufacturer's installation instructions and recommendations.

3.7 INSPECTION AND TESTING:

- A. Refer to specification section for general inspection and testing requirements and performance requirements of test gauges.
- B. Drainage and vent water test:
 - 1. A water test shall be applied to the drainage system within the building either in its entirety or in sections.
 - 2. If applied to the entire system, all openings in the piping shall be tightly closed, except the highest opening, and the system shall be filled with water to the point of overflow.
 - 3. If the system is tested in sections, each opening shall be tightly plugged except the highest openings of the section under test, and each section shall be filled with water, but no section shall be tested with less than a ten (10) foot head of water.
 - 4. In testing successive sections, at least the upper ten (10) feet of the next preceding section shall be tested so that no joint or pipe in the building, except the uppermost ten (10) feet of the system shall have been submitted to a test of less than a ten (10) foot head of water.
 - 5. This pressure shall be held for at least fifteen (15) minutes. Then the system shall then be tight at all points.

- C. Drainage and vent final test:
 - 1. The final test of the completed drainage and vent systems shall be visual and in sufficient detail to determine compliance with the provisions of the contract documents.

END OF SECTION

SECTION 22 14 00

ROOF DRAINAGE SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY:

- A. Section includes:
 - 1. Aboveground storm drainage piping.
 - 2. Elevator sump pump discharge piping.
 - 3. Valves.
 - 4. Roof drains.
 - 5. Discharge outlets.
 - 6. Cleanouts.

1.2 REFERENCES:

- A. ASME International:
 - 1. ASME A112.21.2 – Roof Drains.
 - 2. ASME B1.20.1 – Pipe Threads, General Purpose (Inch).
 - 3. ASME B16.11 – Forged Fittings, Socket-Welding and Threaded.
 - 4. ASME B31.9 – Building Services Piping.
- B. ASTM International:
 - 1. ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - 2. ASTM A74 – Standard Specification for Cast Iron Soil Pipe and Fittings.
 - 3. ASTM A888 – Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
 - 4. ASTM C564 – Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
 - 5. ASTM C1540 – Standard Specification for Heavy Duty Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings.
 - 6. ASTM C1563 – Standard Test Method for Gaskets for Use in Connection with Hub and Spigot Cast Iron Soil Pipe and Fittings for Sanitary Drain, Waste, Vent, and Storm Piping Applications.
- C. Cast Iron Soil Pipe Institute:
 - 1. CISPI 301 – Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
 - 2. CISPI 310 – Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
- D. Manufacturers Standardization Society of the Valve and Fittings Industry:
 - 1. MSS SP 80 – Bronze Gate, Globe, Angle and Check Valves.

1.3 SUBMITTALS:

- A. Refer to specification section 22 01 05 for submittal requirements, definitions, and procedures.
- B. Submit manufacturer's data for the following:
 - 1. Aboveground storm drainage piping.
 - 2. Elevator sump pump discharge piping.
 - 3. Valves.
 - 4. Roof drains.

- 5. Discharge outlets.
- 6. Cleanouts.

1.4 OPERATION AND MAINTENANCE MANUALS:

- A. Refer to specification section 22 01 05 for submittal requirements, definitions, and procedures.
- B. Submit manufacturer's data, manufacturer's warranties, and operation and maintenance instructions for the following:
 - 1. Aboveground storm drainage piping.
 - 2. Elevator sump pump discharge piping.
 - 3. Valves.
 - 4. Roof drains.
 - 5. Discharge outlets.
 - 6. Cleanouts.

PART 2 - PRODUCTS

2.1 UNDERGROUND STORM DRAINAGE PIPING:

- A. Cast iron pipe:
 - 1. Pipe:
 - a. Hub and spigot: ASTM A74.
 - 2. Fittings:
 - a. Hub and spigot: ASTM A74.
 - 3. Joints:
 - a. Hub and spigot:
 - 1) Compression gasket: ASTM C564, ASTM C1563.
- B. Pipe fittings shall not have ledges, shoulders, or reductions capable of retarding or obstructing flow in the piping. Threaded drainage pipe fittings shall be of the recessed drainage type.

2.2 ABOVEGROUND STORM DRAINAGE PIPING:

- A. Cast iron pipe:
 - 1. Pipe:
 - a. Hubless: ASTM A888, CISPI 301.
 - 2. Fittings:
 - a. Hubless: ASTM A888, CISPI 301.
 - 3. Joints:
 - a. Hubless shielded couplings: ASTM C564, CISPI 310.
 - 1) Heavy duty: ASTM C1540.
- B. Pipe fittings shall not have ledges, shoulders, or reductions capable of retarding or obstructing flow in the piping. Threaded drainage pipe fittings shall be of the recessed drainage type.

2.3 VALVES:

- A. Gate Valves:
 - 1. Two (2) inches and smaller: MSS SP 80, Class 150, bronze body, bronze trim, full-port, threaded bonnet, non-rising stem, hand-wheel, inside screw with back-seating stem, solid wedge disc, alloy seat rings, threaded ends.
- B. Swing check valves:
 - 1. Two (2) inches and smaller: MSS SP 80, Class 150, bronze body and cap, bronze seat, Buna-N disc, threaded ends.

2.4 ROOF DRAINS:

- A. Roof drain (RD1):

1. Assembly: ASME A112.21.2.
 2. Body: Lacquered cast iron with sump.
 3. Strainer: Removable cast bronze dome with vandal proof screws.
 4. Accessories: Coordinate with roofing type:
 - a. Membrane flange and membrane clamp with integral gravel stop.
 - b. Adjustable under deck clamp.
 - c. Roof sump receiver.
 - d. Waterproofing flange.
 - e. Controlled flow weir.
 - f. Leveling frame.
 - g. Adjustable extension sleeve for roof insulation.
 - h. Perforated or slotted ballast guard extension for inverted roof.
 - i. Perforated stainless steel ballast guard extension.
- B. Roof drain (RD2):
1. Assembly: ASME A112.21.2.
 2. Body: Lacquered cast iron with sump.
 3. Strainer: Removable cast bronze dome with vandal proof screws.
 4. Accessories: Coordinate with roofing type:
 - a. Internal two-inch water dam.
 - b. Membrane flange and membrane clamp with integral gravel stop.
 - c. Adjustable under deck clamp.
 - d. Roof sump receiver.
 - e. Waterproofing flange.
 - f. Controlled flow weir.
 - g. Leveling frame.
 - h. Adjustable extension sleeve for roof insulation.
 - i. Perforated or slotted ballast guard extension for inverted roof.
 - j. Perforated stainless steel ballast guard extension.

2.5 DISCHARGE OUTLETS:

- A. Downspout nozzles:
1. Stainless steel nozzle with anchoring wall flange and hinged, perforated outlet. Provide with outlet suitable for connection to piping.

2.6 CLEANOUTS:

- A. Cleanout plugs shall be brass. Brass cleanout plugs shall be utilized with metallic drain, waste, and vent piping only, and shall conform to ASTM A74. Cleanouts with plate-style access covers shall be fitted with corrosion-resistant fasteners.
- B. Exterior surfaced areas: Round or square access frame and non-skid cover.
- C. Exterior unsurfaced areas: Line type with round cover with gasket.
- D. Interior finished floor areas: Body with anchor flange, reversible clamping collar, threaded top assembly, and round scored cover with gasket in service areas and round or square depressed cover with gasket to accept floor finish in finished floor areas.
- E. Interior finished wall areas: Line type with round cover with gasket, and round stainless-steel access cover secured with machine screw.
- F. Interior unfinished accessible areas: Caulked or threaded type.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION:

- A. Fittings shall be installed to guide sewage and waste in the direction of flow. Change in direction shall be made by fittings installed in accordance with the North Caroling Plumbing Code.
- B. Where separate systems of sanitary drainage and storm drainage are installed in the same property, the sanitary and storm building sewers or drains shall be permitted to be laid side by side in one trench.
- C. Horizontal storm drainage piping shall be installed in uniform alignment at uniform slopes. The minimum slope of a horizontal drainage pipe shall be one-quarter (1/4) inch per foot, unless noted otherwise on the plans.
- D. The size of storm drainage piping shall not be reduced in size in the direction of flow.
- E. Joints between cast iron pipe or fittings shall comply with the following:
 - 1. Compression gasket joints: Compression gaskets for hub and spigot pipe and fittings shall conform to ASTM C564 and shall be tested to ASTM C1563. Gaskets shall be compressed when the pipe is fully inserted.
 - 2. Mechanical joint couplings: Mechanical joint couplings for hubless pipe and fittings shall comply with CISPI 310 or ASTM C1540. The elastomeric sealing sleeve shall conform to ASTM C564 and shall be provided with a center stop. Mechanical joint couplings shall be installed in accordance with the manufacturer's instructions.

3.2 ROOF DRAIN INSTALLATION:

- A. Coordinate mounting and flashing accessories with the general contractor prior to ordering.
- B. Furnish roof drains to general contractor for installation.

3.3 DISCHARGE OUTLET INSTALLATION:

- A. Coordinate installation with general contractor. Maintain full or half masonry unit spacing for penetrations through masonry walls.

3.4 CLEANOUT INSTALLATION:

- A. Plugs shall have raised square or countersunk square heads. Countersunk heads shall be installed where raised heads are a trip hazard.
- B. Cleanouts shall be located in accordance with the following:
 - 1. All horizontal drains shall be provided with cleanouts located not more than one hundred (100) feet apart.
 - 2. One cleanout shall be required for every four (4) horizontal forty-five (45) degree changes located in series. A long sweep bend is equivalent to two (2) forty-five (45) degree bends.
 - 3. A cleanout shall be provided at the base of each stack.
 - 4. There shall be a cleanout at the junction of the storm drain and the storm sewer. The cleanout shall be outside the building wall and shall be brought up to the finished ground level. An approved two-way cleanout is to be used at this location to serve as a required cleanout for both the storm drain and storm sewer.
- C. Cleanouts on concealed piping or piping under a floor slab or in a crawlspace of less than twenty-four (24) inches in height or a plenum shall be extended through and terminate with the finished wall, floor, or ground surface or shall be extended to the outside of the building.
- D. Cleanout plugs shall not be covered with cement, plaster, or any other permanent finish material. Where it is necessary to conceal a cleanout or to terminate a cleanout in an area subject to vehicular traffic, the covering plate, access door, or cleanout shall be of an approved type designed and installed for this purpose.

- E. Every cleanout shall be installed to open to allow cleaning in the direction of flow of the drainage piping or at right angles thereto.
- F. Cleanouts shall be the same nominal size of the pipe they serve up to four (4) inches. For pipes larger than four (4) inches nominal size, the minimum size of the cleanout shall be four (4) inches.
- G. Cleanouts on six (6) inch and smaller pipes shall be provided with a clearance of not less than eighteen (18) inches for rodding. Cleanouts on eight (8) inch and larger pipes shall be provided with a clearance of not less than thirty-six (36) inches for rodding.
- H. Access shall be provided to all cleanouts.
- I. Each horizontal storm drainage pipe shall be provided with a clean out at the upstream end of the pipe.

3.5 INSPECTION AND TESTING:

- A. Refer to section 22 01 00 for general inspection and testing requirements and performance requirements of test gauges.
- B. Drainage and vent water test:
 - 1. A water test shall be applied to the storm drainage system within the building either in its entirety or in sections.
 - 2. If applied to the entire system, all openings in the piping shall be tightly closed, except the highest opening, and the system shall be filled with water to the point of overflow.
 - 3. If the system is tested in sections, each opening shall be tightly plugged except the highest openings of the section under test, and each section shall be filled with water, but no section shall be tested with less than a ten (10) foot head of water.
 - 4. In testing successive sections, at least the upper ten (10) feet of the next preceding section shall be tested so that no joint or pipe in the building, except the uppermost ten (10) feet of the system shall have been submitted to a test of less than a ten (10) foot head of water.
 - 5. This pressure shall be held for at least fifteen (15) minutes. Then the system shall then be tight at all points.
- C. Drainage and vent final test:
 - 1. The final test of the completed storm drainage systems shall be visual and in sufficient detail to determine compliance with the provisions of the contract documents.

END OF SECTION

SECTION 22 16 00
FUEL GAS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY:

- A. Section includes:
 - 1. Underground piping.
 - 2. Aboveground piping.
 - 3. Unions, adapters, and flanges.
 - 4. Valves.

1.2 REFERENCES:

- A. ASME International:
 - 1. ASME B1.20.1 – Pipe Threads, General Purpose (Inch).
 - 2. ASME B16.3 – Malleable Iron Threaded Fittings: Classes 150 and 300.
 - 3. ASME B31.9 – Building Services Piping.
- B. ASTM International:
 - 1. ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

1.3 SUBMITTALS:

- A. Refer to specification section 22 01 05 for submittal requirements, definitions, and procedures.
- B. Submit manufacturer's data for the following:
 - 1. Aboveground piping.
 - 2. Unions, adapters, and flanges.
 - 3. Valves.

1.4 OPERATION AND MAINTENANCE MANUALS:

- A. Refer to specification section 22 01 05 for submittal requirements, definitions, and procedures.
- B. Submit manufacturer's data, manufacturer's product warranties, and operation and maintenance instructions for the following:
 - 1. Aboveground piping.
 - 2. Unions, adapters, and flanges.
 - 3. Valves.

PART 2 - PRODUCTS

2.1 ABOVEGROUND PIPING:

- A. Steel pipe: ASTM A53.
 - 1. Fittings:
 - a. Threaded: ASME B16.3.

2.2 UNIONS, ADAPTERS, AND FLANGES:

- A. Malleable iron unions for threaded ferrous piping.

2.3 VALVES:

- A. Plug:
 - 1. Cast iron body, eccentric action plug, with resilient plug facings of nitrile butadiene.
- B. Pressure regulators:

1. Diaphragm actuated with cast iron body, aluminum diaphragm chamber, and all internal parts designed for use with natural gas.
2. Adjustable, with automatic loading, automatic low-pressure cut-off, and full internal relief.
3. The regulator shall be adjusted for outlet pressure indicated on the drawings. The outlet pressure shall not vary more than one (1) inch of water column from the set point at specified capacity.
4. The regulator shall be capable of complete shut-off in the event the supply pressure is interrupted or the gas demand exceeds the regulator capacity and shall remain off until the regulator is manually reset.
5. The regulator shall have a weatherproof, bug proof, screened vent cap installed in the vent tapping.

PART 3 - EXECUTION

3.1 SERVICE CONNECTIONS:

- A. Coordinate new gas service complete with bulk storage, supply to building, and regulator to system supply with the utility provider.

3.2 PIPING INSTALLATION:

- A. Piping shall be neatly arranged – straight, parallel, or at right angles to walls – and cut accurately to established measurements.
- B. Group piping whenever practical at common elevations.
- C. Pipes shall be worked into place without springing or forcing.
- D. Sufficient headroom shall be provided to enable the clearing of light fixtures, ductwork, sprinklers, aisles, passageways, windows, doors, and other openings.
- E. Pipes shall not interfere with access to maintain equipment.
- F. Pipes shall be clean, free of cuttings and foreign matter inside, and exposed ends shall be covered during site storage and installation. Split, bent, flattened, or otherwise damaged pipe or tubing shall not be used.
- G. Sufficient clearance shall be provided from walls, ceilings, and floors to permit the welding, soldering, or connecting of joints and valves. No less than six (6) inches of clearance shall be provided.
- H. Piping systems shall not interfere with the proper operation and maintenance of safety or relief valves.
- I. Install unions downstream of valves and at equipment or apparatus connections.
- J. Provide access doors where valves are not accessible. Refer to section 22 01 00.
- K. Joints between steel pipe or fittings shall comply with the following:
 1. Threaded joints: Threads shall conform to ASME B1.20.1. Pipe-joint compound or tape shall be applied on the male threads only.

3.3 VALVE INSTALLATION:

- A. Provide temporary protective coating on steel valves.
- B. Install valves with stems upright or horizontal, not inverted.
- C. Access shall be provided to all shutoff valves. Provide access doors where valves are not accessible. Refer to specification section 22 01 00.

3.4 INSPECTION AND TESTING:

- A. Prior to acceptance and initial operation, all piping installations shall be inspected, and pressure tested to determine that the materials, design, fabrication, and installation practices are in accordance with the North Carolina Fuel Gas Code.

1. Inspection shall consist of visual examination, during or after manufacture, fabrication, assembly, or pressure tests as appropriate.
 2. In the event repairs or additions are made after the pressure test, the affected piping shall be tested.
 - a. Minor repairs and additions are not required to be pressure tested if the work is inspected and connections are tested with a noncorrosive leak-detecting fluid or other approved detecting methods.
 3. Where new branches are installed to new appliances, only the newly installed branches shall be required to be pressure tested. Connections between the new piping and the existing piping shall be tested with a noncorrosive leak-detecting fluid or other approved detecting methods.
 4. A piping system shall be permitted to be tested as a complete unit or in sections. Under no circumstances shall a valve in a line be used as a bulkhead between gas in one section of the piping system and test medium in an adjacent section, unless two valves are installed in series with a valved "telltale" located between these valves. A valve shall not be subjected to the test pressure unless it can be determined that the valve, including the valve-closing mechanism, is designed to safely withstand the test pressure.
 5. Regulator and valve assemblies fabricated independently of the piping system in which they are to be installed shall be permitted to be tested with inert gas or air at the time of fabrication.
- B. The test medium shall be air, nitrogen, carbon dioxide, or an inert gas. Oxygen shall not be used.
- C. Pipe joints, including welds, shall be left exposed for examination during the test.
1. Concealed pipe end joints that have been previously tested are permitted to remain concealed.
 2. Expansion joints shall be provided with temporary restraints, if required, for the additional thrust load under test.
 3. Appliances and equipment that are not to be included in the test shall be either disconnected from the piping or isolated by blanks, blind flanges, or caps. Flanged joints at which blinds are inserted to blank off other equipment during the test shall not be required to be tested.
 4. Where the piping system is connected to appliances or equipment designed for operating pressures of less than the test pressure, such appliances or equipment shall be isolated from the piping system by disconnecting them and capping the outlet(s).
 5. Where the piping system is connected to appliances or equipment designed for operating pressures equal to or greater than the test pressure, such appliances or equipment shall be isolated from the piping system by closing the individual appliance or equipment shutoff valve.
 6. All testing of piping systems shall be done with due regard for the safety of employees and the public during the test. Bulkheads, anchorage, and bracing suitably design to resist test pressures shall be installed if necessary. Prior to testing, the interior of the pipe shall be cleared of all foreign material.
- D. Test pressure shall be measured with a manometer or with a pressure-measuring device designed and calibrated to read, record, or indicate a pressure loss caused by leakage during the pressure test period. The source of pressure shall be isolated before the pressure tests are made. Mechanical gauges used to measure test pressures shall have a range such that the highest end of the scale is not greater than five times the test pressure.
1. The test pressure to be used shall be no less than one-and-one-half (1-1/2) times the proposed maximum working pressure, but not less than three (3) psig, irrespective of design pressure. Where the test pressure exceeds one-hundred-twenty-five (125) psig, the

- test pressure shall not exceed a value that produces a hoop stress in the piping greater than fifty (50) percent of the specified minimum yield strength of the pipe.
2. Test duration shall not be less than thirty (30) minutes for each five hundred (500) cubic feet of pipe volume or fraction thereof. When using a system having a volume less than ten (10) cubic feet, the test duration shall be not less than ten (10) minutes. The duration of the test shall not be required to exceed twenty-four (24) hours.
- E. The piping system shall withstand the test pressure specified without showing any evidence of leakage or other defects. Any reduction of test pressures as indicated by pressure gauges shall be deemed to indicate the presence of a leak unless such reduction can be readily attributed to some other cause.
1. The leakage shall be located by means of an approved gas detector, a noncorrosive leak detection fluid, or other approved leak detection methods. Matches, candles, open flames, or other methods that could provide a source of ignition shall not be used.
 2. Where leakage or other defects are located, the affected portion of the piping system shall be repaired or replaced and retested.

END OF SECTION

SECTION 22 34 00

FUEL-FIRED DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY:

- A. Section includes:
 - 1. Storage type water heaters.

1.2 REFERENCES:

- A. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
 - 1. ASHRAE 90.1 – Energy Standard for Buildings Except Low-Rise Residential Buildings.
- B. ASME International:
 - 1. ASME PTC 25 – Pressure Relief Devices.
 - 2. ASME Section VIII – Boiler and Pressure Vessel Code - Pressure Vessels.
- C. National Fire Protection Association (NFPA):
 - 1. NFPA 70 – National Electrical Code.

1.3 SUBMITTALS:

- A. Refer to specification section 22 01 05 for submittal requirements, definitions, and procedures.
- B. Submit manufacturer's data, manufacturer's warranties, and operation and maintenance instructions for the following:
 - 1. Storage type water heaters.

1.4 OPERATION AND MAINTENANCE MANUALS:

- A. Refer to specification section 22 01 05 for submittal requirements, definitions, and procedures.
- B. Submit manufacturer's data, manufacturer's warranties, and operation and maintenance instructions for the following:
 - 1. Storage type water heaters.

PART 2 - PRODUCTS

2.1 STORAGE TYPE WATER HEATERS:

- A. Type: Factory-assembled and wired, natural gas-fired, vertical storage.
- B. Capacity: As specified in water heater schedule on drawings.
- C. Tank: Glass-lined welded steel; four (4) inch diameter inspection port, thermally insulated with minimum two (2) inches polyurethane encased in corrosion-resistant steel jacket; baked-on enamel finish.
- D. Controls: Automatic water thermostat with adjustable temperature range from 120 to 180 degrees F. Automatic reset high temperature limiting thermostat factory set at 195 degrees F, gas pressure regulator, multi-ribbon or tubular burner, 100 percent safety shut-off pilot and thermocouple, flue baffle and draft hood.
- E. Accessories: Brass water connections and dip tube, drain valve, magnesium anode, and ASME rated temperature and pressure relief valve.
- F. Electrical characteristics: As specified in water heater schedule on drawings.
- G. Disconnect switch: Provided by electrical contractor.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Maintain manufacturer's recommended clearances around and over water heaters.
- B. Connect fuel gas piping in accordance with the North Carolina Fuel Gas Code.
- C. Connect fuel gas piping to water heater, full size of water heater gas train inlet. Arrange piping with clearances for burner removal and service.
- D. Connect domestic cold-water piping to supply and return water heater connections.
- E. Install the following piping accessories. Refer to specification section 22 11 00.
 - 1. On supply:
 - a. Thermometer well and thermometer
 - b. Shutoff valve
 - 2. On return:
 - a. Thermometer well and thermometer
 - b. Shutoff valve
- F. Install the following piping accessories on natural gas piping connections. Refer to specification section 22 16 00.
 - 1. Shutoff valve
- G. Connect flue and intake full size to water heater in accordance with the manufacturer's instructions. Only chlorinated polyvinyl chloride (CPVC) pressure piping shall be permitted.

END OF SECTION

SECTION 22 40 00

PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Flush valve water closets.
 - 2. Lavatories.
 - 3. Electric water coolers.
 - 4. Sinks.
 - 5. Showers.
 - 6. Custodial sinks.
 - 7. Utility sinks.
 - 8. Automatic clothes washers.
 - 9. Dishwashers.
 - 10. Emergency fixtures.
 - 11. ADA compliant insulation kits.

1.2 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI A117.1 – Accessible and Usable Buildings and Facilities.
- B. United States Department of Justice:
 - 1. ADA Standards for Accessible Design.

1.3 SUBMITTALS

- A. Refer to specification section 22 01 05 for submittal requirements, definitions, and procedures.
- B. Submit manufacturer's data for the following:
 - 1. Flush valve water closets.
 - 2. Lavatories.
 - 3. Electric water coolers.
 - 4. Sinks.
 - 5. Showers.
 - 6. Custodial sinks.
 - 7. Utility sinks.
 - 8. Automatic clothes washers.
 - 9. Dishwashers.
 - 10. Emergency fixtures.
 - 11. ADA compliant insulation kits.

1.4 OPERATION AND MAINTENANCE MANUALS

- A. Refer to specification section 22 01 05 for submittal requirements, definitions, and procedures.
- B. Submit manufacturer's data, manufacturer's warranties, and operation and maintenance instructions for the following:
 - 1. Flush valve water closets.
 - 2. Lavatories.
 - 3. Electric water coolers.

4. Sinks.
5. Showers.
6. Custodial sinks.
7. Utility sinks.
8. Automatic clothes washers.
9. Dishwashers.
10. Emergency fixtures.
11. ADA compliant insulation kits.

PART 2 - PRODUCTS

2.1 FLUSH VALVE WATER CLOSETS

- A. Bowl: ASME A112.19.2; floor mounted, siphon jet, vitreous China closet bowl with elongated rim, 1-1/2-inch top spud, bolt caps.
- B. Exposed flush valve: ASME A112.18.1; exposed chrome-plated, diaphragm type with self-generating operated solenoid operator and infrared sensor, escutcheon, seat bumper, integral screwdriver stop and vacuum breaker; maximum 1.28-gallon flush volume.
- C. Seat: white plastic, open front, extended back, self-sustaining check hinge, brass bolts, without cover.

2.2 LAVATORIES

- A. Vitreous China wall-hung basin: ASME A112.19.2; vitreous China wall-hung lavatory, twenty (20) by eighteen (18) inches nominal dimensions, with four- (4) inch high back, drillings to match faucet, rectangular basin with splash lip, and front overflow.
- B. Sensor-operated faucet: ASME A112.18.1; chrome-plated metered, mixing faucet with self-generating operated solenoid operator and infrared sensor, vandal proof water economy aerator with maximum 0.5 gallons per minute flow.
- C. Manual faucet: ASME A112.18.1; chrome-plated brass supply and spout, vandal proof water economy aerator with maximum 0.5 gpm flow, indexed single lever handle.
- D. Accessories:
 1. Chrome plated seventeen (17) gauge brass P-trap with cleanout plug and arm with escutcheon.
 2. Perforated open strainer.
 3. Screwdriver stops.
 4. Rigid supplies with escutcheons.
 5. Trap and waste offset and insulated to meet ADA compliance where exposed.
- E. Wall-mounted carrier: ASME A112.6.1; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, concealed arm supports, bearing plate and studs.

2.3 ELECTRIC WATER COOLERS

- A. Fountain:
 1. ARI 1010; surface-mounted electric water cooler with stainless steel top, stainless steel body, elevated anti-squirt bubbler with stream guard, automatic stream regulator, push button, mounting bracket, refrigerated with integral air-cooled condenser.
 2. Capacity: Eight (8) gpm of fifty (50) degrees Fahrenheit water with inlet at eighty (80) degrees Fahrenheit and room temperature of ninety (90) degrees Fahrenheit.
 3. Electrical: Maximum one-half (1/2) horsepower compressor, six- (6) feet cord and plug for connection to electric wiring system including grounding connector.
- B. Provide supply with replaceable inline cartridge water filter.

- C. Provide with sensor-operated bottle-filling station at ADA-height unit.

2.4 SINKS

- A. Single compartment bowl: ASME A112.19.3; nominal thirty (30) inches by eighteen (18) inches by ten (10) inches dimensions, undermount, stainless steel, self-rimming and undercoated, with 1-1/2-inch stainless steel drain, ledge back drilled for trim.
- B. Town sink trim: ASME A112.18.1; chrome-plated brass supply with gooseneck swing spout, vandal proof water economy aerator with maximum 1.5-gpm flow, indexed single lever handle and pull-down hand spray.
- C. Fire department trim: ASME A112.18.1; chrome-plated brass supply with semi-professional style, gooseneck swing spout, vandal proof water economy aerator with maximum 1.5-gpm flow, indexed single lever handle.
- D. Accessories:
 - 1. Chrome-plated seventeen- (17) gauge brass P-trap with cleanout plug and arm with escutcheon.
 - 2. Perforated open strainer.
 - 3. Screwdriver stops.
 - 4. Rigid supplies with escutcheons.
 - 5. Trap and waste offset and insulated to meet ADA compliance where exposed.
- E. Provide water filtration system supplying cold water to faucet only.

2.5 SHOWER TRIM

- A. Shower trim: ASME A112.18.1; concealed shower pressure balanced mixing valve, indexed control, integral service stops, bent shower arm with flow control and adjustable spray ball joint showerhead with escutcheon; maximum 1.5-gpm flow. All internal parts shall be brass – plastic stems are prohibited.
- B. ADA compliant shower trim: ASME A112.18.1; concealed shower pressure balanced mixing valve, indexed control, integral service stops, bent shower arm with flow control and adjustable spray ball joint showerhead with escutcheon, handheld shower with sixty- (60) inches metal clad hose with slide bar, female inlet; maximum 1.5-gpm flow. All internal parts shall be brass – plastic stems are prohibited.
- C. Provide with additional foot hydrant with cold water supply only.

2.6 CUSTODIAL SINKS

- A. Basin: Twenty-four (24) by twenty-four (24) by twelve (12) inch nominal dimensions molded stone, floor mounted, with one-inch-wide shoulders with stainless steel caps, stainless steel strainer. Provide walls adjacent to basin with stainless steel wall guards extending thirty-six (36) inches above top of basin.
- B. Trim: Exposed wall type supply with lever indexed handles, spout wall brace, vacuum breaker, hose end spout, strainers, eccentric adjustable inlets, integral screwdriver stops with covering caps and adjustable threaded wall flanges. Provide with five feet of 1/2-inch diameter plain end reinforced rubber hose, hose clamp, and mop hanger.

2.7 UTILITY SINKS:

- A. Basin: Twenty-four (24) by twenty-four (24) by twelve (12) inch nominal dimensions stainless steel, floor mounted, with stainless steel legs, high back drilled for wall-mounted supply trim.
- B. Trim: Exposed wall type supply with lever indexed handles, high-arc spout, adjustable threaded wall flanges, with secondary squeeze-handle hand spray and mounting bracket.

2.8 AUTOMATIC CLOTHES WASHERS

- A. Fixtures shall be provided by others. The contractor shall provide final connections to the fixture.
- B. Recessed valve box: White, powder-coated metal preformed rough-in box with brass quarter-turn arrester valves with single lever handle, socket for two- (2) inch waste, slip-in finishing cover.

2.9 DOMESTIC DISHWASHERS

- A. Fixtures shall be provided by others. The contractor shall provide final connections to the fixture from the adjacent sink.

2.10 EMERGENCY FIXTURES:

- A. Accessible, plumbed emergency shower with eyewash combination units:
 - 1. Piping:
 - a. Material: Galvanized steel.
 - b. Unit supply: NPS 1-1/4".
 - c. Unit drain: Outlet at back, hard piped to sanitary waste.
 - 2. Shower:
 - a. Capacity: Not less than 20 gpm for at least 15 minutes.
 - b. Supply piping: NPS 1" with flow regulator and stay-open control valve.
 - c. Control-valve actuator: Pull rod.
 - d. Shower head: 8-inch-minimum diameter, plastic.
 - e. Mounting: Pedestal.
 - 3. Eyewash unit:
 - a. Capacity: Not less than 0.4 gpm for at least 15 minutes.
 - b. Supply piping: NPS 1/2" with flow regulator and stay-open control valve.
 - c. Control-valve actuator: Paddle.
 - d. Spray-head assembly: Two receptor-mounted spray heads.
 - e. Receptor: Plastic bowl.
 - f. Mounting: Attached shower pedestal.

2.11 ADA COMPLIANT INSULATION KIT

- A. Safety covers conforming to ANSI A117.1 and consisting of insulation kit of molded closed cell antimicrobial vinyl construction, minimum 1/8-inch-thick, white color, for insulating tailpiece, P-trap, valves, and supply piping. Furnish with cleanout angle valve access covers.

PART 3 - EXECUTION

3.1 PREINSTALLATION

- A. Verify walls and floor finishes are prepared and ready for installation of fixtures.
- B. Confirm millwork is constructed with adequate provision for installation of countertop lavatories and sinks.
- C. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough in and installation.
- D. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture schedule for each fixture.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. For ADA compliant fixtures, installation shall comply with the requirements of the latest edition of the Department of Justice's document *ADA Standards for Accessible Design*. These guidelines shall apply unless superseded by more stringent state or local requirements.
- B. The supply lines and fittings for every plumbing fixture shall be installed to prevent backflow.
- C. Plumbing fixtures shall be installed to afford easy access for cleaning both the fixture and the area around the fixture.
- D. Fixtures shall be set level and in proper alignment to adjacent walls.
- E. Joints formed where fixtures contact walls or floors shall be sealed as indicated.
- F. Slip joint connections are prohibited.

3.3 WATER CLOSET INSTALLATION

- A. Connections between the drain and floor outlet water closets shall be made with a floor flange. The flange shall be attached to the drain and anchored to the structure. Floor outlet fixtures shall be secured to the floor of floor flanges by screws or bolts of corrosion-resistant material. Floor flanges shall meet the following requirements:
 - 1. Floor flanges for water closets shall not be less than a two (2) inch caulking depth for cast iron.
 - 2. Floor flanges of hard lead shall weigh not less than one (1) pound, nine (9) ounces and shall be composed of lead alloy with not less than 7.75 percent antimony by weight.
- B. Seal fixture connection to floor with white acrylic caulk.
- C. A water closet shall not be set closer than fifteen (15) inches from its center to any side wall, partition, vanity, or other obstruction, or closer than thirty (30) inches center-to-center between adjacent fixtures. There shall be at least twenty-one (21) inches clearance in front of the water closet to any wall, fixture, or door.
- D. Water closet compartments shall not be less than thirty (30) inches wide and sixty (60) inches deep.

3.4 LAVATORY INSTALLATION

- A. Connect fixture securely so that the countertop or carrier bears the entire weight of the fixture. None of the loads shall be transferred to the piping system. Seal fixture connection to countertop or wall with seal of white putty, white acrylic caulk, or concealed vinyl gasket.
- B. Install each fixture with trap easily removable for servicing and cleaning.
- C. A lavatory shall not be set closer than fifteen (15) inches from its center to any side wall, partition, vanity, or other obstruction, or closer than thirty (30) inches center-to-center between adjacent fixtures. There shall be at least twenty-one (21) inches clearance in front of the lavatory to any wall, fixture, or door.

3.5 ELECTRIC WATER COOLER INSTALLATION

- A. Connect fixture securely so that the mounting bracket bears the entire weight of the fixture. None of the loads shall be transferred to the piping system. Seal fixture connection to wall with white acrylic caulk.
- B. Install each fixture with filter easily removable for replacement.
- C. Adjust stops or valves for intended to control water flow rate to fixtures without splashing, noise, or overflow.

3.6 SINK INSTALLATIO

- A. Connect fixture securely so that the countertop bears the entire weight of the fixture. None of the loads shall be transferred to the piping system. Seal fixture connection to countertop with seal of white putty, white acrylic caulk, or concealed vinyl gasket.
- B. Install each fixture with trap easily removable for servicing and cleaning.

3.7 SHOWER INSTALLATION

- A. Shower liner test:
 - 1. Where shower floors and receptors are made water-tight in installations not consisting of prefabricated receptors, the completed liner installation shall be tested by the following procedure:
 - a. The pipe from the shower drain shall be plugged water-tight for the test.
 - b. The floor and receptor area shall be filled with potable water to a depth of not less than two (2) inches measured at the threshold.
 - c. Where a threshold of at least two (2) inches does not exist, a temporary threshold shall be constructed to retain the test water in the lined floor or receptor area to a level not less than two (2) inches deep measured at the threshold.
 - d. The water shall be retained for a test period of not less than fifteen (15) minutes, and there shall not be evidence of leakage.

3.8 CUSTODIAL SINK INSTALLATION

- A. Basin shall be set in a bed of mortar and allowed to set before pipe connection is made. Waste outlet connection to piping shall be made with threaded fittings. When installed on an above grade floor, install fixture with trap easily removable for servicing and cleaning.

3.9 AUTOMATIC CLOTHES WASHER INSTALLATION

- A. Confirm that the water supply connection is protected against backflow by an integral air gap prior to installation. Where the fixture does not have an integral air gap, provide a backflow preventer in accordance with specification section 22 11 00.
- B. Securely support valve box from structural members on both sides.

3.10 DISHWASHER INSTALLATION

- A. Confirm that the water supply connection is protected against backflow by an integral air gap prior to installation. Where the fixture does not have an integral air gap, provide a backflow preventer in accordance with specification section 22 11 00.
- B. Waste connection shall discharge into a wye-branch fitting on the tailpiece of the kitchen sink. The waste line shall connect to a deck-mounted air gap or the waste line shall rise and be securely fastened to the underside of the sink rim or counter.

3.11 EMERGENCY FIXTURE INSTALLATION

- A. Install in strict compliance with ANSI Z358.1 and the manufacturer's printed instructions and detail shown on drawings.
- B. Eyewash waste outlet to be hard piped to sanitary waste system and not discharged to floor.
- C. Align floor drain for shower with showerhead.

3.12 ADA COMPLIANT INSULATION KIT INSTALLATION

- A. Install on each lavatory or sink with exposed piping, including those that are not specified as ADA compliant fixtures.

- B. Installation shall allow for access to cleanout plugs and valves without removal of the entire insulation kit.

END OF SECTION

SECTION 23 05 00

COMMON WORK RESULTS FOR HVAC

PART 1: GENERAL

1.1 RELATED PROVISIONS

- a. The requirements of the general conditions and of Division 01 apply to that portion of the work specified in this section.
- b. These specifications and the accompanying drawings shall include the furnishing of all labor, tools, materials, fixtures, transportation, appurtenances, and service necessary and incidental to the installation of a complete and operative system as indicated and intended on the Drawings and as herein specified.
- c. Contractor shall coordinate the work and equipment of this division with the work and equipment specified elsewhere in order to assure a complete and satisfactory installation. Work such as excavation, backfill, concrete, flashing, etc., which is required by the work of this Division of the Specifications, shall be provided by this Division unless otherwise indicated.
- d. Minor details not usually shown or specified, but necessary for the proper installation and operation, shall be included in the work, the same as if herein specified or shown.

1.2 DESCRIPTION OF THE WORK:

- a. Work included under this Division includes installation of a new cooling and heating system and associated electrical system and controls system. The systems shall be installed complete, with boilers, piping, chiller, pumps and auxiliaries as hereinafter called for. Miscellaneous items including conduits, concrete slab, etc., are to be provided as indicated.
- b. It shall be the responsibility of the Contractor to provide a complete and operating system according to the true intent and meaning of the plans and specifications and all pipe, controls and equipment, etc.

1.3 DEFINITION

- a. The word "Contractor" as used in this Section of the Specifications refers to the HVAC Contractor unless specifically noted otherwise. The word "provide" means furnish, fabricate, complete, install, erect, including labor and incidental materials, necessary to complete in place and ready for operation or use the items referred to or described herein, and/or as shown or referred to on the Contract Drawings.

1.4 HVAC CONTRACTOR'S QUALIFICATIONS

- a. It is assumed that the contractor has had sufficient general knowledge and experience to anticipate the needs for a construction of this nature. The contractor shall furnish all items required to complete the construction in accordance with reasonable interpretation of the intent of the Drawings and Specifications. Any minor items required by Code, law or regulations shall be provided whether or not specified or specifically shown.
- b. All work must be done by first class and experienced mechanics properly supervised, and it is understood that the Engineer has the right to stop any work that is not being properly done and has the right to demand that any incompetent workman be removed from the job and a competent workman be substituted therefor.
- c. All work must be done in strict accordance with standards of AME, ASHRAE and the building laws of all character in force in the locality where the apparatus is being installed. All work must also be in accordance with rules and regulations of the National Board of Fire Underwriters.

1.5 DUTIES OF CONTRACTOR

- a. Contractor is responsible for familiarizing himself with the details of the construction of the building. Work under these specifications installed improperly or which requires changing due to improper reading or interpretation of building plans shall be corrected and changed as directed by Engineer without additional cost to the Owner.
- b. Contractor shall leave the premises in a clean and orderly manner upon completion of work, and shall remove from premises all debris that has accumulated during the progress of the work. The HVAC Contractor shall have the permanent HVAC systems in sufficient readiness for furnishing temporary climatic control at the time the building is enclosed. The HVAC systems control shall maintain climatic control throughout the enclosed portion of the building sufficient to allow completion of the interior finishers of the building. A building shall be considered enclosed when it has windows installed and when doorways and other openings have protection which will provide reasonable climatic control. The appropriate climatic condition shall be jointly determined by the Contractor and the Architect. Use of the equipment in this manner shall in no way affect the warranty requirements of the Contractor.

1.6 CODES, RULES, PERMITS AND FEES

- a. The contractor shall give all necessary notices, obtain all permits and pay all government sales taxes, fees and other costs including utility connections or extension, in connection with his work; file all necessary plans, prepare all documents and obtain all necessary approvals of all governmental departments having jurisdiction; obtain all required certificates for inspection for his work and deliver same to the Architect before request for acceptance and final payment for the work.
- b. The contractor shall include in the work, without extra cost to the Owner, any labor, materials, services, apparatus, ordinances, rules and regulations as required to complete the project in accordance with the intent of the drawings.

- c. All materials furnished and all work installed shall comply with the National Fire Codes of the National Fire Protection Association, with the requirements of all governmental departments having jurisdiction.

1.7 SURVEYS AND MEASUREMENTS

- a. The contractor shall base all measurements, both horizontal and vertical, from established bench marks. All work shall agree with these established lines and levels. Verify all measurements at the site and check correctness of same as related to the work.
- b. Should the contractor discover any discrepancy between actual measurements and those indicated, which prevents following good practice or the intent of the drawings and Specifications, he shall notify the Architect and shall not proceed with his work until he has received instructions from the Architect.

1.8 PLANS

- a. Except where dimensions are shown, mechanical plans are diagrammatic; see Architectural drawings for building dimensions and locations of windows, doors, ceiling diffusers, lights, etc. The plans are not intended to show each and every fitting, valve, pipe or pipe hanger, or a complete detail of all the work to be done, but are for the purpose of illustrating the type of system, pipe and duct sizes, etc. and special conditions considered necessary for the experienced mechanic to take off his material and lay out his work. Contractor shall be responsible for taking such measurements as may be necessary at the job, and adapting his work to the local conditions.

1.9 DRAWINGS AND SPECIFICATIONS

- a. Plans are diagrammatic, and it sometimes occurs that conditions exist in buildings which require certain changes in drawings and specifications. In event that such changes are necessary, the same are to be made by Contractor without expense to the Owner, provided however, that such changes, do not require furnishing more material or performing more labor than the true intent of the drawings and specifications demand.
- b. It is understood that while the drawings are to be followed as closely as circumstances will permit, the Contractor is held responsible for the installation of the system according to the true intent and meaning of the drawings. Anything not entirely clear on the drawings or in the specifications will be fully explained if application is made to the Engineer. Should however, conditions arise where in the judgment of the Contractor certain changes would be advisable. Contractor will communicate with Engineer and secure approval of the changes before going ahead with the work.
- c. The electrical and mechanical systems for this job have been designed on the basis of the mechanical equipment listed or data given herein or on the drawings. It shall be the responsibility of the Contractor to determine that the electrical service outlets, wiring, conduit and all overcurrent protective and safety devices furnished are

adequate to meet Code Requirements for the equipment which he proposes to use. Changes required in the electrical system to accommodate the proposed mechanical equipment shall be worked out and the details submitted for approval. The cost of making the necessary changes to the electrical system shall be the responsibility of the Contractor.

1.10 SHOP DRAWINGS

- a. Refer to Division 01.
- b. All items submitted to Architect for review shall bear stamp or notation indicating contractor's prior review and approval.
- c. Any Electrical or other changes required by substituted equipment to be made at no change in contract price.
- d. Submit manufacturer's certified performance data for all equipment.
- e. Coordinate installation drawings with other parts of the work, whether specified in this Division or other Divisions.
- f. Approval of shop drawings by the Engineer shall not relieve the Contractor from his obligation to provide equipment, control, and operation to the true intent of plans and specifications.
- g. The Contractor shall submit to the Engineer, within ten (10) days after approval of bids by the owner, a list indicating the manufacturer of all equipment and materials which he proposes to use. After that date, no substitution will be approved and all items shall be as specified.

1.11 COORDINATION DRAWINGS

- a. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 2. Roof framing and support members relative to duct penetrations.
 3. Ceiling suspension assembly members.
 4. Size and location of initial access modules for acoustical tile.
 5. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

1.12 SCAFFOLDING, RIGGING, HOISTING:

- a. This contractor shall furnish all scaffolding rigging, hoisting, and services necessary to erection and delivery into the premises of any equipment and apparatus furnished. Remove same from premises when no longer required.

1.13 FOUNDATIONS, SUPPORTS, PIERS, ATTACHMENTS:

- a. Contractor shall furnish and install all necessary foundations, supports, pads, bases and piers required for all air conditioning equipment, piping, pumps, tanks, compressors, and for all other equipment furnished under this contract.

1.14 SLEEVES AND OPENINGS:

- a. Contractor must have an experienced mechanic on the job before concrete slab floors or concrete masonry walls are poured or built into place, whose duty it shall be to locate exact positions of any and all holes necessary for future installation of his pipe work, ducts or equipment. Where pipes pass through concrete or masonry walls or floors, steel pipe sleeves shall be furnished. These shall be the same length as wall thickness and shall extend 1/2" above finished floors. Pipe sleeves in equipment room floors shall extend 3" above refinished floor. Pipe sleeves in equipment room floors shall extend 3" above finished floor. Sleeves shall be placed in position by this Contractor.
- b. This Contractor shall arrange for proper openings in the building to admit his equipment. If it becomes necessary to cut any portion of building to admit his equipment, portions cut must be restored to their former condition by this Contractor.
- c. This Contractor will provide duct openings or chases in masonry or concrete; however, it is this Contractor's responsibility to advise exact dimensions, shape and locations of openings required in sufficient time for the Contractor to make necessary provisions. This Contractor shall be responsible for correct size and location of each opening for his equipment through these openings.
- d. Wall openings that require a fire or smoke damper shall be made as nearly possible to the damper or duct size so that an angle frame can close the opening entirely.
- e. Where pipes or ducts penetrate floors or partitions which are fire or smoke barriers, the integrity of the barrier shall not be compromised by such penetration.

1.15 CUTTING AND PATCHING:

- a. The Contractor shall do all cutting, fitting and patching as required to install piping and equipment except openings through the roof shall be provided by the General Contractor. Patching shall be done by mechanics skilled in the various trades and work shall match the existing work.
- b. All exposed openings in walls and floors for piping shall be core drilled. Cutting of holes by hand will not be allowed.
- c. Provide all required protection including but not limited to, welding blankets, dust covers, shoring bracing and supports to maintaining structural integrity, safety and cleanliness of the work.

1.16 EXCAVATION AND BACKFILLING:

- a. All excavation and backfilling, puddling and tamping required to properly install work under this contract shall be done by this Contractor.
- b. Trenches shall be on an even grade and firmly packed to form a solid foundation for laying piping. The Contractor is cautioned to comply with the North Carolina Department of Labor requirements concerning shoring for excavations.
- c. Backfill shall be clear of rocks and trash. Backfilling shall be water tamped so as to provide firm footing for finish work, and shall be maintained at proper level for duration of the Contract. No backfilling shall be done until work to be covered has been inspected. Excessive excavation material shall be deposited on site and leveled as directed by the engineer.

1.17 POURED IN PLACE CONCRETE WORK:

- a. Furnish and install all concrete work required for the construction of anchors, guide bases and elsewhere as indicated on the Drawings. Refer to appropriate Section in Division 3 for specification requirements.

1.18 STORAGE OF MATERIALS:

- a. Equipment, ductwork, piping, and other equipment stored on site shall be protected from mud, dust, debris, weather, vermin, and construction traffic.
- b. Equipment, ductwork, piping, and other equipment shall be capped or otherwise covered to prevent water, dust, and debris intrusion. Cellophane membrane may be used for duct and equipment with care taken to maintain the seal integrity. Covering shall be replaced if seal is disturbed. Covering shall be removed only when necessary.
- c. Where pipe or ductwork becomes damaged by rust, dirt, dust, mud, or construction debris, it must be thoroughly cleaned and prepared to a like-new condition before installation.
- d. Porous materials such as duct liner and insulation that become saturated with water shall be discarded and replaced.
- e. Any equipment and/or materials affected (including aesthetically) as a result of improper storage shall be cleaned or replaced at contractor expense.

PART 2: PRODUCTS

2.1 MATERIALS

- a. Provide equipment complete with all components and accessories necessary to its satisfactory operation.
- b. Listing of a manufacturer's name in this Division does not infer conformity to all requirements of the Contract Documents, nor waive requirements thereof.

PART 3: EXECUTION

3.1 BELT DRIVES

- a. V-belt drives shall be rated at not less than 200% of nominal motor horsepower.

- b. Motor sheaves shall be fixed pitch type.
- c. Scheduled fan static pressures are estimated. Provide one extra drive per device as required to allow adjustment to deliver scheduled air quantities against actual system resistance.
- d. Provide guards for all belt drives not enclosed within equipment housings. Provide openings in guard at driving and driven sheaves for use of revolution counter.

3.2 MAINTENANCE AND OPERATING INSTRUCTIONS

- a. Upon completion of all work, the Contractor shall furnish a complete set of operating instructions for all equipment. Such instructions shall be diagrammatic in form on heavy white paper, suitably framed, protected with glass and hung where directed by the owner. A preliminary draft of the instruction sheets shall be submitted to the engineer for approval before making same.
- b. Manufacturer's instruction books, card, etc., (to each individual piece of equipment furnished under this contract) shall be furnished to the owner. These shall contain instructions for the operation and maintenance of all equipment. Where such is not furnished by the manufacturer, the contractor shall give written instructions to the owner for the maintenance of the equipment involved.

3.3 DUCTS, PLENUM, ETC.

- a. As indicated on drawings, provide a system of ducts for supplying returning and exhausting air from various spaces. All details of the ductwork are not indicated and the necessary bends, offsets and transformations must be furnished whether shown or not.
- b. All sheet metal ducts, casing, plenums, etc., of sizes indicated, shall be constructed from prime galvanized sheet steel, and shall be in accordance with or equal to standards set forth in latest issue of SMACNA low velocity duct manual for gauges of materials, (2" pressure), workmanship, method of fabrication and erection.
- c. All uninsulated panels of ducts over twelve inches (12") wide shall be cross-broken, except on plenums, which shall be braced with angle iron as required to prevent breathing.
- d. All ductwork must present a smooth interior and joints must be airtight. Where there is evidence of undue leakage at the joints in low pressure ducts, they shall be sealed with cement similar to Foster 30-02.
- e. Depending upon space requirements, round or square elbows may be used as required or at the Contractors option in low velocity ducts. All elbows shall be constructed for minimum pressure drop. All elbows with an inside radius less than 3/4 the width of the duct must be fitted with multiple double thickness turning vanes.
- f. No transformations or offsets shall be made with a slope greater than (7 to 1), space conditions permitting.

- g. Where indicated on drawings, ductwork is to be lined with flexible fiberglass acoustics material weighing not less than 1 1/2 lb. per cubic foot and having a flame spread classification of not more than twenty-five (25) as listed under Underwriters Laboratories. Liner shall be applied according to SMACNA duct liner standard. Thickness shall be as indicated on the drawings. Duct sizes on plan are inside clear sizes, increase the actual sheet metal size accordingly in sizing the duct.
- h. The lining shall be secured to the ductwork with a suitable adhesive and with mechanical fasteners center. Liner shall be cut such that adjacent sections of insulation butt together and are sealed with Foster 30-02 joints.
- i. All duct connections to and from all centrifugal fans or cabinets containing fans, shall be made with fabric equal to "Ventfab" as made by Ventfabrics, Inc., not less than four inches (4") long secured by peripheral iron straps holding fabric in galvanized iron, except as otherwise noted.
- j. Vertical ducts shall be supported by means of an angle iron frame riveted to the ductwork on at least two (2) sides. Horizontal runs of ductwork shall be supported on not more than 8'-0" centers as required.
- k. Manual volume and splitter dampers shall be furnished and installed where shown and where necessary for proper regulation of the air distribution. A quadrant and set screw equal to "Ventlock" #641 shall be installed for all dampers which are concealed above plaster or gypsum board ceilings, or behind the masonry construction, furnish and install concealed regulators ("Ventlock" #666) with chrome cover plate.
- l. All ductwork shall operate without chatter and vibration, and shall be free from pulsations.
- m. See section 233113 for metal ductwork requirements.

3.4 ACCESS DOORS OR PANELS

- a. Provide duct access doors of approved construction at any apparatus requiring service and inspection. Doors shall suit finish in which installed.
- b. Access doors in rated walls or assemblies shall be rated as required to maintain rating of assembly. Rated access doors shall bear U.L. Label.

3.5 CLEANING DUCT SYSTEM

- a. Upon complete installation of ducts, clean entire system of rubbish, plaster, dirt, etc., before installing any outlets. After installation of outlets and connections to fans are made, blow out entire systems with all control devices wide open.

3.6 ITEMS OF ELECTRICAL EQUIPMENT

- a. All electrical work shall be done by properly licensed electrical mechanics in accordance with Division 26 of the specifications under supervision of a licensed Electrical Contractor as approved by the Architect.
- b. The Electrical Contractor shall provide all power wiring to motor starter and/or disconnect switch and from starter/disconnect switch to motor. The Mechanical Contractor shall provide all control wiring, low voltage or line voltage, as required for the operation of all mechanical equipment. All control devices such as motor starters, thermostats, switches, etc. shall be provided by the Mechanical Contractor.
- c. All motor starters shall be provided with a “hand-off-auto” switch on the starter cover.
- d. All items of mechanical equipment electrically operated shall be in complete accordance with electrical division of the specifications. Mechanical equipment, other than individually mounted motors, shall be factory prewired so that it will only be necessary to bring connections to a single set of terminals.
- e. Mechanical equipment electrical components shall all be bonded together and connected to electrical system ground.
- f. All mechanical equipment shall be U.L. listed and labeled as a complete package, not through individual components or parts. Provide required 3rd party field UL listing services as required to comply.

3.7 WARRANTY AND SERVICE

- a. Upon completion of all work, the contractor shall check the system out so that all motor bearings are greased as required and have all systems balanced. He shall be responsible for original service, of starting the system up, and providing one set of replacement filters after final acceptance.
- b. Refer to equipment specifications for specific warranty information.

3.8 INSPECTION AND ACCEPTANCE TEST

- a. The project will be checked periodically as construction progresses. The contractor shall be responsible for notifying the Engineer at least 48 hours in advance when any work to be covered up is ready for inspection. No work will be covered up until approved by the Engineer.
- b. Upon completion of erection of all equipment and work specified herein and shown approved shop drawings, and at the time designated by the engineer, the contractor shall start all apparatus, making necessary tests as directed and as specified herein, and make adjustments of all parts of all equipment before acceptance of equipment by the owner. The contractor must demonstrate to the owner, by performance, that all equipment operates as specified and meets the guarantee called for.

- c. Tests shall include satisfactory evidence that all systems operate as called for on the drawings, and that all pieces of equipment operate at specified ratings under specified operating conditions.
- d. The contractor shall furnish all fuel and power required for these purposes, and provide the proper and necessary help required to operate the system while tests are being made.
- e. All drainage piping shall be tested by filling with water to a point 10' above the underground drains or to point of discharge to grade and let stand thus filled for 3 hours.
- f. Tests on all pipe work shall be subject to the inspection of the Engineer. He shall be given 24-hours notice when a section pipe is to be tested and the test shall not be removed until permission is given by the Engineer.

3.9 AS BUILT DRAWINGS

- b. This contractor shall keep on the job at all times, a clean set of contract drawings in blueprint form. As the job progresses, any and all deviations from the arrangements, piping runs, equipment locations, etc., shown on the bid prints shall be marked on this set with red ink. These prints shall not be used for any other purpose than to be marked up as "As-Built" Drawings.

3.10 OWNER TRAINING

- A. Engage a factory-authorized service representative with complete knowledge of Project-specific system installed to train Owner's maintenance personnel to adjust, operate, and maintain the equipment listed below:
 - 1. DDC Control Systems
 - 2. Air Handlers
- B. Extent of Training:
 - 1. Base extent of training on scope and complexity of equipment installed and training requirements indicated. Provide extent of training required to satisfy requirements indicated even if more than minimum training requirements are indicated.
 - 2. Inform Owner of anticipated training requirements if more than minimum training requirements are indicated.
 - 3. Minimum Training Requirements:
 - a. Provide not less than the number days of training indicated below.
 - 1) DDC Control Systems - 2 days (16 hours)
 - 2) Air Handlers - 1 day (8 hours)
 - b. Stagger training over multiple training classes to accommodate Owner's requirements. All training shall occur before end of warranty period.
- C. Training Schedule:

1. Schedule training with Owner **20** business days before expected Substantial Completion.
2. Training shall occur within normal business hours at a mutually agreed on time. Unless otherwise agreed to, training shall occur Monday through Friday, except on U.S. Federal holidays, with two morning sessions and two afternoon sessions.
3. Provide staggered training schedule as requested by Owner.

D. Training Attendee List and Sign-in Sheet:

1. Request from Owner in advance of training a proposed attendee list with name, phone number and e-mail address.
2. Provide a preprinted sign-in sheet for each training session with proposed attendees listed and no fewer than six blank spaces to add additional attendees.
3. Circulate sign-in sheet at beginning of each session and solicit attendees to sign or initial in applicable location.
4. At end of each training day, send Owner an e-mail with an attachment of scanned copy (PDF) of circulated sign-in sheet for each session.

E. Attendee Training Manuals:

1. Provide each attendee with a color hard copy of all training materials and visual presentations.
2. Hard-copy materials shall be organized in a three-ring binder with table of contents and individual divider tabs marked for each logical grouping of subject matter. Organize material to provide space for attendees to take handwritten notes within training manuals.
3. In addition to hard-copy materials included in training manual, provide each binder with a sleeve or pocket that includes a DVD or flash drive with PDF copy of all hard-copy materials.

F. Organization of Training Sessions:

1. Organize training sessions into logical groupings of technical content and to reflect different levels of operators having access to system. Plan training sessions to accommodate the following three levels of operators:
 - a. Daily operators.
 - b. Advanced operators.
 - c. System managers and administrators.

G. Training Outline:

1. Submit training outline for Owner review at least **10** business day before scheduling training.
2. Outline shall include a detailed agenda for each training day that is broken down into each of four training sessions that day, training objectives for each training session and synopses for each lesson planned.

H. On-Site Training:

1. Owner will provide conditioned classroom or workspace with ample desks or tables, chairs, power and data connectivity for instructor and each attendee.

2. Instructor shall provide training materials, projector and other audiovisual equipment used in training.
3. Provide as much of training located on-site as deemed feasible and practical by Owner.
4. On-site training shall include regular walk-through tours, as required, to observe each unique product type installed with hands-on review of operation, calibration and service requirements.
5. Operator workstation provided with DDC system shall be used in training. If operator workstation is not indicated, provide a temporary workstation to convey training content.

I. Training Content:

1. Basic operation of each system.
2. Understanding each unique product type installed including performance and service requirements for each.
3. Understanding operation of each system and equipment controlled by DDC system including sequences of operation, each unique control algorithm and each unique optimization routine.

END OF SECTION

SECTION 23 05 13

COMMON MOTOR REQUIREMENTS FOR HVAC 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 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.

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 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Energy efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
 - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
 - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Multispeed Motors: Separate winding for each speed.
- F. Rotor: Random-wound, squirrel cage.
- G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- H. Temperature Rise: Match insulation rating.
- I. Insulation: Class F.
- J. Code Letter Designation:
 - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.

- 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
- C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
 - 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.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 23 05 19

METERS AND GAGES FOR HVAC 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. Thermometers.
 - 2. Gages.
 - 3. Test plugs.
 - 4. Flowmeters.
 - 5. Thermal-energy meters.
- B. Related Sections:
 - 1. Division 23 Section "Steam and Condensate Heating Piping" for steam and condensate meters.
 - 2. Division 23 Section "Facility Natural-Gas Piping" for gas meters.

1.3 DEFINITIONS

- A. CR: Chlorosulfonated polyethylene synthetic rubber.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated; include performance curves.
- B. Shop Drawings: Schedule for thermometers, gages, flowmeters and thermal-energy meters indicating manufacturer's number, scale range, and location for each.
- C. Product Certificates: For each type of thermometer, gage, flowmeter and thermal-energy meter, signed by product manufacturer.
- D. Operation and Maintenance Data: For flowmeters and thermal-energy meters to include operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 METAL-CASE, LIQUID-IN-GLASS THERMOMETERS

- A. Case: Die-cast aluminum or brass, 7 inches long.
- B. Tube: Red or blue reading, mercury or organic-liquid filled, with magnifying lens.
- C. Tube Background: Satin-faced, nonreflective aluminum with permanently etched scale markings.
- D. Window: Glass or plastic.
- E. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.
- F. Stem: Copper-plated steel, aluminum, or brass for thermowell installation and of length to suit installation.
- G. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.2 DUCT-TYPE, LIQUID-IN-GLASS THERMOMETERS

- A. Case: Die-cast aluminum, 7 inches long.
- B. Tube: Red or blue reading, mercury or organic filled, with magnifying lens.
- C. Tube Background: Satin-faced, nonreflective aluminum with permanently etched scale markings.
- D. Window: Glass or plastic.
- E. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.
- F. Stem: Metal, for installation in mounting bracket and of length to suit installation.
- G. Mounting Bracket: Flanged fitting for attachment to duct and made to hold thermometer stem.
- H. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.3 THERMOWELLS

- A. Manufacturers: Same as manufacturer of thermometer being used.
- B. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer.

2.4 PRESSURE GAGES

- A. Direct-Mounting, Dial-Type Pressure Gages: Indicating-dial type complying with ASME B40.100.
 - 1. Case: Liquid-filled type, drawn steel or cast aluminum, 4-1/2-inch diameter.
 - 2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
 - 3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
 - 4. Movement: Mechanical, with link to pressure element and connection to pointer.
 - 5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
 - 6. Pointer: Red metal.
 - 7. Window: Glass or plastic.
 - 8. Ring: Brass.
 - 9. Accuracy: Grade A, plus or minus 1 percent of middle half scale.
 - 10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
 - 11. Range for Fluids under Pressure: Two times operating pressure.
- B. Remote-Mounting, Dial-Type Pressure Gages: ASME B40.100, indicating-dial type.
 - 1. Case: Dry type, drawn steel or cast aluminum, 4-1/2-inch diameter for panel mounting.
 - 2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
 - 3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
 - 4. Movement: Mechanical, with link to pressure element and connection to pointer.
 - 5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
 - 6. Pointer: Red metal.
 - 7. Window: Glass or plastic.
 - 8. Ring: Brass.
 - 9. Accuracy: Grade A, plus or minus 1 percent of middle half scale.
 - 10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
 - 11. Range for Fluids under Pressure: Two times operating pressure.
- C. Pressure-Gage Fittings:
 - 1. Valves: NPS 1/4 brass or stainless-steel needle type.
 - 2. Syphons: NPS 1/4 coil of brass tubing with threaded ends.
 - 3. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

2.5 TEST PLUGS

- A. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping.
- B. Minimum Pressure and Temperature Rating: 300 psig at 250 deg F.
- C. Core Inserts: One or two self-sealing rubber valves.
 - 1. Insert material for air, water, oil, or gas service at 20 to 200 deg F shall be CR.

2. Insert material for air or water service at minus 30 to plus 275 deg F shall be EPDM.
- D. Test Kit: Furnish one test kit(s) containing one pressure gage and adaptor, two thermometer(s), and carrying case. Pressure gage, adapter probes, and thermometer sensing elements shall be of diameter to fit test plugs and of length to project into piping.
 1. Pressure Gage: Small bourdon-tube insertion type with 2- to 3-inch- diameter dial and probe. Dial range shall be 0 to 200 psig.
 2. Low-Range Thermometer: Small bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial ranges shall be 25 to 125 deg F.
 3. High-Range Thermometer: Small bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial ranges shall be 0 to 220 deg F.
 4. Carrying case shall have formed instrument padding.

2.6 WAFER-ORIFICE FLOWMETERS

- A. Description: Differential-pressure-design orifice insert for installation between pipe flanges; with calibrated flow-measuring element, separate flowmeter, hoses or tubing, valves, fittings, and conversion chart compatible with flow-measuring element, flowmeter, and system fluid.
- B. Construction: Cast-iron body, brass valves with integral check valves and caps, and calibrated nameplate.
- C. Pressure Rating: 300 psig.
- D. Temperature Rating: 250 deg F.
- E. Range: Flow range of flow-measuring element and flowmeter shall cover operating range of equipment or system served.
- F. Permanent Indicators: Suitable for wall or bracket mounting, calibrated for connected flowmeter element, and having 6-inch- diameter, or equivalent, dial with fittings and copper tubing for connecting to flowmeter element.
 1. Scale: Gallons per minute.
 2. Accuracy: Plus or minus 1 percent between 20 and 80 percent of range.
- G. Portable Indicators: Differential-pressure type calibrated for connected flowmeter element and having two 12-foot hoses in carrying case.
 1. Scale: Gallons per minute.
 2. Accuracy: Plus or minus 2 percent between 20 and 80 percent of range.
- H. Operating Instructions: Include complete instructions with each flowmeter.

2.7 VENTURI FLOWMETERS

- A. Description: Differential-pressure design for installation in piping; with calibrated flow-measuring element, separate flowmeter, hoses or tubing, valves, fittings, and conversion chart compatible with flow-measuring element, flowmeter, and system fluid.

- B. Construction: Bronze, brass, or factory-primed steel; with brass fittings and attached tag with flow conversion data.
- C. Pressure Rating: 300 psig.
- D. Temperature Rating: 250 deg F.
- E. End Connections for NPS 2 and Smaller: Threaded.
- F. End Connections for NPS 2-1/2 and Larger: Flanged or welded.
- G. Range: Flow range of flow-measuring element and flowmeter shall cover operating range of equipment or system served.
- H. Permanent Indicators: Suitable for wall or bracket mounting, calibrated for connected flowmeter element, and having 6-inch- diameter, or equivalent, dial with fittings and copper tubing for connecting to flowmeter element.
 - 1. Scale: Gallons per minute.
 - 2. Accuracy: Plus or minus 1 percent between 20 and 80 percent of range.
- I. Portable Indicators: Differential-pressure type calibrated for connected flowmeter element and having two 12-foot hoses in carrying case.
 - 1. Scale: Gallons per minute.
 - 2. Accuracy: Plus or minus 2 percent between 20 and 80 percent of range.
- J. Operating Instructions: Include complete instructions with each flowmeter.

2.8 TURBINE FLOWMETERS

- A. Description: Insertion type for inserting turbine into piping and measuring flow directly in gallons per minute.
- B. Construction: Bronze or stainless-steel body; with plastic turbine or impeller and integral direct-reading scale.
- C. Pressure Rating: 150 psig minimum.
- D. Temperature Rating: 220 deg F. minimum.
- E. Display: Visual instantaneous rate of flow.
- F. Accuracy: Plus or minus 2-1/2 percent.

2.9 PITOT-TUBE FLOWMETERS

- A. Description: Insertion-type, differential-pressure design for inserting probe into piping and measuring flow directly in gallons per minute.

- B. Construction: Stainless-steel probe of length to span inside of pipe; with integral transmitter and direct-reading scale.
- C. Pressure Rating: 150 psig minimum.
- D. Temperature Rating: 220 deg F. minimum.
- E. Display: Visual instantaneous rate of flow.
- F. Integral Transformer: For low-voltage power connection.
- G. Accuracy: Plus or minus 1 percent for liquids and gases.

2.10 FLOW INDICATORS

- A. Description: Instrument for installation in piping systems for visual verification of flow.
- B. Construction: Bronze or stainless-steel body; with sight glass and plastic pelton-wheel indicator, and threaded or flanged ends.
- C. Pressure Rating: 150 psig.
- D. Temperature Rating: 220 deg F.
- E. End Connections for NPS 2 and Smaller: Threaded.
- F. End Connections for NPS 2-1/2 and Larger: Flanged.

2.11 INSERTION-TURBINE, THERMAL-ENERGY METER SYSTEMS

- A. Description: Flow sensor, strainer, two temperature sensors, transmitter, meter, and connecting wiring.
- B. Flow Sensor: Insertion-type turbine or paddle-wheel element with corrosion-resistant-metal body and transmitter.
 - 1. Pressure Rating: 150 psig.
 - 2. Temperature Range: 40 to 250 deg F.
- C. Meter: Solid-state integrating type.
 - 1. Data Output: Six-digit electromechanical counter with readout in kilowatts per hour or British thermal units.
 - 2. Accuracy: Plus or minus 1 percent.
 - 3. Battery Pack: Five-year lithium battery.
- D. Strainer: Full size of main line piping.

2.12 INLINE-TURBINE, THERMAL-ENERGY METER SYSTEMS

- A. Description: Flow sensor, two temperature sensors, transmitter, meter, and connecting wiring.
- B. Flow Sensor: Turbine-type water meter with corrosion-resistant-metal body and transmitter.
 - 1. Pressure Rating: 150-psig minimum working-pressure rating.
 - 2. Temperature Range: 40 to 250 deg F.
- C. Meter: Solid-state integrating type.
 - 1. Data Output: Six-digit electromechanical counter with readout in kilowatts per hour or British thermal units.
 - 2. Accuracy: Plus or minus 1 percent.
 - 3. Battery Pack: Five-year lithium battery.
- D. Strainer: Full size of main line piping.

PART 3 - EXECUTION

3.1 THERMOMETER APPLICATIONS

- A. Install liquid-in-glass thermometers as indicated on the drawings and in the following locations:
 - 1. Inlet and outlet of each hydronic zone.
 - 2. Inlet and outlet of each thermal storage tank.
- B. Provide the following temperature ranges for thermometers:
 - 1. Condenser Water: 30 to 120 deg F, with 2-degree scale divisions.
 - 2. Air Ducts: Minus 40 to plus 110 deg F, with 2-degree scale divisions.

3.2 GAGE APPLICATIONS

- A. Install dry-case-type pressure gages for discharge of each pressure-reducing valve.
- B. Install liquid-filled-case-type pressure gages at suction and discharge of each pump.

3.3 INSTALLATIONS

- A. Install direct-mounting thermometers and adjust vertical and tilted positions.
- B. Install remote-mounting dial thermometers on panel, with tubing connecting panel and thermometer bulb supported to prevent kinks. Use minimum tubing length.
- C. Install thermowells with socket extending one-third of diameter of pipe and in vertical position in piping tees where thermometers are indicated.

- D. Duct Thermometer Support Flanges: Install in wall of duct where duct thermometers are indicated. Attach to duct with screws.
- E. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.
- F. Install remote-mounting pressure gages on panel.
- G. Install needle-valve and snubber fitting in piping for each pressure gage for fluids (except steam).
- H. Install needle-valve and syphon fitting in piping for each pressure gage for steam.
- I. Install test plugs in tees in piping.
- J. Install flow indicators, in accessible positions for easy viewing, in piping systems.
- K. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters as prescribed by manufacturer's written instructions.
- L. Install flowmeter elements in accessible positions in piping systems.
- M. Install differential-pressure-type flowmeter elements with at least minimum straight lengths of pipe upstream and downstream from element as prescribed by manufacturer's written instructions.
- N. Install wafer-orifice flowmeter elements between pipe flanges.
- O. Install permanent indicators on walls or brackets in accessible and readable positions.
- P. Install connection fittings for attachment to portable indicators in accessible locations.
- Q. Install flowmeters at discharge of hydronic system pumps and at inlet of hydronic air coils.
- R. Assemble components and install thermal-energy meters.
- S. Mount meters on wall if accessible; if not, provide brackets to support meters.

3.4 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance for meters, gages, machines, and equipment.
- B. Connect flowmeter-system elements to meters.
- C. Connect flowmeter transmitters to meters.
- D. Connect thermal-energy-meter transmitters to meters.

3.5 ADJUSTING

- A. Calibrate meters according to manufacturer's written instructions, after installation.
- B. Adjust faces of meters and gages to proper angle for best visibility.

END OF SECTION

SECTION 23 05 23

GENERAL-DUTY VALVES FOR HVAC 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. Brass ball valves.
 - 2. Bronze ball valves.
 - 3. Iron ball valves.
 - 4. Iron, single-flange butterfly valves.
 - 5. Iron, grooved-end butterfly valves.
 - 6. High-performance butterfly valves.
 - 7. Bronze swing check valves.
 - 8. Iron swing check valves.
 - 9. Iron swing check valves with closure control.
 - 10. Iron, grooved-end swing-check valves.
 - 11. Iron, center-guided check valves.
 - 12. Iron, plate-type check valves.
 - 13. Bronze gate valves.
 - 14. Iron gate valves.
 - 15. Bronze globe valves.
 - 16. Iron globe valves.
 - 17. Lubricated plug valves.
 - 18. Eccentric plug valves.
- B. Related Sections:
 - 1. Division 23 HVAC piping Sections for specialty valves applicable to those Sections only.
 - 2. Division 23 Section "Identification for HVAC Piping and Equipment" for valve tags and schedules.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.

1.4 SUBMITTALS

- A. Product Data: For each type of valve indicated.

1.5 ACCEPTABLE MANUFACTURERS

- A. All valves shall be manufactured in the USA.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. American Valve Co.
 - 2. Cameron
 - 3. Conbraco Industries.
 - 4. Hammond Valve
 - 5. Milwaukee Valve Co.
 - 6. NIBCO Inc.
 - 7. Powell Valves
 - 8. Watts Regulator Co

1.6 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 2. ASME B31.1 for power piping valves.
 - 3. ASME B31.9 for building services piping valves.

1.7 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 angle, gate, and globe valves closed to prevent rattling.
 - 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 - 5. Set butterfly valves closed or slightly open.
 - 6. Block check valves in either closed or open position.

- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to HVAC valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
 - 1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
 - 2. Handwheel: For valves other than quarter-turn types.
 - 3. Handlever: For quarter-turn valves NPS 6 and smaller.
 - 4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug-valve head.
- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
 - 1. Gate Valves: With rising stem.
 - 2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 - 3. Butterfly Valves: With extended neck.
- F. Valve-End Connections:
 - 1. Flanged: With flanges according to ASME B16.1 for iron valves.
 - 2. Grooved: With grooves according to AWWA C606.
 - 3. Solder Joint: With sockets according to ASME B16.18.
 - 4. Threaded: With threads according to ASME B1.20.1.
- G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRASS BALL VALVES

- A. Three-Piece, Full-Port, Brass Ball Valves with Brass Trim:

1. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig.
- c. CWP Rating: 600 psig.
- d. Body Design: Three piece.
- e. Body Material: Forged brass.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Brass.
- i. Ball: Chrome-plated brass.
- j. Port: Full.

B. Three-Piece, Full-Port, Brass Ball Valves with Stainless-Steel Trim:

1. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig.
- c. CWP Rating: 600 psig.
- d. Body Design: Three piece.
- e. Body Material: Forged brass.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Stainless steel.
- i. Ball: Stainless steel, vented.
- j. Port: Full.

2.3 BRONZE BALL VALVES

A. Three-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig.
- c. CWP Rating: 600 psig.
- d. Body Design: Three piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Bronze.
- i. Ball: Chrome-plated brass.
- j. Port: Full.

B. Three-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Description:

- a. Standard: MSS SP-110.

- b. SWP Rating: 150 psig.
- c. CWP Rating: 600 psig.
- d. Body Design: Three piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Stainless steel.
- i. Ball: Stainless steel, vented.
- j. Port: Full.

2.4 IRON BALL VALVES

A. Class 150, Iron Ball Valves:

- 1. Description:
 - a. Standard: MSS SP-72.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Split body.
 - d. Body Material: ASTM A 126, gray iron.
 - e. Ends: Flanged.
 - f. Seats: PTFE or TFE.
 - g. Stem: Stainless steel.
 - h. Ball: Stainless steel.
 - i. Port: Full.

2.5 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Aluminum-Bronze Disc:

- 1. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: NBR.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Aluminum bronze.

2.6 IRON, GROOVED-END BUTTERFLY VALVES

A. 175 CWP, Iron, Grooved-End Butterfly Valves:

- 1. Description:
 - a. Standard: MSS SP-67, Type I.

- b. CWP Rating: 175 psig.
- c. Body Material: Coated, ductile iron.
- d. Stem: Two-piece stainless steel.
- e. Disc: Coated, ductile iron.
- f. Seal: EPDM.

2.7 HIGH-PERFORMANCE BUTTERFLY VALVES

A. Class 150, Single-Flange, High-Performance Butterfly Valves:

- 1. Description:
 - a. Standard: MSS SP-68.
 - b. CWP Rating: 285 psig at 100 deg F.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: Carbon steel, cast iron, ductile iron, or stainless steel.
 - e. Seat: Reinforced PTFE or metal.
 - f. Stem: Stainless steel; offset from seat plane.
 - g. Disc: Carbon steel.
 - h. Service: Bidirectional.

2.8 BRONZE SWING CHECK VALVES

A. Class 150, Bronze Swing Check Valves with Bronze Disc:

- 1. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 300 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.

2.9 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Metal Seats:

- 1. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 150 psig.
 - d. Body Design: Clear or full waterway.
 - e. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - f. Ends: Flanged.
 - g. Trim: Bronze.

- h. Gasket: Asbestos free.

2.10 IRON SWING CHECK VALVES WITH CLOSURE CONTROL

- A. Class 125, Iron Swing Check Valves with Lever- and Spring-Closure Control:

- 1. Description:

- a. Standard: MSS SP-71, Type I.
- b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
- c. NPS 14 to NPS 24, CWP Rating: 150 psig.
- d. Body Design: Clear or full waterway.
- e. Body Material: ASTM A 126, gray iron with bolted bonnet.
- f. Ends: Flanged.
- g. Trim: Bronze.
- h. Gasket: Asbestos free.
- i. Closure Control: Factory-installed, exterior lever and spring.

2.11 IRON, GROOVED-END SWING CHECK VALVES

- A. 300 CWP, Iron, Grooved-End Swing Check Valves:

- 1. Description:

- a. CWP Rating: 300 psig.
- b. Body Material: ASTM A 536, ductile iron.
- c. Seal: EPDM.
- d. Disc: Spring operated, ductile iron or stainless steel.

2.12 IRON, CENTER-GUIDED CHECK VALVES

- A. Class 150, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:

- 1. Description:

- a. Standard: MSS SP-125.
- b. NPS 2-1/2 to NPS 12, CWP Rating: 300 psig.
- c. NPS 14 to NPS 24, CWP Rating: 250 psig.
- d. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
- e. Style: Compact wafer.
- f. Seat: EPDM or NBR.

2.13 IRON, PLATE-TYPE CHECK VALVES

- A. Class 150, Iron, Dual-Plate Check Valves with Resilient Seat:

- 1. Description:

- a. Standard: API 594.
- b. NPS 2-1/2 to NPS 12, CWP Rating: 300 psig.
- c. NPS 14 to NPS 24, CWP Rating: 250 psig.
- d. Body Design: Wafer, spring-loaded plates.
- e. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
- f. Seat: EPDM or NBR.

2.14 BRONZE GATE VALVES

A. Class 150, NRS Bronze Gate Valves:

- 1. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 300 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.

2.15 IRON GATE VALVES

A. Class 125, OS&Y, Iron Gate Valves:

- 1. Description:
 - a. Standard: MSS SP-70, Type I.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 150 psig.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze.
 - g. Disc: Solid wedge.
 - h. Packing and Gasket: Asbestos free.

2.16 BRONZE GLOBE VALVES

A. Class 150, Bronze Globe Valves with Bronze Disc:

- 1. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 300 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded.
 - e. Stem and Disc: Bronze.
 - f. Packing: Asbestos free.

- g. Handwheel: Malleable iron, bronze, or aluminum.

2.17 IRON GLOBE VALVES

A. Class 125, Iron Globe Valves:

1. Description:

- a. Standard: MSS SP-85, Type I.
- b. CWP Rating: 200 psig.
- c. Body Material: ASTM A 126, gray iron with bolted bonnet.
- d. Ends: Flanged.
- e. Trim: Bronze.
- f. Packing and Gasket: Asbestos free.

2.18 LUBRICATED PLUG VALVES

A. Class 125, Regular-Gland, Lubricated Plug Valves with Flanged Ends:

1. Description:

- a. Standard: MSS SP-78, Type II.
- b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
- c. NPS 14 to NPS 24, CWP Rating: 150 psig.
- d. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
- e. Pattern: Regular or short.
- f. Plug: Cast iron or bronze with sealant groove.

2.19 ECCENTRIC PLUG VALVES

A. 175 CWP, Eccentric Plug Valves with Resilient Seating.

1. Description:

- a. Standard: MSS SP-108.
- b. CWP Rating: 175 psig minimum.
- c. Body and Plug: ASTM A 48/A 48M, gray iron; ASTM A 126, gray iron; or ASTM A 536, ductile iron.
- d. Bearings: Oil-impregnated bronze or stainless steel.
- e. Ends: Flanged.
- f. Stem-Seal Packing: Asbestos free.
- g. Plug, Resilient-Seating Material: Suitable for potable-water service unless otherwise indicated.

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 check valves for proper direction of flow and as follows:
 - 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.

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. Shutoff Service: Ball, butterfly valves.
 - 2. Butterfly Valve Dead-End Service: Single-flange (lug) type.

3. Throttling Service except Steam: Globe, ball, or butterfly valves.
 4. Throttling Service, Steam: Globe or butterfly valves.
 5. Pump-Discharge Check Valves:
 - a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
 - b. NPS 2-1/2 and Larger: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal or resilient-seat check valves.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 2. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 3. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 4. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.5 CHILLED-WATER, CONDENSER WATER AND HOT WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
1. Ball Valves: Three piece, full port, brass or bronze with brass trim.
 2. Bronze Swing Check Valves: Class 150, bronze disc.
 3. Bronze Gate Valves: Class 150, NRS, bronze.
 4. Bronze Globe Valves: Class 150, bronze disc.
- B. Pipe NPS 2-1/2 and Larger:
1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
 2. Iron Ball Valves, NPS 2-1/2 to NPS 10: Class 150.
 3. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12: 200 CWP, NBR seat, aluminum-bronze disc.
 4. Iron, Grooved-End Butterfly Valves, NPS 2-1/2 to NPS 12: 175 CWP.
 5. High-Performance Butterfly Valves: Class 150, single flange.
 6. Iron Swing Check Valves: Class 125, metal seats.
 7. Iron Swing Check Valves with Closure Control, NPS 2-1/2 to NPS 12: Class 125, lever and spring.
 8. Iron, Grooved-End Check Valves, NPS 3 to NPS 12: 300 CWP.
 9. Iron, Center-Guided Check Valves: Class 150, compact-wafer, resilient seat.
 10. Iron, Plate-Type Check Valves: Class 150; single plate; resilient seat.
 11. Iron Gate Valves: Class 125, OS&Y.
 12. Iron Globe Valves: Class 125.
 13. Lubricated Plug Valves: Class 125, flanged.
 14. Eccentric Plug Valves: 175 CWP, resilient seating.

END OF SECTION

SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC 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 1 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. Steel pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Metal framing systems.
 - 4. Thermal-hanger shield inserts.
 - 5. Fastener systems.
 - 6. Pipe stands.
 - 7. Equipment supports.
- B. Related Sections include the following:
 - 1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
 - 2. Division 21 Section "Water-Based Fire-Suppression Systems" for pipe hangers for fire-protection piping.
 - 3. Division 23 Section "Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.
 - 4. Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" for vibration isolation devices.
 - 5. Division 23 Section(s) "Metal Ducts" for duct hangers and supports.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel pipe hangers and supports.
 - 2. Fiberglass pipe hangers.
 - 3. Thermal-hanger shield inserts.
 - 4. Powder-actuated fastener systems.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze pipe hangers. Include Product Data for components.
 - 2. Metal framing systems. Include Product Data for components.
 - 3. Pipe stands. Include Product Data for components.
 - 4. Equipment supports.
- C. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel.", AWS D1.3, "Structural Welding Code--Sheet Steel.", AWS D1.4, "Structural Welding Code--Reinforcing Steel." and ASME Boiler and Pressure Vessel Code: Section IX.
- B. 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."
 - 4. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
 - 5. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

- C. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- D. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
- C. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS

- A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.
- B. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.
- C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches 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 zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.7 PIPE STAND FABRICATION

- A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod-roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

- C. Low-Type, Single-Pipe Stand: One-piece plastic base unit with plastic roller, for roof installation without membrane penetration.
- D. High-Type, Single-Pipe Stand: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
 - 1. Base: Plastic.
 - 2. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
 - 3. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
- E. High-Type, Multiple-Pipe Stand: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
 - 1. Bases: One or more plastic.
 - 2. Vertical Members: Two or more protective-coated-steel channels.
 - 3. Horizontal Member: Protective-coated-steel channel.
 - 4. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.
- F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe support made from structural-steel shape, continuous-thread rods, and rollers for mounting on permanent stationary roof curb.

2.8 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.9 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink 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 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 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 padded hangers for plastic piping and piping that is subject to scratching.
- F. 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 non-insulated or insulated stationary pipes, NPS 1/2 to NPS 30.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
 - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
 - 5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, 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 non-insulated stationary pipes, NPS 3/4 to NPS 8.
 - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 8.
 - 8. Adjustable Band Hangers (MSS Type 9): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 8.
 - 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 2.
 - 10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of non-insulated stationary pipes, NPS 3/8 to NPS 8.
 - 11. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of non-insulated stationary pipes, NPS 3/8 to NPS 3.
 - 12. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
 - 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, with steel pipe base stanchion support and cast-iron floor flange.
 - 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange 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, 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, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
 - 18. 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.
 - 19. 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.
 - 20. 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.
 - 21. 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.

- G. 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.

- H. 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. 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 piping installations.

- I. 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.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 - 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.

- J. 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.
- K. 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.
- L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- N. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Install hangers for plastic piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- 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 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-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 2. Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. Refer to Division 07 Section "Roof Accessories" for curbs.
- H. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- J. 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.
- 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 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 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 so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.

- O. Insulated Piping: Comply with the following:
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 according to ASME B31.1 for power piping and 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 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 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: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
 5. Pipes NPS 8 and Larger: Include wood inserts.
 6. Insert Material: Length at least as long as protective shield.
 7. Thermal-Hanger Shields: Install with insulation 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 smooth bearing surface.
- 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 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 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 2”.

3.6 PAINTING

- A. Touch Up: 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 minimum dry film thickness of 2.0 mils.
- B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 23 05 48

VIBRATION AND SEISMIC CONTROLS FOR HVAC 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. This Section includes the following:
 - 1. Isolation pads.
 - 2. Isolation mounts.
 - 3. Freestanding and restrained spring isolators.
 - 4. Housed spring mounts.
 - 5. Spring hangers.
 - 6. Spring hangers with vertical-limit stops.
 - 7. Seismic snubbers.
 - 8. Restraining braces and cables.

1.3 DEFINITIONS

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.

1.4 PERFORMANCE REQUIREMENTS

- A. The Mechanical Contractor shall be responsible for providing restraints to resist the earthquake effects on the mechanical system. The requirements for these restraints are found in the North Carolina State Building Code and ASCE 7.
- B. The Mechanical Contractor shall refer to the latest edition of the "Seismic Restraint Manual Guidelines for Mechanical System" published by SMACNA for guidelines to determine the correct restraints for sheet metal ducts, piping, and conduit, etc.
- C. The Mechanical Contractor shall retain the services of a Professional Structural Engineer registered in the State of North Carolina to design seismic restraint elements required for this project. The engineer's computations, bearing his professional seal, shall accompany shop drawings which show Code compliance. Computations and shop drawings shall be submitted for review prior to the purchasing of materials, equipment systems, and assemblies.

- D. The professional engineer retained by the Mechanical Contractor for seismic restraint calculations shall visit the job site upon completion of the seismic restraint installation. This Engineer shall provide in writing verification of compliance with the approved seismic submittal. This verification shall bear the Engineer's professional seal. Job site inspection by other than this Engineer is not acceptable. This engineer shall also be responsible for any required special inspections and associated documentation related to seismic restraints.
- E. Seismic-Restraint Loading:
 - 1. Site Class as Defined in the NC State Building Code (Chapter 16) and ASCE 7, as determined by the project Structural Engineer of record.
 - 2. Assigned Seismic Use Group or Building Category as Defined in the NC State Building Code (Chapter 16) and ASCE 7.
 - a. Component Importance Factor.
 - b. Component Response Modification Factor.
 - c. Component Amplification Factor.
 - 3. Design Spectral Response Acceleration at Short Periods (0.2 Second).
 - 4. Design Spectral Response Acceleration at 1-Second Period.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
 - 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.
 - 3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.
- B. Delegated-Design Submittal: For vibration isolation and seismic-restraint 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, seismic forces required to select vibration isolators, seismic restraints, and for designing vibration isolation bases.
 - a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Division 22 Sections for equipment mounted outdoors.

2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
3. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.
4. Seismic-Restraint Details:
 - a. Design Analysis: To support selection and arrangement of seismic 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 spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
 - c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Division 22 Sections for equipment mounted outdoors.
 - d. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).
- C. Coordination Drawings: Show coordination of seismic bracing for HVAC piping and equipment 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. Review of the seismic design and shop drawings by the Engineer/Architect or his agent shall not relieve the Contractor of his responsibility to comply with the seismic or any other requirements of the North Carolina State Building Code, Section 1607.

1.6 QUALITY ASSURANCE

- A. The professional Engineer retained by the Mechanical Contractor for seismic restraint calculations shall visit the job site upon completion of the seismic restraint installation. This Engineer shall provide in writing verification of compliance with the approved seismic submittal. This verification shall bear the Engineer's professional seal. Job site inspection by other than this Engineer is not acceptable.
- B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

- D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - 1. Kinetics Noise Control.
 - 2. Mason Industries.
 - 3. Vibration Eliminator Co., Inc.
 - 4. Vibration Isolation.
 - 5. Vibration Mountings & Controls, Inc.
- B. Pads: Arranged 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. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.
 - 1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 - 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.
- D. Restrained Mounts: All-directional mountings with seismic restraint.
 - 1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 - 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.
- E. 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.
- F. 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.
- G. Housed Spring Mounts: Housed spring isolator with integral seismic snubbers.
1. Housing: Ductile-iron or steel housing to provide all-directional seismic restraint.
 2. Base: Factory drilled for bolting to structure.
 3. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch travel up or down before contacting a resilient collar.
- H. Spring Hangers: 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. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
- I. Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.

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.
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.

2.2 VIBRATION ISOLATION EQUIPMENT BASES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
1. Mason Industries.
 2. Vibration Eliminator Co., Inc.
 3. Vibration Isolation.
 4. Vibration Mountings & Controls, Inc.

2.3 SEISMIC-RESTRAINT DEVICES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
1. Hilti, Inc.
 2. Kinetics Noise Control.
 3. Mason Industries.
- B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- C. Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
 2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
 3. Maximum 1/4-inch air gap, and minimum 1/4-inch- thick resilient cushion.

- D. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with 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; and rated in tension, compression, and torsion forces.
- E. Restraint Cables: ASTM A 603 galvanized-steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.
- F. Hanger Rod Stiffener: Reinforcing steel angle clamped to hanger rod.
- G. 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.
- H. 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.
- I. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- J. Mechanical Anchor Bolts: 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 E 488. Minimum length of eight times diameter.
- K. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl 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 E 488.

2.4 FACTORY FINISHES

- A. Finish: Manufacturer's standard prime-coat finish ready for field painting.
- B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
 - 1. Powder coating on springs and housings.
 - 2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
 - 3. Baked enamel or powder coat for metal components on isolators for interior use.
 - 4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control 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 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 due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Comply with requirements in Division 07 Section "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- B. Equipment Restraints:
 - 1. Install seismic snubbers on HVAC 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. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
- C. Piping Restraints:
 - 1. Comply with requirements in MSS SP-127.
 - 2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
 - 3. Brace a change of direction longer than 12 feet.
- D. Install cables so they do not bend across edges of adjacent equipment or building structure.

- E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
- F. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- G. 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.
- H. 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.
- I. Drilled-in 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 the 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. Wedge Anchors: 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 Anchors: 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 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Division 22 Section "Hydronic Piping" for piping flexible connections.

3.5 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. 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 postconnection 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.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.

3.6 ADJUSTING

- A. Adjust isolators after piping 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.
- C. Adjust active height of spring isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION

SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Valve tags.

1.2 SUBMITTAL

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

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Plastic Labels for Equipment (Note: Plastic Labels utilized in a return air plenum shall be listed and approved for use in a return air plenum):
 - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
 - 2. Letter Color: White.
 - 3. Background Color: Red.
 - 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
 - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 6. 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.
 - 7. Fasteners: Stainless-steel rivets or self-tapping screws.
 - 8. 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.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Red.
- C. Background Color: White.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. 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.
- 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. (Note: Plastic Labels utilized in a return air plenum shall be listed and approved for use in a return air plenum):
- 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, 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: At least 1-1/2 inches high.

2.4 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 2. Fasteners: Brass wire-link or beaded chain.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
1. Valve-tag schedule shall be included in operation and maintenance data.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of 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.
- C. Major mechanical equipment shall include:
- a. All AC units and heat pump units (split or packaged, water or air cooled)
 - b. Pumps
 - c. Fans
 - d. Expansion Tanks
 - e. Air Separators

3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Division 09.
- B. 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 along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

C. Pipe Label Color Schedule:

1. Geothermal/Condenser-Water Piping:
 - a. Background Color: Green.
 - b. Letter Color: White.
2. Refrigerant Piping:
 - a. Background Color: Yellow.
 - b. Letter Color: Black.
3. Drain Piping:
 - a. Background Color: Yellow.
 - b. Letter Color: Black.

3.4 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; and shutoff valves. 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. Geothermal/Condenser Water: 2 inches, round.
 - b. Refrigerant: 2 inches, round.
 - c. Gas: 2 inches, round.
 2. Valve-Tag Color:
 - a. Geothermal/Condenser Water: Natural.
 - b. Refrigerant: Natural.
 - c. Gas: Natural.
 3. Letter Color:
 - a. Geothermal/Condenser Water: Black.
 - b. Refrigerant: Black.
 - c. Gas: Black.

3.5 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

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 TAB to produce design objectives for the following:
 - 1. Air Systems:
 - a. Constant-volume air systems.
 - b. Dual-duct systems.
 - c. Variable-air-volume systems.
 - d. Multizone systems.
 - e. Induction-unit systems.
 - 2. Hydronic Piping Systems:
 - a. Constant-flow systems.
 - b. Variable-flow systems.
 - c. Primary-secondary systems.
 - 3. Steam systems.
 - 4. HVAC equipment quantitative-performance settings.
 - 5. Kitchen hood airflow balancing.
 - 6. Laboratory fume hood airflow balancing.
 - 7. Exhaust hood airflow balancing.
 - 8. Space pressurization testing and adjusting.
 - 9. Vibration measuring.
 - 10. Sound level measuring.
 - 11. Stair-tower pressurization testing and adjusting.
 - 12. Smoke-control systems testing and adjusting.
 - 13. Indoor-air quality measuring.
 - 14. Existing systems TAB.
 - 15. Verifying that automatic control devices are functioning properly.
 - 16. Reporting results of activities and procedures specified in this Section.

1.3 DEFINITIONS

- A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.
- C. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.
- D. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.
- E. NC: Noise criteria.
- F. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- G. RC: Room criteria.
- H. Report Forms: Test data sheets for recording test data in logical order.
- I. Smoke-Control System: An engineered system that uses fans to produce airflow and pressure differences across barriers to limit smoke movement.
- J. Smoke-Control Zone: A space within a building that is enclosed by smoke barriers and is a part of a zoned smoke-control system.
- K. Stair Pressurization System: A type of smoke-control system that is intended to positively pressurize stair towers with outdoor air by using fans to keep smoke from contaminating the stair towers during an alarm condition.
- L. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.
- M. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
- N. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- O. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
- P. TAB: Testing, adjusting, and balancing.
- Q. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

- R. Test: A procedure to determine quantitative performance of systems or equipment.
- S. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

1.4 SUBMITTALS

- A. Qualification Data: Within 15 days from Contractor's Notice to Proceed, submit 4 copies of evidence that TAB firm and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 30 days from Contractor's Notice to Proceed, submit 4 copies of the Contract Documents review report as specified in Part 3.
- C. Strategies and Procedures Plan: Within 60 days from Contractor's Notice to Proceed, submit 4 copies of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation" Article. Include a complete set of report forms intended for use on this Project.
- D. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.
- E. Sample Report Forms: Submit two sets of sample TAB report forms.
- F. Warranties specified in this Section.

1.5 QUALITY ASSURANCE

- A. TAB Firm Qualifications: Engage a TAB firm certified by AABC or NEBB.
- B. TAB Conference: Meet with Owner's and Architect's representatives on approval of TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, HVAC controls installers, and other support personnel. Provide seven days' advance notice of scheduled meeting time and location.
 - 1. Agenda Items: Include at least the following:
 - a. Submittal distribution requirements.
 - b. The Contract Documents examination report.
 - c. TAB plan.
 - d. Work schedule and Project-site access requirements.
 - e. Coordination and cooperation of trades and subcontractors.
 - f. Coordination of documentation and communication flow.
- C. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.

2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.
- D. TAB Report Forms: Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems." or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."
- E. Instrumentation Type, Quantity, and Accuracy: As described in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."
- F. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.
 1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.
- G. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2007, Section 7.2.2 - "Air Balancing."
- H. ASHRAE/IESNA 90.1-2007 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2007, Section 6.7.2.3 - "System Balancing."

1.6 COORDINATION

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.
- B. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
- C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.7 WARRANTY

- A. National Project Performance Guarantee: Provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:
 1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
 2. Systems are balanced to optimum performance capabilities within design and installation limits.

- B. Special Guarantee: Provide a guarantee on NEBB forms stating that NEBB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee shall include the following provisions:
 - 1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
 - 2. Systems are balanced to optimum performance capabilities within design and installation limits.

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.
 - 1. Contract Documents are defined in the General and Supplementary Conditions of Contract.
 - 2. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- B. Examine approved submittal data of HVAC systems and equipment.
- C. Examine Project Record Documents described in Division 01 Section "Project Record Documents."
- 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. 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. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.
- F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.
- G. Examine system and equipment test reports.

- H. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- J. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- K. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.
- L. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.
- M. Examine strainers for clean screens and proper perforations.
- N. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- O. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- P. Examine system pumps to ensure absence of entrained air in the suction piping.
- Q. Examine equipment for installation and for properly operating safety interlocks and controls.
- R. Examine automatic temperature system components to verify the following:
 - 1. Dampers, valves, and other controlled devices are operated by the intended controller.
 - 2. Dampers and valves are in the position indicated by the controller.
 - 3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
 - 4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
 - 5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
 - 6. Sensors are located to sense only the intended conditions.
 - 7. Sequence of operation for control modes is according to the Contract Documents.
 - 8. Controller set points are set at indicated values.
 - 9. Interlocked systems are operating.
 - 10. Changeover from heating to cooling mode occurs according to indicated values.
- S. 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 strategies and step-by-step procedures.
- B. Complete system readiness checks and prepare system readiness reports. Verify the following:
 - 1. Permanent electrical power wiring is complete.
 - 2. Hydronic systems are filled, clean, and free of air.
 - 3. Automatic temperature-control systems are operational.
 - 4. Equipment and duct access doors are securely closed.
 - 5. Balance, smoke, and fire dampers are open.
 - 6. Isolating and balancing valves are open and control valves are operational.
 - 7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 - 8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems", NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.
 - 1. Comply with requirements in ASHRAE 62.1-2007, Section 7.2.2 - "Air Balancing."
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.
- C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 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' "as-built" 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 outside-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 for proper sealing of air duct system.

3.5 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 fan static pressures to determine actual static pressure as follows:
 - a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 - 2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
 - 3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.
 - 4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
 - 5. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
 - 6. 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 will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes 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 static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
 - a. Where sufficient space in submain 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. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure terminal outlets and inlets without making adjustments.
 - 1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.
 - 1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 - 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

- A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a maximum set-point airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.
- B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
 - 1. Set outside-air dampers at minimum, and return- and exhaust-air dampers at a position that simulates full-cooling load.
 - 2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
 - 3. Measure total system airflow. Adjust to within indicated airflow.

4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
 5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow as described for constant-volume air systems.
 - a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
 6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.
 7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
 8. Record the final fan performance data.
- C. Pressure-Dependent, Variable-Air-Volume Systems without Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Balance systems similar to constant-volume air systems.
 2. Set terminal units and supply fan at full-airflow condition.
 3. Adjust inlet dampers of each terminal unit to indicated airflow and verify operation of the static-pressure controller. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
 4. Readjust fan airflow for final maximum readings.
 5. Measure operating static pressure at the sensor that controls the supply fan, if one is installed, and verify operation of the static-pressure controller.
 6. Set supply fan at minimum airflow if minimum airflow is indicated. Measure static pressure to verify that it is being maintained by the controller.
 7. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow as described for constant-volume air systems.
 - a. If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.
 8. Measure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.
- D. Pressure-Dependent, Variable-Air-Volume Systems with Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set system at maximum indicated airflow by setting the required number of terminal units at minimum airflow. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.
 2. Adjust supply fan to maximum indicated airflow with the variable-airflow controller set at maximum airflow.

3. Set terminal units at full-airflow condition.
4. Adjust terminal units starting at the supply-fan end of the system and continuing progressively to the end of the system. Adjust inlet dampers of each terminal unit to indicated airflow. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
5. Adjust terminal units for minimum airflow.
6. Measure static pressure at the sensor.
7. Measure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.

3.7 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
 1. Open all manual valves for maximum flow.
 2. Check expansion tank liquid level.
 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. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
 8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.8 PROCEDURES FOR HYDRONIC SYSTEMS

- A. Measure water flow at pumps. Use the following procedures, except for positive-displacement pumps:
 1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
 2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
 3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake

- horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
4. Report flow rates that are not within plus or minus 5 percent of design.
- B. Set calibrated balancing valves, if installed, at calculated presettings.
- C. Measure flow at all stations and adjust, where necessary, to obtain first balance.
1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
- D. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
- E. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
1. Determine the balancing station with the highest percentage over indicated flow.
 2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
 3. Record settings and mark balancing devices.
- F. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
- G. Measure the differential-pressure control valve settings existing at the conclusions of balancing.

3.9 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

- A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.10 PROCEDURES FOR PRIMARY-SECONDARY-FLOW HYDRONIC SYSTEMS

- A. Balance the primary system crossover flow first, then balance the secondary system.

3.11 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
1. Manufacturer, model, and serial numbers.
 2. Motor horsepower rating.
 3. Motor rpm.
 4. Efficiency rating.
 5. Nameplate and measured voltage, each phase.
 6. Nameplate and measured amperage, each phase.
 7. Starter thermal-protection-element rating.

- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.12 PROCEDURES FOR CHILLERS

- A. Balance water flow through each evaporator and condenser to within specified tolerances of indicated flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:
 - 1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.
 - 2. If water-cooled chillers, condenser-water entering and leaving temperatures, pressure drop, and water flow.
 - 3. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.
 - 4. Power factor if factory-installed instrumentation is furnished for measuring kilowatt.
 - 5. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatt.
 - 6. Capacity: Calculate in tons of cooling.
 - 7. If air-cooled chillers, verify condenser-fan rotation and record fan and motor data including number of fans and entering- and leaving-air temperatures.

3.13 PROCEDURES FOR COOLING TOWERS

- A. Shut off makeup water for the duration of the test, and verify that makeup and blowdown systems are fully operational after tests and before leaving the equipment. Perform the following tests and record the results:
 - 1. Measure condenser-water flow to each cell of the cooling tower.
 - 2. Measure entering- and leaving-water temperatures.
 - 3. Measure wet- and dry-bulb temperatures of entering air.
 - 4. Measure wet- and dry-bulb temperatures of leaving air.
 - 5. Measure condenser-water flow rate recirculating through the cooling tower.
 - 6. Measure cooling tower pump discharge pressure.
 - 7. Adjust water level and feed rate of makeup-water system.

3.14 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record compressor data.

3.15 PROCEDURES FOR BOILERS

- A. If hydronic, measure entering- and leaving-water temperatures and water flow.
- B. If steam, measure entering-water temperature and flow and leaving steam pressure, temperature, and flow.

3.16 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Water Coils: Measure the following data for each coil:
 - 1. Entering- and leaving-water temperature.
 - 2. Water flow rate.
 - 3. Water pressure drop.
 - 4. Dry-bulb temperature of entering and leaving air.
 - 5. Wet-bulb temperature of entering and leaving air for cooling coils.
 - 6. Airflow.
 - 7. Air pressure drop.
- B. Electric-Heating Coils: Measure the following data for each coil:
 - 1. Nameplate data.
 - 2. Airflow.
 - 3. Entering- and leaving-air temperature at full load.
 - 4. Voltage and amperage input of each phase at full load and at each incremental stage.
 - 5. Calculated kilowatt at full load.
 - 6. Fuse or circuit-breaker rating for overload protection.
- C. Refrigerant Coils: Measure the following data for each coil:
 - 1. Dry-bulb temperature of entering and leaving air.
 - 2. Wet-bulb temperature of entering and leaving air.
 - 3. Airflow.
 - 4. Air pressure drop.
 - 5. Refrigerant suction pressure and temperature.

3.17 PROCEDURES FOR TEMPERATURE MEASUREMENTS

- A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.
- B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of two successive eight-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.
- C. Measure outside-air, wet- and dry-bulb temperatures.

3.18 PROCEDURES FOR COMMERCIAL KITCHEN HOODS

- A. Measure, adjust, and record the airflow of each kitchen hood. For kitchen hoods designed with integral makeup air, measure and adjust the exhaust and makeup airflow. Measure airflow by duct Pitot-tube traverse. If a duct Pitot-tube traverse is not possible, provide an explanation in the report of the reason(s) why and also the reason why the method used was chosen.
 - 1. Install welded test ports in the sides of the exhaust duct for the duct Pitot-tube traverse. Install each test port with a threaded cap that is liquid tight.
- B. After balancing is complete, do the following:
 - 1. Measure and record the static pressure at the hood exhaust-duct connection.
 - 2. Measure and record the hood face velocity. Make measurements at multiple points across the face of the hood. Perform measurements at a maximum of 12 inches (300 mm) between points and between any point and the perimeter. Calculate the average of the measurements recorded. Verify that the hood average face velocity complies with the Contract Documents and governing codes.
 - 3. Check the hood for capture and containment of smoke using a smoke emitting device. Observe the smoke pattern. Make adjustments to room airflow patterns to achieve optimum results.
- C. Visually inspect the hood exhaust duct throughout its entire length in compliance with authorities having jurisdiction. Begin at the hood connection and end at the point it discharges outdoors. Report findings.
 - 1. Check duct slopes as required.
 - 2. Verify that duct access is installed as required.
 - 3. Verify that point of termination is as required.
 - 4. Verify that duct air velocity is within the range required.
 - 5. Verify that duct is within a fire-rated enclosure.
- D. Report deficiencies.

3.19 PROCEDURES FOR LABORATORY FUME HOODS

- A. Before performing laboratory fume hood testing, measure, adjust and record the supply airflow and airflow patterns of each supply air outlet that is located in the same room as the hood. Adjust the air outlet flow pattern to minimize turbulence and to achieve the desired airflow patterns at the face and inside the hood. Verify that adequate makeup air is available to achieve the indicated flow of the hood.
- B. Measure, adjust, and record the airflow of each laboratory fume hood by duct Pitot-tube traverse with the laboratory fume hood sash in the design open position.
 - 1. For laboratory fume hoods installed in variable exhaust systems, measure, adjust, and record the hood exhaust airflow at maximum and at minimum airflow conditions.
 - 2. For laboratory fume hoods designed with integral makeup air, measure, adjust, and record the exhaust and makeup airflow.

- C. For laboratory fume hoods that are connected to centralized exhaust systems using automatic dampers, adjust the damper controller to obtain the indicated exhaust airflow.
- D. After balancing is complete, do the following:
 - 1. Measure and record the static pressure at the hood duct connection with the hood operating at indicated airflow.
 - 2. Measure and record the face velocity across the open sash face area. Measure the face velocity at each point in a grid pattern. Perform measurements at a maximum of 12 inches between points and between any point and the perimeter of the opening.
 - a. For laboratory fume hoods designed to maintain a constant face velocity at varying sash positions, also measure and record the face velocity at 50 and 25 percent of the design open sash position.
 - b. Calculate and report the average face velocity by averaging all velocity measurements.
 - c. Calculate and report the exhaust airflow by multiplying the calculated average face velocity by the sash open area. Compare this quantity with the exhaust airflow measured by duct Pitot-tube traverse. Report differences.
 - d. If the average face velocity is less than the indicated face velocity, retest the average face velocity and adjust hood baffles, fan drives, and other parts of the system to provide the indicated average face velocity.
 - 3. Check each laboratory fume hood for the capture and containment of smoke by using a hand-held emitting device. Observe the capture and containment of smoke flow pattern across the open face and inside the hood. Make adjustments necessary to achieve the desired results.
- E. With the room and laboratory fume hoods operating at indicated conditions, perform an "as-installed" performance test of the laboratory fume hood according to ASHRAE 110. Test each laboratory fume hood(s) and document the test results.

3.20 PROCEDURES FOR EXHAUST HOODS

- A. Measure, adjust, and record the airflow of each exhaust hood. Measure airflow by duct Pitot-tube traverse. If a duct Pitot-tube traverse is not possible, explain why, in the report, and explain the test method used.
- B. After balancing is complete, do the following:
 - 1. Measure and record the static pressure at the hood exhaust-duct connection.
 - 2. Check the hood for capture and containment of smoke using a smoke emitting device. Observe the smoke pattern. Make adjustments to achieve optimum results.

3.21 PROCEDURES FOR SPACE PRESSURIZATION MEASUREMENTS AND ADJUSTMENTS

- A. Before testing for space pressurization, observe the space to verify the integrity of the space boundaries. Verify that windows and doors are closed and applicable safing, gaskets, and

sealants are installed. Report deficiencies and postpone testing until after the reported deficiencies are corrected.

- B. Measure, adjust, and record the pressurization of each room, each zone, and each building by adjusting the supply, return, and exhaust airflows to achieve the indicated conditions.
- C. Measure space pressure differential where pressure is used as the design criteria, and measure airflow differential where differential airflow is used as the design criteria for space pressurization.
 - 1. For pressure measurements, measure and record the pressure difference between the intended spaces at the door with all doors in the space closed. Record the high-pressure side, low-pressure side, and pressure difference between each adjacent space.
 - 2. For applications with cascading levels of space pressurization, begin in the most critical space and work to the least critical space.
 - 3. Test room pressurization first, then zones, and finish with building pressurization.
- D. To achieve indicated pressurization, set the supply airflow to the indicated conditions and adjust the exhaust and return airflow to achieve the indicated pressure or airflow difference.
- E. For spaces with pressurization being monitored and controlled automatically, observe and adjust the controls to achieve the desired set point.
 - 1. Compare the values of the measurements taken to the measured values of the control system instruments and report findings.
 - 2. Check the repeatability of the controls by successive tests designed to temporarily alter the ability to achieve space pressurization. Test overpressurization and underpressurization, and observe and report on the system's ability to revert to the set point.
 - 3. For spaces served by variable-air-volume supply and exhaust systems, measure space pressurization at indicated airflow and minimum airflow conditions.
- F. In spaces that employ multiple modes of operation, such as normal mode and emergency mode or occupied mode and unoccupied mode, measure, adjust, and record data for each operating mode.
- G. Record indicated conditions and corresponding initial and final measurements. Report deficiencies.

3.22 TEMPERATURE-CONTROL VERIFICATION

- A. Verify that controllers are calibrated and commissioned.
- B. Check transmitter and controller locations and note conditions that would adversely affect control functions.
- C. Record controller settings and note variances between set points and actual measurements.
- D. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).

- E. Check free travel and proper operation of control devices such as damper and valve operators.
- F. Check the sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water flow measurements. Note the speed of response to input changes.
- G. Check the interaction of electrically operated switch transducers.
- H. Check the interaction of interlock and lockout systems.
- I. Check main control supply-air pressure and observe compressor and dryer operations.
- J. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or nongrounded power supply.
- K. Note operation of electric actuators using spring return for proper fail-safe operations.

3.23 TOLERANCES

- A. Set HVAC system airflow and water flow rates within the following tolerances (code required minimums must meet or exceed rates indicated on plans):
 - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Minus 5 to plus 10 percent.
 - 2. Air Outlets and Inlets: minus 10 to plus 10 percent.
 - 3. Heating-Water Flow Rate: minus 10 to plus 10 percent.
 - 4. Cooling-Water Flow Rate: minus 10 to plus 10 percent.

3.24 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: As Work progresses, prepare 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.

3.25 FINAL REPORT

- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.
- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.

1. Include a list of instruments used for procedures, along with proof of calibration.
- C. 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, but do not include Shop Drawings and Product Data.
- D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
1. Title page.
 2. Name and address of TAB firm.
 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 firm 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, type size, and fittings.
 14. Notes to explain why certain final data in the body of reports varies from indicated values.
 15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outside-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.
- E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outside, supply, return, and exhaust airflows.

2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

F. Air-Handling Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data: Include the following:
 - a. Unit identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Unit arrangement and class.
 - g. Discharge arrangement.
 - h. Sheave make, size in inches, and bore.
 - i. Sheave dimensions, center-to-center, and amount of adjustments in inches.
 - j. Number of belts, make, and size.
 - k. Number of filters, type, and size.
2. Motor Data:
 - a. Make and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Sheave dimensions, center-to-center, and amount of adjustments in inches.
3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Filter static-pressure differential in inches wg.
 - f. Preheat coil static-pressure differential in inches wg.
 - g. Cooling coil static-pressure differential in inches wg.
 - h. Heating coil static-pressure differential in inches wg.
 - i. Outside airflow in cfm.
 - j. Return airflow in cfm.
 - k. Outside-air damper position.
 - l. Return-air damper position.
 - m. Vortex damper position.

G. 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. Outside-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.
 - l. Refrigerant expansion valve and refrigerant types.
 - m. Refrigerant suction pressure in psig.
 - n. Refrigerant suction temperature in deg F.
 - o. Inlet steam pressure in psig.
- H. Gas- and Oil-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:
1. Unit Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Fuel type in input data.
 - g. Output capacity in Btuh.
 - h. Ignition type.
 - i. Burner-control types.
 - j. Motor horsepower and rpm.
 - k. Motor volts, phase, and hertz.
 - l. Motor full-load amperage and service factor.
 - m. Sheave make, size in inches, and bore.
 - n. Sheave dimensions, center-to-center, and amount of adjustments in inches.
 2. Test Data (Indicated and Actual Values):

- a. Total airflow rate in cfm.
 - b. Entering-air temperature in deg F.
 - c. Leaving-air temperature in deg F.
 - d. Air temperature differential in deg F.
 - e. Entering-air static pressure in inches wg.
 - f. Leaving-air static pressure in inches wg.
 - g. Air static-pressure differential in inches wg.
 - h. Low-fire fuel input in Btuh.
 - i. High-fire fuel input in Btuh.
 - j. Manifold pressure in psig.
 - k. High-temperature-limit setting in deg F.
 - l. Operating set point in Btuh.
 - m. Motor voltage at each connection.
 - n. Motor amperage for each phase.
 - o. Heating value of fuel in Btuh.
- I. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:
 - 1. Unit Data:
 - a. System identification.
 - b. Location.
 - c. Coil identification.
 - d. Capacity in Btuh.
 - e. Number of stages.
 - f. Connected volts, phase, and hertz.
 - g. Rated amperage.
 - h. Airflow rate in cfm.
 - i. Face area in sq. ft..
 - j. Minimum face velocity in fpm.
 - 2. Test Data (Indicated and Actual Values):
 - a. Heat output in Btuh.
 - b. Airflow rate in cfm.
 - c. Air velocity in fpm.
 - d. Entering-air temperature in deg F.
 - e. Leaving-air temperature in deg F.
 - f. Voltage at each connection.
 - g. Amperage for each phase.
- J. 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. Sheave dimensions, center-to-center, and amount of adjustments in inches.
 - 2. Motor Data:
 - a. Make and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Sheave dimensions, center-to-center, and amount of adjustments in inches.
 - g. Number of belts, make, and size.
 - 3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Suction static pressure in inches wg.
- K. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
 - 1. Report Data:
 - a. System 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.
- L. Air-Terminal-Device Reports:
 - 1. Unit Data:
 - a. System and air-handling unit identification.
 - b. Location and zone.
 - c. Test apparatus used.
 - d. Area served.
 - e. Air-terminal-device make.
 - f. Air-terminal-device number from system diagram.
 - g. Air-terminal-device type and model number.
 - h. Air-terminal-device size.

- i. Air-terminal-device 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 as needed in cfm.
 - d. Preliminary velocity as needed in fpm.
 - e. Final airflow rate in cfm.
 - f. Final velocity in fpm.
 - g. Space temperature in deg F.
- M. 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.
- N. Packaged Chiller Reports:
1. Unit Data:
 - a. Unit identification.
 - b. Make and model number.
 - c. Manufacturer's serial number.
 - d. Refrigerant type and capacity in gal..
 - e. Starter type and size.
 - f. Starter thermal protection size.
 - g. Compressor make and model number.
 - h. Compressor manufacturer's serial number.
 2. Water-Cooled Condenser Test Data (Indicated and Actual Values):
 - a. Refrigerant pressure in psig.
 - b. Refrigerant temperature in deg F.
 - c. Entering-water temperature in deg F.
 - d. Leaving-water temperature in deg F.
 - e. Entering-water pressure in feet of head or psig.

- f. Water pressure differential in feet of head or psig.
- 3. Air-Cooled Condenser Test Data (Indicated and Actual Values):
 - a. Refrigerant pressure in psig.
 - b. Refrigerant temperature in deg F.
 - c. Entering- and leaving-air temperature in deg F.
- 4. Evaporator Test Reports (Indicated and Actual Values):
 - a. Refrigerant pressure in psig.
 - b. Refrigerant temperature in deg F.
 - c. Entering-water temperature in deg F.
 - d. Leaving-water temperature in deg F.
 - e. Entering-water pressure in feet of head or psig.
 - f. Water pressure differential in feet of head or psig.
- 5. Compressor Test Data (Indicated and Actual Values):
 - a. Suction pressure in psig.
 - b. Suction temperature in deg F.
 - c. Discharge pressure in psig.
 - d. Discharge temperature in deg F.
 - e. Oil pressure in psig.
 - f. Oil temperature in deg F.
 - g. Voltage at each connection.
 - h. Amperage for each phase.
 - i. Kilowatt input.
 - j. Crankcase heater kilowatt.
 - k. Chilled-water control set point in deg F.
 - l. Condenser-water control set point in deg F.
 - m. Refrigerant low-pressure-cutoff set point in psig.
 - n. Refrigerant high-pressure-cutoff set point in psig.
- 6. Refrigerant Test Data (Indicated and Actual Values):
 - a. Oil level.
 - b. Refrigerant level.
 - c. Relief valve setting in psig.
 - d. Unloader set points in psig.
 - e. Percentage of cylinders unloaded.
 - f. Bearing temperatures in deg F.
 - g. Vane position.
 - h. Low-temperature-cutoff set point in deg F.
- O. Compressor and Condenser Reports: For refrigerant side of unitary systems, stand-alone refrigerant compressors, air-cooled condensing units, or water-cooled condensing units, include the following:
 - 1. Unit Data:

- a. Unit identification.
 - b. Location.
 - c. Unit make and model number.
 - d. Compressor make.
 - e. Compressor model and serial numbers.
 - f. Refrigerant weight in lb.
 - g. Low ambient temperature cutoff in deg F.
- 2. Test Data (Indicated and Actual Values):
 - a. Inlet-duct static pressure in inches wg.
 - b. Outlet-duct static pressure in inches wg.
 - c. Entering-air, dry-bulb temperature in deg F.
 - d. Leaving-air, dry-bulb temperature in deg F.
 - e. Condenser entering-water temperature in deg F.
 - f. Condenser leaving-water temperature in deg F.
 - g. Condenser-water temperature differential in deg F.
 - h. Condenser entering-water pressure in feet of head or psig.
 - i. Condenser leaving-water pressure in feet of head or psig.
 - j. Condenser-water pressure differential in feet of head or psig.
 - k. Control settings.
 - l. Unloader set points.
 - m. Low-pressure-cutout set point in psig.
 - n. High-pressure-cutout set point in psig.
 - o. Suction pressure in psig.
 - p. Suction temperature in deg F.
 - q. Condenser refrigerant pressure in psig.
 - r. Condenser refrigerant temperature in deg F.
 - s. Oil pressure in psig.
 - t. Oil temperature in deg F.
 - u. Voltage at each connection.
 - v. Amperage for each phase.
 - w. Kilowatt input.
 - x. Crankcase heater kilowatt.
 - y. Number of fans.
 - z. Condenser fan rpm.
 - aa. Condenser fan airflow rate in cfm.
 - bb. Condenser fan motor make, frame size, rpm, and horsepower.
 - cc. Condenser fan motor voltage at each connection.
 - dd. Condenser fan motor amperage for each phase.
- P. Cooling Tower or Condenser Test Reports: For cooling towers or condensers, include the following:
 - 1. Unit Data:
 - a. Unit identification.
 - b. Make and type.
 - c. Model and serial numbers.
 - d. Nominal cooling capacity in tons.
 - e. Refrigerant type and weight in lb.

- f. Water-treatment chemical feeder and chemical.
 - g. Number and type of fans.
 - h. Fan motor make, frame size, rpm, and horsepower.
 - i. Fan motor voltage at each connection.
 - j. Sheave make, size in inches, and bore.
 - k. Sheave dimensions, center-to-center, and amount of adjustments in inches.
 - l. Number of belts, make, and size.
 - m. Pump make and model number.
 - n. Pump manufacturer's serial number.
 - o. Pump motor make and frame size.
 - p. Pump motor horsepower and rpm.
- 2. Pump Test Data (Indicated and Actual Values):
 - a. Voltage at each connection.
 - b. Amperage for each phase.
 - c. Water flow rate in gpm.
- 3. Water Test Data (Indicated and Actual Values):
 - a. Entering-water temperature in deg F.
 - b. Leaving-water temperature in deg F.
 - c. Water temperature differential in deg F.
 - d. Entering-water pressure in feet of head or psig.
 - e. Leaving-water pressure in feet of head or psig.
 - f. Water pressure differential in feet of head or psig.
 - g. Water flow rate in gpm.
 - h. Bleed water flow rate in gpm.
- 4. Air Data (Indicated and Actual Values):
 - a. Duct airflow rate in cfm.
 - b. Inlet-duct static pressure in inches wg.
 - c. Outlet-duct static pressure in inches wg.
 - d. Average entering-air, wet-bulb temperature in deg F.
 - e. Average leaving-air, wet-bulb temperature in deg F.
 - f. Ambient wet-bulb temperature in deg F.
- Q. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:
 - 1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Service.
 - d. Make and size.
 - e. Model and serial numbers.
 - f. Water flow rate in gpm.
 - g. Water pressure differential in feet of head or psig.
 - h. Required net positive suction head in feet of head or psig.

- i. Pump rpm.
 - j. Impeller diameter in inches.
 - k. Motor make and frame size.
 - l. Motor horsepower and rpm.
 - m. Voltage at each connection.
 - n. Amperage for each phase.
 - o. Full-load amperage and service factor.
 - p. Seal type.
 - 2. Test Data (Indicated and Actual Values):
 - a. Static head in feet of head or psig.
 - b. Pump shutoff pressure in feet of head or psig.
 - c. Actual impeller size in inches.
 - d. Full-open flow rate in gpm.
 - e. Full-open pressure in feet of head or psig.
 - f. Final discharge pressure in feet of head or psig.
 - g. Final suction pressure in feet of head or psig.
 - h. Final total pressure in feet of head or psig.
 - i. Final water flow rate in gpm.
 - j. Voltage at each connection.
 - k. Amperage for each phase.
- R. Boiler Test Reports:
- 1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Service.
 - d. Make and type.
 - e. Model and serial numbers.
 - f. Fuel type and input in Btuh.
 - g. Number of passes.
 - h. Ignition type.
 - i. Burner-control types.
 - j. Voltage at each connection.
 - k. Amperage for each phase.
 - 2. Test Data (Indicated and Actual Values):
 - a. Operating pressure in psig.
 - b. Operating temperature in deg F.
 - c. Entering-water temperature in deg F.
 - d. Leaving-water temperature in deg F.
 - e. Number of safety valves and sizes in NPS.
 - f. Safety valve settings in psig.
 - g. High-limit setting in psig.
 - h. Operating-control setting.
 - i. High-fire set point.
 - j. Low-fire set point.

- k. Voltage at each connection.
- l. Amperage for each phase.
- m. Draft fan voltage at each connection.
- n. Draft fan amperage for each phase.
- o. Manifold pressure in psig.

S. Air-to-Air Heat-Recovery Unit Reports:

- 1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Service.
 - d. Make and type.
 - e. Model and serial numbers.
- 2. Motor Data:
 - a. Make and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Sheave dimensions, center-to-center, and amount of adjustments in inches.
- 3. If fans are an integral part of the unit, include the following for each fan:
 - a. Make and type.
 - b. Arrangement and size.
 - c. Sheave make, size in inches, and bore.
 - d. Sheave dimensions, center-to-center, and amount of adjustments in inches.
- 4. Test Data (Indicated and Actual Values):
 - a. Total exhaust airflow rate in cfm.
 - b. Purge exhaust airflow rate in cfm.
 - c. Outside airflow rate in cfm.
 - d. Total exhaust fan static pressure in inches wg.
 - e. Total outside-air fan static pressure in inches wg.
 - f. Pressure drop on each side of recovery wheel in inches wg.
 - g. Exhaust air temperature entering in deg F.
 - h. Exhaust air temperature leaving in deg F.
 - i. Outside-air temperature entering in deg F.
 - j. Outside-air temperature leaving in deg F.
 - k. Calculate sensible and total heat capacity of each airstream in MBh.

T. Instrument Calibration Reports:

- 1. Report Data:
 - a. Instrument type and make.

- b. Serial number.
- c. Application.
- d. Dates of use.
- e. Dates of calibration.

3.26 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, 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. Randomly 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. Measure sound levels at two locations.
 - e. Measure space pressure of at least 10 percent of locations.
 - f. Verify that balancing devices are marked with final balance position.
 - g. Note deviations to the Contract Documents in the Final Report.

B. Final Inspection:

1. After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Architect.
2. TAB firm test and balance engineer shall conduct the inspection in the presence of Architect.
3. Architect shall randomly select measurements documented in the final report to be rechecked. The rechecking shall be limited to either 10 percent of the total measurements recorded, or the extent of measurements that can be accomplished in a normal 8-hour business day.
4. If the 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."
5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
6. TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.
7. Request a second final inspection. If the second final inspection also fails, Owner shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.

3.27 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional testing and balancing 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 testing, inspecting, and adjusting during near-peak summer and winter conditions.

END OF SECTION

SECTION 23 07 00
HVAC 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:

1. Insulation Materials:
 - a. Cellular glass.
 - b. Flexible elastomeric.
 - c. Mineral fiber.
 - d. Phenolic.
2. Fire-rated insulation systems.
3. Adhesives.
4. Mastics.
5. Lagging adhesives.
6. Sealants.
7. Factory-applied jackets.
8. Field-applied fabric-reinforcing mesh.
9. Field-applied cloths.
10. Field-applied jackets.
11. Tapes.
12. Securements.
13. Corner angles.

- B. Related Sections:

1. Division 21 Section "Fire-Suppression Systems Insulation."
2. Division 22 Section "Plumbing Insulation."
3. Division 23 Section "Metal Ducts" for duct liners.

1.3 ACCEPTABLE MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Aeroflex
 2. Armacell
 3. Certain Teed Corp.
 4. Johns Manville
 5. Knauf Insulation
 6. Owens Corning
 7. Pittsburg Corning Corp.

- B. Listing of manufacturers name does not guarantee approval. All equipment must meet or exceed quality and capacities of specified equipment. Final approval will be based on equipment submittals. Any manufacturer not listed but wishing to bid this project shall submit a written request 14 days prior to bid date, prior approval is required for all manufacturers not listed.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).
- B. Qualification Data: For qualified Installer.
- C. 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.
- 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. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting 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 and inspecting 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 size and location of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule 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. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Block Insulation: ASTM C 552, Type I.
 - 2. Special-Shaped Insulation: ASTM C 552, Type III.
 - 3. Board Insulation: ASTM C 552, Type IV.
 - 4. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
 - 5. Preformed Pipe Insulation with Factory-Applied ASJ-SSL: Comply with ASTM C 552, Type II, Class 2.
 - 6. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- G. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
- H. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- I. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. For equipment applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- J. Mineral-Fiber, Preformed Pipe Insulation:

1. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 2. Type II, 1200 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type II, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- K. Mineral-Fiber, Pipe Insulation Wicking System: Preformed pipe insulation complying with ASTM C 547, Type I, Grade A, with absorbent cloth factory applied to the entire inside surface of preformed pipe insulation and extended through the longitudinal joint to outside surface of insulation under insulation jacket. Factory apply a white, polymer, vapor-retarder jacket with self-sealing adhesive tape seam and evaporation holes running continuously along the longitudinal seam, exposing the absorbent cloth.
- L. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- M. Phenolic:
1. Preformed pipe insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type III, Grade 1.
 2. Block insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type II, Grade 1.
 3. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
 4. Factory-Applied Jacket: Requirements are specified in "Factory-Applied Jackets" Article.
 - a. Preformed Pipe Insulation: ASJ.
 - b. Board for Duct and Plenum Applications: ASJ.
 - c. Board for Equipment Applications: ASJ.

2.2 FIRE-RATED INSULATION SYSTEMS

- A. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 2-hour fire rating by a NRTL acceptable to authority having jurisdiction.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; FlameChek.
 - b. Johns Manville; Firetemp Wrap.
 - c. Nelson Firestop Products; Nelson FSB Flameshield Blanket.
 - d. Thermal Ceramics; FireMaster Duct Wrap.
 - e. 3M; Fire Barrier Wrap Products.

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. Cellular-Glass & Phenolic Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.
 - 1. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - 1. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - 1. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- F. PVC Jacket Adhesive: Compatible with PVC jacket.
 - 1. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
 - 1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
 - 1. Water-Vapor Permeance: ASTM E 96, 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, 59 percent by volume and 71 percent by weight.
 - 4. Color: White.
- C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.
 - 1. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
 - 2. Service Temperature Range: 0 to 180 deg F.
 - 3. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
 - 4. Color: White.
- D. 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.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
2. Service Temperature Range: Minus 20 to plus 200 deg F.
3. Solids Content: 63 percent by volume and 73 percent by weight.
4. 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. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct, equipment, and pipe insulation.
3. Service Temperature Range: Minus 50 to plus 180 deg F.
4. Color: White.

2.6 SEALANTS

A. Joint Sealants: Cellular-Glass & Phenolic Products.

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 100 to plus 300 deg F.
4. Color: White or gray.
5. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. 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. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC 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: White.
5. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

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.
 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.
 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
 4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
 5. PVDC Jacket for Indoor Applications: 4-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
 6. PVDC Jacket for Outdoor Applications: 6-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.
 7. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.
 8. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to ASTM E 96, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.8 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric for Pipe Insulation: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch for covering pipe and pipe fittings.
- B. Woven Glass-Fiber Fabric for Duct and Equipment Insulation: Approximately 6 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. inch for covering equipment.
- C. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch, in a Leno weave, for duct, equipment, and 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..

2.10 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, 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 D 1784, 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: Color-code jackets based on system.
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.
4. Factory-fabricated tank heads and tank side panels.

D. Metal Jacket:

1. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.
 - a. Finish and thickness are indicated in field-applied jacket schedules.
 - b. Moisture Barrier for Indoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
 - c. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
 - d. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-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- 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 aluminum-foil facing.
- F. PVDC Jacket for Indoor Applications: 4-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
- G. PVDC Jacket for Outdoor Applications: 6-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.
- 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 C 1136.

1. Width: 3 inches.
 2. Thickness: 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: 3 inches.
 2. Thickness: 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.
- 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.
 2. Thickness: 6 mils.
 3. Adhesion: 64 ounces force/inch in width.
 4. Elongation: 500 percent.
 5. Tensile Strength: 18 lbf/inch in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Width: 2 inches.
 2. Thickness: 3.7 mils.
 3. Adhesion: 100 ounces force/inch in width.
 4. Elongation: 5 percent.
 5. Tensile Strength: 34 lbf/inch in width.
- E. PVDC Tape for Indoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.
1. Width: 3 inches.
 2. Film Thickness: 4 mils.
 3. Adhesive Thickness: 1.5 mils.
 4. Elongation at Break: 145 percent.
 5. Tensile Strength: 55 lbf/inch in width.
- F. PVDC Tape for Outdoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.
1. Width: 3 inches.
 2. Film Thickness: 6 mils.
 3. Adhesive Thickness: 1.5 mils.
 4. Elongation at Break: 145 percent.
 5. Tensile Strength: 55 lbf/inch in width.

2.12 SECUREMENTS

- A. Bands:

1. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing or closed seal.
2. 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- 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- 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, 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: Aluminum, 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, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. 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, 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: Aluminum, 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, aluminum sheet, with beveled edge sized as required 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 as required 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.

2.13 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.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
 - 1. Verify that systems and equipment to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
 - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and 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 thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. 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 with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- B. Coordinate insulation installation with the trade 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 equipment, ducts and fittings, and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. 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- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
- 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. 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 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. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. 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 07 Section "Penetration Firestopping" firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
 - 1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
 - 2. Pipe: Install insulation continuously through floor penetrations.
 - 3. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.5 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

- 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 according to manufacturer's recommended coverage rates per unit area, for 100 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 from insulation end joints, and 16 inches 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 from each end. Install wire or cable between two circumferential girdles 12 inches 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 o.c. Use this network for securing insulation with tie wire or bands.

7. Stagger joints between insulation layers at least 3 inches.
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 centers, starting at corners. Install 3/8-inch- diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
2. Fabricate boxes from galvanized steel, at least 0.050 inch 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.

3.6 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, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as 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 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 used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe

- diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
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 two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 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 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.
 9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- 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 adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.7 CELLULAR-GLASS INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of 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 services, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

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 cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.8 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

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.

B. Insulation Installation on Pipe Flanges:

1. Install 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 cut sections of sheet insulation of same thickness as pipe insulation.

4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install mitered sections of pipe insulation.
 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed valve covers manufactured of same material as pipe insulation when available.
 2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 3. Install insulation to flanges as specified for flange insulation application.
 4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.9 MINERAL-FIBER INSULATION INSTALLATION

- 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 o.c.
 4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- 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, and seal joints with flashing sealant.
- C. 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.

D. 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.

E. 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, for 75 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 o.c.
 - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. 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. 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 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. 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 2 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 o.c.

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 o.c.
- F. 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, for 75 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 o.c.
 - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. 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 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. 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 2 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 o.c.

3.10 PHENOLIC INSULATION INSTALLATION

A. General Installation Requirements:

1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation materials.
2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with 0.062-inch wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.

B. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of 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 services, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets with vapor retarders on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

C. 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 cut sections of block insulation of same material and thickness as pipe insulation.

D. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

E. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.11 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 overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- 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 laps at longitudinal seams and 3-inch- 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 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 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 o.c. and at end joints.
- E. Where PVDC jackets are indicated, install as follows:
1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
 2. Wrap factory-presize jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
 3. Continuous jacket can be spiral wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
 4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. The 33-1/2-inch- circumference limit allows for 2-inch- 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 "fish-mouthing," and use PVDC tape along lap seal to secure joint.
 5. 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.

3.12 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- B. Insulate duct access panels and doors to achieve same fire rating as duct.
- C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Division 07 Section "Penetration Firestopping."

3.13 FINISHES

- A. Duct, Equipment, and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.
 - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: Coat exposed outdoor flexible elastomeric insulation with two coats of manufacturer's recommended protective white coating; or cover with aluminum jacketing all exposed outdoor flexible elastomeric insulation, in lieu of paint.
- 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.

3.14 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. 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 one 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 one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. 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.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.15 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
 - 1. Indoor, concealed supply, return, and outdoor air.
 - 2. Indoor, exposed outdoor air.
 - 3. Indoor, concealed and exposed, Type I, commercial, kitchen hood exhaust.

4. Indoor, concealed and exposed kitchen hood make-up air.
5. Outdoor, concealed supply and return.
6. Outdoor, exposed supply and return.

B. Items Not Insulated:

1. Fibrous-glass ducts.
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Indoor, exposed supply and return air in air conditioned, occupied spaces
4. Exhaust ductwork, including Type II Kitchen Exhaust and Dishwasher Exhaust
5. Factory-insulated flexible ducts.
6. Factory-insulated plenums and casings.
7. Flexible connectors.
8. Vibration-control devices.
9. Factory-insulated access panels and doors.

3.16 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Supply-air Ducts, Concealed (installed above ceilings),

1. Mineral-Fiber Blanket: 2 inches thick and installed R-6.0.

B. Return-air Ducts, Concealed (installed above ceilings),

1. Mineral-Fiber Blanket: 2 inches thick and installed R-6.0.

C. Exposed Supply and Return Ductwork in Air Conditioned, Occupied Spaces, and Exhaust Air Ductwork:

1. None.

D. Exposed Supply and Return Ductwork exposed in Air Conditioned Utility Spaces (Conditioned Mechanical Rooms or Mechanical Rooms used as Return Air Plenums) and Exposed in Non-Air Conditioned Spaces (Boiler Rooms, et. Al):

1. Mineral-Fiber Board Insulation: 2 inches thick and installed R-6.0.

E. Outside-Air Ducts:

1. Mineral-Fiber Blanket: 2 inches thick and installed R-6.0.

F. Type-I Commercial Kitchen Hood Exhaust Ducts:

1. Fire Rated Insulation System as identified in this specification section.

G. Type-II Commercial Kitchen Hood and Dishwasher Exhaust Ducts:

1. None.

H. Kitchen Hood Make-Up Air Ducts:

1. Mineral-Fiber Blanket: 2 inches thick and installed R-6.0.

3.17 EQUIPMENT INSULATION SCHEDULE

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.
- B. Insulate indoor and outdoor equipment in paragraphs below that is not factory insulated.
- C. Condenser-water pump insulation shall be one of the following:
 - 1. None
- D. Condenser-water expansion/compression tank insulation shall be one of the following:
 - 1. None
- E. Condenser-water air-separator insulation shall be one of the following:
 - 1. None

3.18 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. Underground piping.
 - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.
 - 4. Condenser Water Supply and Return piping

3.19 INDOOR PIPING INSULATION SCHEDULE

- A. Condensate and Equipment Drain Water below 60 Deg F:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Cellular Glass: 1-1/2 inches thick.
 - b. Flexible Elastomeric: 3/4 inch thick.

3.20 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. Ducts, Plenums, and Piping, Concealed (installed above ceilings) and Exposed in Air Conditioned Occupied Spaces:
 - 1. None.
- D. Ducts, Plenums, and Piping, Exposed in Air Conditioned Utility Spaces (Conditioned Mechanical Rooms and Mechanical Rooms used as Return Air Plenums):

1. 8 ounce canvas with lagging adhesive.
- E. Ducts, Plenums, and Piping, Exposed in Non-Air Conditioned Spaces (Boiler Rooms, et. al.):
1. PVC: 20 mils thick (N/A if installed in a return air plenum).
 2. Aluminum, Smooth: 0.016 inch thick.
- F. Equipment, Concealed (installed above ceilings):
1. None.
- G. Equipment, Exposed (all applications):
1. PVC: 20 mils thick (N/A if installed in a return air plenum)
 2. Aluminum, Smooth: 0.016 inch thick.

END OF SECTION

SECTION 23 09 00

DIRECT DIGITAL CONTROL SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.
- B. Related Sections include the following:
 - 1. Division 23 Section "Meters and Gages for HVAC Piping" for measuring equipment that relates to this Section.

1.3 DEFINITIONS

- A. DDC: Direct digital control.
- B. I/O: Input/output.
- C. LonWorks: A control network technology platform for designing and implementing interoperable control devices and networks.
- D. MS/TP: Master slave/token passing.
- E. PC: Personal computer.
- F. PID: Proportional plus integral plus derivative.
- G. RTD: Resistance temperature detector.

1.4 SYSTEM PERFORMANCE

- A. Comply with the following performance requirements:
 - 1. Graphic Display: Display graphic with minimum 20 dynamic points with current data within 15 seconds.
 - 2. Graphic Refresh: Update graphic with minimum 20 dynamic points with current data within 15 seconds.
 - 3. Object Command: Reaction time of less than ten seconds between operator command of a binary object and device reaction.
 - 4. Object Scan: Transmit change of state and change of analog values to control units or workstation within ten seconds.
 - 5. Alarm Response Time: Annunciate alarm at workstation within 45 seconds. Multiple workstations must receive alarms within five seconds of each other.
 - 6. Program Execution Frequency: Run capability of applications as often as one minute, but selected consistent with mechanical process under control.
 - 7. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per 10 seconds.

8. Reporting Accuracy and Stability of Control: Maintain measured variables within tolerances as follows:
 - a. Water Temperature: Plus or minus 2 deg F.
 - b. Water Flow: Plus or minus 5 percent of full scale.
 - c. Water Pressure: Plus or minus 2 percent of full scale.
 - d. Space Temperature: Plus or minus 1.5 deg F.
 - e. Ducted Air Temperature: Plus or minus 2 deg F.
 - f. Outside Air Temperature: Plus or minus 2 deg F.
 - g. Dew Point Temperature: Plus or minus 3 deg F.
 - h. Temperature Differential: Plus or minus 0.25 deg F.
 - i. Relative Humidity: Plus or minus 5 percent.
 - j. Airflow (Pressurized Spaces): Plus or minus 3 percent of full scale.
 - k. Airflow (Measuring Stations): Plus or minus 5 percent of full scale.
 - l. Airflow (Terminal): Plus or minus 10 percent of full scale.
 - m. Air Pressure (Space): Plus or minus 0.01-inch wg.
 - n. Air Pressure (Ducts): Plus or minus 0.1-inch wg.
 - o. Carbon Monoxide: Plus or minus 5 percent of reading.
 - p. Carbon Dioxide: Plus or minus 50 ppm.
 - q. Electrical: Plus or minus 5 percent of reading.

1.5 SEQUENCE OF OPERATION – See Plans for points list and sequence of operation.

1.6 SUBMITTALS

- A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated. Submittals shall demonstrate compliance with technical requirements by reference to each subsection of the specification. Where a specific item does not comply with the specification requirements, the deviation shall be presented to the Owner and A/E a minimum of 14 working days prior to bid, along with information as to how the intent of the specification requirement is to be satisfied, for approval. It is the Contractor's responsibility to demonstrate compliance.
 1. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.
 2. Control System Software: Include technical data for operating system software, operator interface, color graphics, and other third-party applications.
 3. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Bill of materials of equipment indicating quantity, manufacturer, and model number.
2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
3. Wiring Diagrams: Power, signal, and control wiring.
4. Details of control panel faces, including controls, instruments, and labeling.
5. Written description of sequence of operation.
6. Schedule of dampers including size, leakage, and flow characteristics.
7. Schedule of valves including flow characteristics.
8. DDC System Hardware:
 - a. Wiring diagrams for control units with termination numbers.
 - b. Schematic diagrams and floor plans for field sensors and control hardware.
 - c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.
9. Control System Software: List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.
10. Controlled Systems:
 - a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
 - b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
 - c. Written description of sequence of operation including schematic diagram.
 - d. Points list.
- C. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with ASHRAE 135.
- D. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with LonWorks.
- E. Software and Firmware Operational Documentation: Include the following:
 1. Software operating and upgrade manuals on pdf file on local C:drive.
 2. Program Software Backup: On a magnetic media or compact disc or on local computer C:drive, complete with data files.
 3. Device address list.
 4. Software license required by and installed for DDC workstations and control systems.
- F. Qualification Data: The DDC system as specified herein shall be provided in its entirety by the controls contractor. Bids by wholesalers, contractors or franchised dealers or any other firm whose principal business is not that of manufacturing and installing automatic temperature control systems shall not be acceptable. Bids and work must be performed by the manufacturer's local factory office.
- G. Operation and Maintenance Data: For HVAC instrumentation and control system to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following:

1. Maintenance instructions.
2. Interconnection wiring diagrams with identified and numbered system components and devices.
3. Help function when using building automation software.
4. Final shop drawings as-builts and product data sheets and sequence of operation.
5. Verification records and list of set points.
6. Three copies of O/M shall be supplied and utilized in operator's training.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Automatic control system manufacturer's who is trained and approved for installation of system components required for this Project. At a minimum, three fulltime factory trained and certified servicemen located with twenty five miles of building services shall be employed by controls subcontractor.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined by a testing agency acceptable to authorities having jurisdiction, and marked for intended use. The system shall have UL 916, UL873 or UL 864 listing applicable to the application and installation.
- C. Comply with ASHRAE 135 for DDC system components.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to equipment manufacturer.
- B. System Software: Update to latest version of software at Project completion.

1.9 COORDINATION

- A. Coordinate location of thermostats, humidistats, CO2 sensors, and other exposed control sensors with plans and room details before installation.
- B. Coordinate supply of conditioned electrical branch circuits for control units and operator workstation.
- C. Coordinate with Division 23 section for "Boilers". It is the intent that the Boiler manufacturer is to provide communications gateway to interface with building automation system. Controls subcontractor is to review the boiler specification and bring to the A/E attention if the boiler specification is not properly coordinated.
- D. Coordinate equipment with Division 26 Section "Electrical Power Monitoring and Control" to achieve 120Vac for building automation system. BAS contractor shall provide all 120Vac circuits required for building automation use from any nearest electrical panel available spare circuit. Mark locations on as-built drawings.
- E. Coordinate equipment with Division 26 Section "Panelboards" to achieve compatibility with starter coils and annunciation devices.
- F. Coordinate equipment with Division 26 Section "Motor-Control Centers" to achieve compatibility with motor starters and annunciation devices.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 CONTROL SYSTEM

- A. Manufacturers:
 - 1. Schneider Electric
 - 2. Automated Logic Controls
 - 3. Johnson Controls Inc.
 - 4. Siemens
 - 5. ECS
 - 6. Trane
- B. Qualification Data: The DDC system as specified herein shall be provided in its entirety by the controls contractor. Bids by wholesalers, contractors or franchised dealers or any other firm whose principal business is not that of manufacturing and installing automatic temperature control systems shall not be acceptable. Bids and work must be performed by the manufacturer's local factory office.
- C. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, and accessories to control mechanical systems. Common industry protocols shall be BacNet over IP, LonTalk for all systems including primary and secondary networks. Ethernet connections to interface with the LAN or WAN.
- D. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems. An operator workstation permits interface with the network via dynamic color graphics with each mechanical system, building floor plan, and control device depicted by point-and-click graphics.

2.3 DDC EQUIPMENT

- A. Operator Workstation: Provide a computer workstation and installed at school system central maintenance office with the minimum performances as required by the BAS manufacturer.
- B. Building Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; integral interface equipment; and backup power source.
 - 1. Units monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation or diagnostic terminal unit.
 - 2. Stand-alone mode control functions operate regardless of network status. Functions include the following:

- a. Global communications.
 - b. Discrete/digital, analog, and pulse I/O.
 - c. Monitoring, controlling, or addressing data points.
 - d. Software applications, scheduling, and alarm processing.
 - e. Testing and developing control algorithms without disrupting field hardware and controlled environment.
- 3. Standard Application Programs:
 - a. Electric Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, night setback/setup, on-off control with differential sequencing, staggered start, anti short cycling, PID control, DDC with fine tuning, and trend logging.
 - b. HVAC Control Programs: Optimal run time, supply-air reset, and enthalpy switchover.
 - c. Chiller Control Programs: Control function of condenser-water reset, chilled-water reset, and equipment sequencing.
 - d. Programming Application Features: Include trend point; alarm processing and messaging; weekly, monthly, and annual scheduling; energy calculations; run-time totalization; and security access.
 - e. Remote communications.
 - f. Maintenance management.
 - g. Units of Measure: Inch-pound and SI (metric).
- 4. ASHRAE 135 Compliance: Control units shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.
- 5. LonWorks or BACnet Compliance: Control units shall use LonTalk or BACnet protocol and communicate using EIA/CEA 709.1 datalink/physical layer protocol.
- C. Programmable Direct Digital Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source.
 - 1. Units monitor or control each I/O point, process information, and download from or upload to operator workstation or diagnostic terminal unit.
 - 2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
 - a. Global communications.
 - b. Discrete/digital, analog, and pulse I/O.
 - c. Monitoring, controlling, or addressing data points.
 - 3. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
 - 4. ASHRAE 135 Compliance: Control units shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.
 - 5. LonWorks or BACnet Compliance: Control units shall use LonTalk or BACnet protocol and communicate using EIA/CEA 709.1 datalink/physical layer protocol.
- D. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.

1. Binary Inputs: Allow monitoring of on-off signals without external power.
 2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
 3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.
 4. Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation..
 5. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA).
 6. Tri-State Outputs: Provide two coordinated binary outputs for control of three-point, floating-type electronic actuators.
 7. Universal I/Os: Provide software selectable binary or analog outputs.
- E. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity..

2.4 WEB BASE OPERATOR INTERFACE

- A. System shall include a web-based operator (WEB-OPS) interface to allow user functions to be accomplished from any network connected PC that includes a web browser.
- B. Operators shall be able to utilize a browser such as Microsoft Internet Explorer with the appropriate plug-in software.
- C. All communications between the web browser and web page server shall be encrypted using 128 bit SSL encryption.
- D. The web page server shall be able to be located on the owners Intranet or on the Internet.
- E. The system shall have adequate capacity to store and serve up to 450 user defined graphics that each include up to 30 points per graphic.
- F. Any unlimited number of users shall be able to access system web pages. Up to 30 users shall be able to use the system simultaneously.
- G. Operators shall be required to enter a valid user name and password to access the system. The view of the system provided for the user will be customized based on user identity.
- H. Operator security. Each operator shall be able to be assigned a unique user name and password. Users shall be assigned to view, view and edit or administrative capability.
- I. The web-based operator interface shall display the same graphics that have been created for any associated Windows-based Operators Workstation. Graphics shall be able to contain both static information such as floor plans and equipment schematics, as well as dynamic information including space temperatures, setpoints, and equipment status information.
- J. All dynamic values shall be refreshed with live data upon initial graphic presentation and automatically refreshed every 10 seconds thereafter. The refresh of dynamic data shall not require a refresh of the static information on the graphic.
- K. Operators with proper security shall be able to override setpoints and equipment operation.
- L. System schedules shall be easily selected for display. Operators with valid security shall be allowed to make changes to schedules including modifications to start and stop times and creating exception days. These changes shall be made graphically within the web browser.
- M. A log of system alarms and events shall be able to be viewed from the web browser. Operators with proper security shall be able to acknowledge alarms.

- N. System trends shall be able to be selected and viewed. Trends shall be shown graphically with the proper axis scaling automatically selected. Multiple trends shall be able to be viewed at one time.

2.5 UNITARY APPLICATION SPECIFIC AND PROGRAMMABLE CONTROLLERS

- A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.
 - 1. Configuration: Diagnostic LEDs for power, communication, and processor; wiring termination to terminal strip or card connected with ribbon cable; memory with bios.
 - 2. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms.
 - 3. LonWorks Compliance: Communicate using EIA/CEA 709.1 datalink/physical layer protocol using LonTalk protocol.
 - 4. Enclosure: Dustproof rated for operation at 32 to 120 deg F.
 - 5. Enclosure: Waterproof rated for operation at 40 to 120 deg F.

2.6 ELECTRONIC SENSORS

- A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required. Thermistor sensing, RTD and transmitter sensing is acceptable for any application.
- B. Fan Coil Unit and Terminal Unit Thermostats and other Thermistor Temperature Sensors (type II) and Transmitters:
 - 1. Manufacturers:
 - a. Kele (Room sensor ST-S24-EW-XA).
 - b. MAMAC Systems, Inc (Room sensor TE-205-EX-X-2).
 - c. Trane (Room sensor BAYSEN074A).
 - 2. Accuracy: Plus or minus 1 deg F at calibration point.
 - 3. Wire: as recommended by building automation system provider.
 - 4. Insertion Elements in Ducts: Single point, length as required by application.
 - 5. Averaging Elements in Ducts: 12 inches.
 - 6. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches.
 - 7. Room Sensor: Kele ST-S24-EW-XA. Sensor with lever setpoint adjust, on/override to. Trane BAYSEN074A.
 - 8. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
- C. RTDs and Transmitters:
 - 1. Manufacturers:
 - a. Kele.
 - b. MAMAC Systems, Inc.
 - c. Basys.
 - d. Veris.

- e. Trane.
- 2. Accuracy: Plus or minus 1 deg F at calibration point.
- 3. Wire: as recommended by building automation system provider.
- 4. Insertion Elements in Ducts: Single point, length as required by application.
- 5. Averaging Elements in Ducts: 12 inches.
- 6. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches.
- 7. Room Sensor: Space sensor located in public area (corridors, lobby, etc) shall be metallic wall plate type 2 thermistor with no logo or adjustment dial. Or sensor with setpoint adjust, on/override to match existing.
- 8. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
- D. Humidity Sensors: Bulk polymer sensor element.
 - 1. Manufacturers:
 - a. ACI model A/RH3-D.
 - b. Vaisala HMD50U.
 - c. Trane 3% RH series type.
 - 2. Accuracy: 3 percent full range with linear output.
 - 3. Room Sensor Range: 20 to 80 percent relative humidity.
 - 4. Room Sensor Cover Construction: Manufacturer's standard locking covers.
 - 5. Duct Sensor: 20 to 80 percent relative humidity range with element guard and mounting plate.
 - 6. Outside-Air Sensor: 20 to 80 percent relative humidity range with mounting enclosure, suitable for operation at outdoor temperatures of 0 to 120 degrees.
 - 7. Duct and Sensors: With element guard and mounting plate, range of 0 to 100 percent relative humidity.
- E. Pressure Transmitters/Transducers:
 - 1. Manufacturers:
 - a. Kele.
 - b. General Eastern Instruments.
 - c. MAMAC Systems, Inc.
 - d. TCS/Basys Controls.
 - e. Vaisala.
 - f. Trane.
 - 2. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.
 - a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
 - b. Output: 4 to 20 mA.
 - c. Building Static-Pressure Range: 0- to 1-inch wg .

- d. Duct Static-Pressure Range: 0- to 5-inch wg.
- 3. Water Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure; linear output 4 to 20 mA.
- 4. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure and tested to 300-psig; linear output 4 to 20 mA.
- 5. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.
- 6. Pressure Transmitters: Direct acting for gas, liquid, or steam service; range suitable for system; linear output 4 to 20 mA.

2.7 STATUS SENSORS

- 1. Manufacturers:
 - a. Trane.
 - b. Veris.
 - c. Kele.
- B. Status Inputs for Fans: Differential-pressure switch with pilot-duty rating and with adjustable range of 0- to 5-inch wg (0 to 1240 Pa). Or current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 120 percent of rated motor current.
- C. Status Inputs for Pumps: Differential-pressure switch with pilot-duty rating and with adjustable pressure-differential range of 8 to 60 psig (55 to 414 kPa), piped across pump.
- D. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 120 percent of rated motor current.
- E. Status of fans, pumps, or motor using current switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.
- F. Water-Flow Switches: Bellows-actuated mercury or snap-acting type with pilot-duty rating, stainless-steel or bronze paddle, with appropriate range and differential adjustment, in NEMA 250, Type 1 enclosure.
 - 1. Manufacturers:
 - a. JCI.
 - b. I.T.M. Instruments Inc.
 - c. Trane.

2.8 CO₂ and CO sensors

- A. Manufacturers:
 - 1. Telaire.
 - 2. Veris.
 - 3. Kele.
 - 4. Vaisala.
 - 5. Trane.

- B. Carbon Dioxide and Carbon Monoxide Sensor and Transmitter: Single detectors using solid-state infrared sensors; suitable over a temperature range of 23 to 130 deg F (minus 5 to plus 55 deg C) and factory calibrated, with continuous or averaged reading, 4- to 20-mA output; for wall mounting or duct mounting as required by application.

2.9 AIR/WATER FLOW MEASURING STATIONS

- A. Duct Airflow Station: Combination of air straightener and multiport, self-averaging pitot tube station. Outside air flow station to be provided by RTU equipment manufacturer.
 - 1. Manufacturers:
 - a. Air Monitor Corporation.
 - b. Ebtron Gold Series.
 - c. Trane Traq.
 - 2. Casing: Galvanized-steel frame.
 - 3. Flow Straightener: Aluminum honeycomb, 3/4-inch (20-mm) parallel cell, 3 inches (75 mm) deep.
 - 4. Sensing Manifold: Copper manifold with bullet-nosed static pressure sensors positioned on equal area basis.
 - 5. Factory mounted Traq damper is acceptable.
 - 6. Ebtron thermal disbursement technology type is acceptable.
 - 7. For water flow Onicon F1210 dual turbine flow meter.

2.10 THERMOSTATS

- A. Manufacturers:
 - 1. Kele.
 - 2. Trane.
 - 3. JCI.
- B. Combination Thermostat and Fan Switches: Line-voltage thermostat with push-button or lever-operated fan switch.
 - 1. Label switches ["FAN ON-OFF"].
 - 2. Mount on single electric switch box.
- C. Low-Voltage, On-Off Thermostats: NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed set-point adjustment, 55 to 85 deg F (13 to 30 deg C) set-point range, and 2 deg F (1 deg C) maximum differential.
- D. Line-Voltage, On-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch or equivalent solid-state type, with heat anticipator; listed for electrical rating; with concealed set-point adjustment, 55 to 85 deg F (13 to 30 deg C) set-point range, and 2 deg F (1 deg C) maximum differential.
 - 1. Electric Heating Thermostats: Equip with off position on dial wired to break ungrounded conductors.
 - 2. Selector Switch: Integral, manual on-off-auto.
- E. Remote-Bulb Thermostats: On-off or modulating type, liquid filled to compensate for changes in ambient temperature; with copper capillary and bulb, unless otherwise indicated.

1. Bulbs in water lines with separate wells of same material as bulb.
 2. Bulbs in air ducts with flanges and shields.
 3. Averaging Elements: Copper tubing with either single- or multiple-unit elements, extended to cover full width of duct or unit; adequately supported.
 4. Scale settings and differential settings are clearly visible and adjustable from front of instrument.
 5. On-Off Thermostat: With precision snap switches and with electrical ratings required by application.
 6. Modulating Thermostats: Construct so complete potentiometer coil and wiper assembly is removable for inspection or replacement without disturbing calibration of instrument.
- F. Fire-Protection Thermostats where shown on plans or points list: Listed and labeled by an NRTL acceptable to authorities having jurisdiction; with fixed or adjustable settings to operate at not less than 75 deg F (24 deg C) above normal maximum operating temperature, and the following:
1. Reset: Manual.
 2. Reset: Automatic, with control circuit arranged to require manual reset at central control panel; with pilot light and reset switch on panel labeled to indicate operation.
- G. Immersion Thermostat: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range and adjustable set point.
- H. Electric, Low-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- reset switch that trips if temperature sensed across any 12 inches (300 mm) of bulb length is equal to or below set point.
1. Bulb Length: Minimum 10 feet.
 2. Quantity: As required by application.
- I. Electric, High-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- reset switch that trips if temperature sensed across any 12 inches (300 mm) of bulb length is equal to or above set point.
1. Bulb Length: Minimum 10 feet.
 2. Quantity: As required by application.

2.11 ACTUATORS

- A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
1. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 2. Belimo, Trane or approved equal. Actuator on VAV, FCU, UV, Blower coil terminal unit valves are failed in place floating signal type.
 3. Nonspring-Return Motors for Valves Larger Than NPS 2-1/2 (DN 65): Size for running torque of 150 in. x lbf (16.9 N x m) and breakaway torque of 300 in. x lbf (33.9 N x m).
 4. Spring-Return Motors for Valves Larger Than NPS 2-1/2 (DN 65): Size for running and breakaway torque of 150 in. x lbf (16.9 N x m).

5. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft. (2.3 sq. m): Size for running torque of 150 in. x lbf (16.9 N x m) and breakaway torque of 300 in. x lbf (33.9 N x m).
 6. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft. (2.3 sq. m): Size for running and breakaway torque of 150 in. x lbf (16.9 N x m).
- B. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
1. Manufacturers:
 - a. Belimo Aircontrols (USA), Inc.
 - b. Trane.
 2. Valves: Size for torque required for valve close off at maximum pump differential pressure.
 3. Dampers: Size for running torque calculated as follows:
 - a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. (86.8 kg-cm/sq. m) of damper.
 - b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. (62 kg-cm/sq. m) of damper.
 - c. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft. (49.6 kg-cm/sq. m) of damper.
 - d. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. (37.2 kg-cm/sq. m) of damper.
 - e. Dampers with 2- to 3-Inch wg (500 to 750 Pa) of Pressure Drop or Face Velocities of 1000 to 2500 fpm (5 to 13 m/s): Increase running torque by 1.5.
 - f. Dampers with 3- to 4-Inch wg (750 to 1000 Pa) of Pressure Drop or Face Velocities of 2500 to 3000 fpm (13 to 15 m/s): Increase running torque by 2.0.
 4. Coupling: V-bolt and V-shaped, toothed cradle.
 5. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
 6. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.
 7. Power Requirements (Two-Position Spring Return): 24 V ac.
 8. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
 9. Proportional Signal: 2- to 10-V dc or 4 to 20 mA.
 10. Tri-state: Floating signal.
 11. Temperature Rating: 40 to 104 deg F (5 to 40 deg C).
 12. Run Time: Sized as required for application.

2.12 CONTROL VALVES

- A. Manufacturers:
1. Belimo.
 2. Trane.
 3. JCI.

4. Hays Fluid Controls.
- B. Control Valves: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.
- C. Hydronic system globe valves shall have the following characteristics:
 1. NPS 2 (DN 50) and Smaller: Class 125 bronze body, bronze trim, rising stem, renewable composition disc, and screwed ends with backseating capacity repackable under pressure.
 2. NPS 2-1/2 (DN 65) and Larger: Class 125 iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.
 3. Internal Construction: Replaceable plugs and stainless-steel or brass seats.
 - a. Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom.
 4. Sizing: 3 to 5 psi maximum pressure drop at design flow rate or the following:
 - a. Two Position: Line size.
 - b. Two-Way Modulating: Either the value specified above or twice the load pressure drop, whichever is more.
 - c. Three-Way Modulating: Twice the load pressure drop, but not more than value specified above.
 5. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.
 6. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 150 percent of total system (pump) head for two-way valves and 100 percent of pressure differential across valve or 100 percent of total system (pump) head.
- D. Butterfly Valves: 200-psig (1380-kPa), maximum pressure differential, ASTM A 126 cast-iron or ASTM A 536 ductile-iron body and bonnet, extended neck, stainless-steel stem, field-replaceable EPDM or Buna N sleeve and stem seals.
 1. Body Style: Wafer.
 2. Disc Type: Nickel-plated ductile iron.
 3. Sizing: 1-psig (7-kPa) maximum pressure drop at design flow rate.
- E. Terminal Unit Control Valves (VAV, FCU, UV): Brass, bronze, copper, or ductile iron body with threaded, sweat, or flanged connection types. Factory set to maintain constant flow rate with +/- 10 % accuracy over system pressure fluctuations; operating ranges shall fall within 2 – 80 psid. Each valve shall have an identification label, or tag attached by chain, and be factory marked with the manufacturer identification, valve series, and flow rate. Optional readout kit including differential pressure gauge, probes, and carrying case must be made available for purchase from the manufacturer.
 1. Operating Pressure: Up to 3" - Minimum 400 PSIG / Above 3" - Minimum 200.
 2. Temperature Range: 32° - 225°F.
 3. Flow Control Cartridge: Cartridge design shall consist of a tamper proof brass, stainless steel, or elastomeric diaphragm and polyphenylsulfone orifice plate. Manufacturer shall offer optional valve body style that allows for flow control cartridge change-out.
 4. Combination Valve Assemblies: Y-Type body to include flow control cartridge, ball valve, pressure/temperature ports, and union end connection.

2.13 DAMPERS

- A. Manufacturers:
 - 1. Ruskin.
 - 2. Trane.
 - 3. JCI.
 - 4. United Enertech Corp.
- B. Dampers: AMCA-rated, parallel or opposed-blade design; 0.108-inch- (2.8-mm-) minimum thick, galvanized-steel or 0.125-inch- (3.2-mm-) minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch- (1.6-mm-) thick galvanized steel with maximum blade width of 8 inches (200 mm) and length of 48 inches (1220 mm).
 - 1. Secure blades to 1/2-inch- (13-mm-) diameter, zinc-plated axles using zinc-plated hardware, with nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
 - 2. Operating Temperature Range: From minus 40 to plus 200 deg F (minus 40 to plus 93 deg C).
 - 3. Edge Seals, Standard Pressure Applications: Closed-cell neoprene.
 - 4. Edge Seals, Low-Leakage Applications: Use inflatable blade edging or replaceable rubber blade seals and spring-loaded stainless-steel side seals, rated for leakage at less than 10 cfm per sq. ft. (50 L/s per sq. m) of damper area, at differential pressure of 4-inch wg (1000 Pa) when damper is held by torque of 50 in. x lbf (5.6 N x m); when tested according to AMCA 500D.

2.14 CONTROL CABLE

- A. HVAC control system shall be full DDC. All control wiring in the cable tray shall use purple and yellow colored plenum rated cable. Each color shall be consistent for the entire project and noted on the plans. Blue should be used for the primary network cable and yellow for the secondary network connections.

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. Verify that duct-, pipe-, and equipment-mounted devices are installed before proceeding with installation.

3.2 INSTALLATION

- A. Install software in control units and operator workstation(s). Implement all features of programs to specified requirements and as appropriate to sequence of operation.
- B. Connect and configure equipment and software to achieve sequence of operation specified.
- C. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices as shown on drawings above the floor.
 - 1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.
- D. Mechanical contractor shall install automatic dampers according to Division 23 Section "Air Duct Accessories."

- E. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.
- F. Install labels and nameplates to identify control components according to Division 23 Section "Identification for HVAC Piping and Equipment."
- G. Mechanical contractor shall install hydronic instrument wells, valves, and other accessories according to Division 23 Section "Hydronic Piping."
- H. Mechanical contractor shall install steam and condensate instrument wells, valves, and other accessories according to Division 23 Section "Steam and Condensate Heating Piping."
- I. Mechanical contractor shall install refrigerant instrument wells, valves, and other accessories according to Division 23 Section "Refrigerant Piping."
- J. Mechanical contractor shall install duct volume-control dampers according to Division 23 Sections specifying air ducts.
- K. Install electronic and fiber-optic cables according to Division 27 Section "Communications Horizontal Cabling."

3.3 ELECTRICAL WIRING AND CONNECTION INSTALLATION

- A. Install raceways, boxes, and cabinets according to Division 26 Section "Raceway and Boxes for Electrical Systems."
- B. Install building wire and cable according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- C. Install signal and communication cable for building automation system:
 - 1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed. In mechanical rooms, install wiring in conduit.
 - 2. In concealed accessible area, install cable using plenum rated cable or in cable tray.
 - 3. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
 - 4. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
 - 5. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
 - 6. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.
- D. Connect manual-reset limit controls independent of manual-control switch positions.
- E. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing.
- B. Perform the following field tests and inspections:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.

2. Test and adjust controls and safeties.
 3. Test each point through its full operating range to verify that safety and operating control set points are as required.
 4. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
 5. Test each system for compliance with sequence of operation.
 6. Test software and hardware interlocks.
- C. DDC Verification:
1. Verify that instruments are installed before calibration, testing, and loop checks.
 2. Check instruments for proper location and accessibility.
 3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
 4. Check instrument tubing for proper fittings, slope, material, and support.
 5. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
 6. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
 7. Check temperature instruments and material and length of sensing elements.
 8. Check control valves. Verify that they are in correct direction..
 9. Check DDC system as follows:
 - a. Verify that DDC controller power supply is from emergency power supply, if applicable.
 - b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
 - c. Verify that spare I/O capacity has been provided.
 - d. Verify that main building unit controller(s) are protected from power supply surges.
- D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.5 ADJUSTING

- A. Calibrating and Adjusting:
1. Verify reading to within accuracy tolerance or use factory calibrated device.
 2. Control System Inputs and Outputs:
 - a. Check analog inputs to verify reading is within accuracy tolerance.
 - b. Stoke analog output from 0 to 100% span.
 - c. Check digital inputs using jumper wire.
 - d. Energize binary output to verify operation.
- B. Adjust initial temperature and humidity set points.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Refer to Division 01 Section "Demonstration and Training."
- B. Demonstrate that all controls are installed, adjusted and can perform all functions required. When coordinated with the Energy Manager with an advance two-week notice, this demonstration may be performed in conjunction with instructions to the Owner's operations personnel.
- C. Final Operational Test: Performance test period is not less than 720 consecutive hours until performance standard is met. Operation reliability level of at least 95%. Whenever downtime occurs, correct defects before resuming test. Failure, due to an individual sensor or controller shall not count as system downtime provided that the system records the fault or that the reliability level for all sensors and controllers together is at least 99 percent of the test period.

3.7 TRAINING

- A. Refer to 230500

3.8 WARRANTY SERVICE

- A. Provide all labor, material and equipment necessary to maintain beneficial performance of the entire control system for a period of one (1) year after acceptance by an authorized representative of the Owner. The controls subcontractor at no charge to the Owner shall promptly correct any defects in workmanship or material during the warranty period. All work shall be accomplished during normal working hours M-F if possible. Critical component failure shall be repaired immediately whether labor involves overtime, weekend, or holidays. Precaution shall be taken to minimize disruption of facility operations.
- B. Owner's involvement in modifications to hardware and/or software or the addition of panels and points shall not void warranty.

END OF SECTION

SECTION 23 21 13

HYDRONIC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper tube and fittings.
2. Steel pipe and fittings.
3. Plastic pipe and fittings.
4. Piping joining materials.
5. Transition fittings.
6. Dielectric fittings.

B. Related Sections include the following:

1. Division 23 Section "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping.

1.2 SUBMITTALS

- A. Product Data: For each type of product.
- B. Qualification Data: For Installer.
- C. Welding certificates.

1.3 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installers of Pressure-Sealed Joints: Installers are to be certified by pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.

B. All piping shall be manufactured in the USA

C. Steel Support Welding: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

D. Pipe Welding: Qualify procedures and operators in accordance with ASME Boiler and Pressure Vessel Code: Section IX.

1. Comply with ASME B31.9 for materials, products, and installation.
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

1.4 WARRANTY

- A. HDPE Manufacturer's Warranty: Manufacturer agrees to repair or replace PE 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 Contractor to manufacturer of valid pressure/leak documentation indicating that the system was tested and passed manufacturer's pressure/leak test and any other manufacturer requirements.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation are to be capable of withstanding the following minimum working pressures and temperatures unless otherwise indicated:
 - 1. Condenser-Water Piping: 150 psig at 150 deg F.
 - 2. Makeup-Water Piping: 80 psig at 150 deg F.
 - 3. Condensate-Drain Piping: 150 deg F.
 - 4. Blowdown-Drain Piping: 200 deg F.
 - 5. Air-Vent Piping: 200 deg F.
 - 6. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

2.2 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tube: ASTM B88, Type L.
- B. Annealed-Temper Copper Tube: ASTM B88, Type K
- C. DWV Copper Tube: ASTM B306, Type DWV.
- D. Cast-Copper, Solder-Joint Fittings: ASME B16.18 pressure fittings. Do not use solder joints on pipe sizes greater than NPS 4.
- E. Wrought-Copper, Solder-Joint Fittings: ASME B16.22 pressure fittings. Do not use solder joints on pipe sizes greater than NPS 4.
- F. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Do not use solder joints on pipe sizes greater than NPS 4.
- G. 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. Do not use solder joints on pipe sizes greater than NPS 4.

- H. Wrought-Copper Unions: ASME B16.22. Do not use solder joints on pipe sizes greater than NPS 4.
- I. 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.
- J. Grooved, Mechanical-Joint, Copper Tube Appurtenances:
 - 1. Source Limitations: Obtain grooved mechanical-joint copper tube appurtenances from single manufacturer.
 - 2. Grooved-End Copper Fittings: ASTM B75 copper tube or ASTM B584 bronze castings.
 - 3. Grooved-End-Tube Couplings: To fit copper-tube dimensions; rigid pattern unless otherwise indicated; gasketed fitting EPDM gasket rated for minimum 230 deg F for use with ferrous housing, and steel bolts and nuts; 300 psig minimum CWP pressure rating.
- K. Copper-Tube, Pressure-Seal-Joint Fittings - Copper or Bronze:
 - 1. Source Limitations: Obtain copper-tube pressure-seal-joint fittings from single manufacturer.
 - 2. Housing: Copper or bronze.
 - 3. O-Rings and Pipe Stops: EPDM.
 - 4. Tools: Manufacturer's special tools.
 - 5. Minimum 200 psig working pressure rating at 250 deg F.

2.3 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A53/A53M black steel with plain ends; welded and seamless, Grade B, and schedule number as indicated in Part 3, "Piping Applications" Article.
- B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in Part 3, "Piping Applications" Article.
- C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in Part 3, "Piping Applications" Article.
- D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3, "Piping Applications" Article.
- E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in "Piping Applications" Article.
- F. Wrought-Steel Fittings: ASTM A234/A234M; wall thickness to match adjoining pipe.
- G. Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - 1. Material Group: 1.1.
 - 2. End Connections: Butt welding.
 - 3. Facings: Raised face.

H. Grooved Mechanical-Joint Fittings and Couplings:

1. Source Limitations: Obtain grooved mechanical-joint fittings and couplings from single manufacturer.
2. Joint Fittings: ASTM A536, Grade 65-45-12 ductile iron; ASTM A47/A47M, Grade 32510 malleable iron; ASTM A53/A53M, Type F, E, or S, Grade B fabricated steel; or ASTM A106/A106M, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
3. Couplings: Ductile- or malleable-iron housing and [EPDM] [or] [nitrile] gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

I. Steel Pipe Nipples: ASTM A733, made of same materials and wall thicknesses as pipe in which they are installed.

2.4 PLASTIC PIPE AND FITTINGS

- A. HDPE Pipe: ASTM F2619/F2619M.
- B. Molded HDPE Fittings: ASTM D2683 or ASTM D3261, ASTM F1055 PE resin, socket, butt-fusion or electro-fusion type, made to match HDPE pipe dimensions and class.
- C. Heat-Pump Piping Minimum Working Pressure: 200 psig .
- D. Heat-Pump Piping Operating Temperature: Between 23 and 104 deg F.
- E. Smoke and Fire Ratings:
1. Where indicated on 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; field installed.
 - a. The system is to have a flame-spread classification of less than 25 and smoke-developed rating of less than 50.
 - b. Pipe, wrap, or insulation as a system to comply with the requirements of CAN/ULC-S102.2, ASTM E84, or UL 2846.
 - c. For insulation required for thermal and condensation conditions, see Section 23 07 19 "HVAC Piping Insulation."

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. Plastic-to-Metal Transition Fittings:
 - 1. Source Limitations: Obtain plastic-to-metal transition fittings from single manufacturer.
 - 2. One-piece fitting with one threaded brass or copper insert and one solvent-cement-joint or fusion welded end of material and wall thickness to match plastic pipe material.
- D. Plastic-to-Metal Transition Unions:
 - 1. Source Limitations: Obtain plastic-to-metal transition unions from single manufacturer.
 - 2. Brass or copper end and solvent-cement-joint end of union to match pipe in size and material.
 - 3. Description:
 - a. Brass threaded end.
 - b. Solvent-cement-joint or fusion-welded plastic end.
 - c. Rubber O-ring.
 - d. 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 Unions:
 - 1. Source Limitations: Obtain dielectric unions from single manufacturer.
 - 2. Description:
 - a. Standard: ASSE 1079.
 - b. Pressure Rating: 250 psig minimum at 180 deg F.
 - c. End Connections: Solder-joint copper alloy and threaded ferrous. Solder joints are not to be used on pipe sizes greater than NPS 4.
- C. Dielectric Flanges:
 - 1. Source Limitations: Obtain dielectric flanges from single manufacturer.
 - 2. Description:
 - a. Standard: ASSE 1079.
 - b. Factory-fabricated, bolted, companion-flange assembly.
 - c. Pressure Rating: 150 psig minimum at 180 deg F.
 - d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Insulating Kits:
 - 1. Source Limitations: Obtain dielectric-flange insulating kits from single manufacturer.

2. Description:
 - a. Nonconducting materials for field assembly of companion flanges.
 - b. Pressure Rating: 150 psig.
 - c. Gasket: Neoprene or phenolic.
 - d. Bolt Sleeves: Phenolic or polyethylene.
 - e. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:

1. Source Limitations: Obtain dielectric nipples from single manufacturer.
2. Description:
 - a. Standard: IAPMO PS 66.
 - b. Electroplated steel nipple, complying with ASTM F1545.
 - c. Pressure Rating: Minimum 300 psig at 225 deg F.
 - d. End Connections: Male threaded or grooved.
 - e. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Condenser-Water Piping, Aboveground, NPS 2 (DN 50) and Smaller, to Be Any of the Following:
 1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
 2. Schedule 40, Grade B, steel pipe; Class 150, malleable-iron, fittings; and threaded or grooved mechanical joints.
 3. HDPE plastic piping and fittings with heat fusion joints.
- B. Condenser-Water Piping, Aboveground, NPS 2-1/2 (DN 65) and Larger, to Be Any of the Following:
 1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
 2. Schedule 40 Grade B, steel pipe; grooved, mechanical joint coupling and fittings; and grooved mechanical joints.
 3. HDPE piping and fittings with heat fusion joints.
- C. Makeup-Water Piping Installed Aboveground to Be Any of the Following:
 1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
 2. HDPE plastic piping and fittings with heat fusion joints.
- D. Condensate-Drain Piping Installed Aboveground to Be Any of the Following:
 1. Type DWV, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
 2. Schedule 40, PVC plastic pipe and fittings and solvent-welded joints.

- E. Air-Vent Piping:
 - 1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems, according to piping manufacturer's written instructions.
 - 2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.
- F. Pressure-Relief-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed, with metal-to-plastic transition fittings for plastic piping systems, according to piping manufacturer's written instructions.

3.2 INSTALLATION OF PIPING

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. 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 piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

- O. Install branch connections to mains using mechanically formed tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
- P. Install valves according to Section 23 05 23 "General-Duty Valves for HVAC Piping."
- Q. Install air vents and pressure-relief valves in accordance with Section 23 21 16 "Hydronic Piping Specialties."
- R. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- S. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.
- T. Install shutoff valve immediately upstream of each dielectric fitting.
- U. Comply with requirements in Section 23 05 00 "Common Work Results for HVAC" for installation of expansion loops, expansion joints, anchors, and pipe alignment guides.
- V. Comply with requirements in Section 23 05 53 "Identification for HVAC Piping and Equipment" for identifying piping.
- W. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 23 05 00 "Common Work Results for HVAC."
- X. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 23 05 00 "Common Work Results for HVAC."
- Y. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 23 05 00 "Common Work Results for HVAC."

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 pipe and fittings before assembly.
- C. Soldered Joints: Apply ASTM B813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints in accordance with ASTM B828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B32.
- D. Brazed Joints: Construct joints in accordance with AWS's "Brazing Handbook," "Pipe and Tube" chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8/A5.8M.

- E. Threaded Joints: Thread pipe with tapered pipe threads in accordance with ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- F. Welded Joints: Construct joints in accordance with AWS D10.12M/D10.12, using qualified processes and welding operators in accordance with "Quality Assurance" Article.
- G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- H. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings in accordance with the following:
 - 1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. PVC Nonpressure Piping: Join in accordance with ASTM D2855.
- I. Fiberglass-Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.
- J. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.
- K. Mechanically Formed Tee Fittings: Use manufacturer-recommended tools, procedure, and brazed joints.
- L. Pressure-Seal Joints: Use manufacturer-recommended tools and procedure. Leave insertion marks on pipe after assembly.

3.4 INSTALLATION OF DIELECTRIC FITTINGS

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric [**nipples**] [**unions**].
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric [**flanges**] [**flange kits**] [**nipples**].
- D. Dielectric Fittings for NPS 5 (DN 125) and Larger: Use dielectric flange kits.

3.5 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for seismic-restraint devices specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC."

- B. Comply with requirements in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment" for hangers, supports, and anchor devices.
- C. Install hangers for copper tubing and steel piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Install hangers for plastic piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- E. Support horizontal piping within 12 inches of each fitting and coupling.
- F. Support vertical runs of copper tubing and steel piping to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- G. Support vertical runs of HDPE piping to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.6 TERMINAL EQUIPMENT CONNECTIONS

- A. Sizes for supply and return piping connections are to be the same as or larger than equipment connections.
- B. Install control valves in accessible locations close to connected equipment.
- C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.
- D. Install ports for pressure gauges and thermometers at coil inlet and outlet connections. Comply with requirements in Section 23 05 00 "Common Work Results for HVAC."

3.7 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 23 05 53 "Identification for HVAC Piping and Equipment."

3.8 SYSTEM STARTUP

- A. Perform the following before operating the system:
 - 1. Open manual valves fully.
 - 2. Inspect pumps for proper rotation.
 - 3. Set makeup pressure-reducing valves for required system pressure.
 - 4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
 - 5. Set temperature controls so all coils are calling for full flow.

6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

3.9 FIELD QUALITY CONTROL

A. Prepare hydronic piping in accordance with ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure is to be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
5. Install pressure-relief valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:

1. Use ambient-temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
3. Isolate expansion tanks and determine that hydronic system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure is not to exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9.
5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

END OF SECTION

SECTION 23 21 13.33
GROUND-LOOP HEAT-PUMP 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 piping for horizontal and vertical, direct-buried, ground-loop, heat-pump systems that operate between 23 and 104 deg F.

1.3 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
 - 1. Ground-Loop, Heat-Pump Piping: 160 psig.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Pipe and fittings.
 - 2. Joining method and equipment.
- B. Field quality-control test reports.

PART 2 - PRODUCTS

2.1 PIPES AND FITTINGS

- A. HDPE Pipe: ASTM D 2239, SDR-11; with PE compound number required to achieve required system working pressure.
 - 1. Molded PE Fittings: ASTM D 2683 or ASTM D 3261, HDPE resin, socket- or butt-fusion type, made to match HDPE pipe dimensions and class.
- B. U-Bend Assembly: Factory fabricated with embossed depth stamp every 36 inches from U-bend.

2.2 BOREHOLE BACKFILL

- A. Surface Seal: Thermally enhanced bentonite-sand mixture with thermal conductivity greater than 1.20 Btu/h x sq. ft. x deg F.
- B. Backfill below Surface Seal: Thermally enhanced bentonite-sand mixture with thermal conductivity greater than 1.20 Btu/h x sq. ft. x deg F.

- C. All backfill materials must comply with all NC State regulations, including Aquifer Protection.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavating, trenching, warning tape, and backfilling are specified in Division 31 Section "Earth Moving."
- B. Well drilling must be performed by a North Carolina certified well driller.
- C. All drilling must comply with all NC State regulations, including Aquifer Protection.
- D. The installation of geothermal supply and return piping and well piping must be performed by a North Carolina H-2 licensed contractor and cannot be subcontracted to an unlicensed contractor.

3.2 HORIZONTAL PIPING INSTALLATION

- A. Separate trenches by 10 feet minimum, unless otherwise indicated. Remove rocks in trenches that could contact pipe.
- B. Backfill to 18 inches above pipe with mud developed from excavated rock-free soil or with sand, pea gravel, or fly ash. Backfill from slurry level to grade with excavated soil, compacting as specified for pipe burial in Division 31 Section "Earth Moving."
- C. Extend pipe from trench onto the bottom of the body of water at an elevation that is at least 12 inches below frost line. Seal membrane or impervious liner under the body of water after installing piping.
- D. Install PE piping in trenches according to ASTM D 2774 or ASTM F 645.
 - 1. Clean PE pipe and fittings and make heat-fusion joints according to ASTM D 2657. Minimize number of joints.
- E. Purge, flush, and pressure test piping before backfilling trenches.
- F. Install continuous detectable warning tape for underground piping. Locate tape a minimum of 24 inches below finished grade, directly over piping. Underground warning tapes are specified in Division 31 Section "Earth Moving."
- G. Common piping installation requirements are specified in Division 23 Section "Common Work Results for HVAC."

3.3 VERTICAL PIPING INSTALLATION

- A. Install HDPE piping in boreholes according to ASTM D 2774 or ASTM F 645.
 - 1. Clean HDPE pipe and fittings and make heat-fusion joints according to ASTM D 2657. Minimize number of joints.
- B. Purge, flush, and pressure test piping before backfilling boreholes.

- C. After installation of loop pipe in borehole, fill piping loop with water or antifreeze solution, and pump backfill into borehole to discharge at base of borehole.
- D. Fill borehole with backfill to a point at least 60 inches below grade and backfill remainder with surface seal material.
- E. Extend piping and connect to water-source, ground-loop, heat-pump 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-source, ground-loop, heat-pump piping systems are installed. Terminate piping with caps. Make connections to building water-source, ground-loop, heat-pump piping systems when those systems are installed.
- F. Wall sleeves are specified in Division 23 Section "Common Work Results for HVAC."
- G. Mechanical sleeve seals are specified in Division 23 Section "Common Work Results for Plumbing."

3.4 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.

3.5 FIELD QUALITY CONTROL

- A. Piping Tests: Fill piping 24 hours before testing and apply test pressure to stabilize piping. Use potable water only.
- B. Hydrostatic Tests: Test at not less than 1-1/2 times the pipe working-pressure rating allowing for static pressure of borehole depth.
 - 1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for 30 minutes. Slowly increase to next test pressure increment and hold for 30 minutes. After testing at maximum test pressure, reduce pressure to 30 psig. Hold for 90 minutes, and measure pressure at 30-minute intervals. Repair leaks and retest until no leaks exist.
- C. Prepare reports of testing activity.

END OF SECTION

SECTION 23 21 23
HYDRONIC PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Close-coupled, in-line centrifugal pumps.
 - 2. Separately coupled, base-mounted, end-suction centrifugal pumps.
 - 3. Wet Rotor Pumps (Circulators)

1.3 DEFINITIONS

- A. Buna-N: Nitrile rubber.
- B. EPT: Ethylene propylene terpolymer.

1.4 SUBMITTALS

- A. Product Data: Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves.
- B. Shop Drawings: Show pump layout and connections. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
 - 1. Wiring Diagrams: Power, signal, and control wiring.
- C. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

1.5 ACCEPTABLE MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Paco, Inc.
 - 2. Bell & Gossett; Div. of ITT Industries.
 - 3. Taco, Inc.
 - 4. Grundfos
- B. Listing of manufacturers name does not guarantee approval. All equipment must meet or exceed quality and capacities of specified equipment. Final approval will be based on equipment submittals. Any manufacturer not listed but wishing to bid this project shall submit a

written request 14 days prior to bid date, prior approval is required for all manufacturers not listed.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain hydronic pumps through one source from a single manufacturer.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of hydronic pumps and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
- 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. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.
- B. Store pumps in dry location.
- C. Retain protective covers for flanges and protective coatings during storage.
- D. Protect bearings and couplings against damage from sand, grit, and other foreign matter.
- E. Comply with pump manufacturer's written rigging instructions.

1.8 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.

PART 2 - PRODUCTS

2.1 CLOSE-COUPLED, IN-LINE CENTRIFUGAL PUMPS

- A. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally or vertically. Rate pump for 175-psig minimum working pressure and a continuous water temperature of 225 deg F.
- B. Pump Construction:
 - 1. Casing: Radially split, cast iron, with threaded gage tappings at inlet and outlet, and threaded flanged connections. Casing shall include vent and drain ports.
 - 2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. Trim impeller to match specified performance.
 - 3. Pump Shaft: Steel, with copper-alloy shaft sleeve.

4. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N bellows and gasket. Include water slinger on shaft between motor and seal.
 5. Packing Seal: Stuffing box, with a minimum of four rings of graphite-impregnated braided yarn with bronze lantern ring between center two graphite rings, and bronze packing gland.
- C. Premium efficiency motor: Single speed, with grease-lubricated ball bearings, unless otherwise indicated; and rigidly mounted to pump casing. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
- D. Capacities and Characteristics: As indicated on the drawings.

2.2 SEPARATELY COUPLED, BASE-MOUNTED, END-SUCTION CENTRIFUGAL PUMPS

- A. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, separately coupled, end-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for base mounting, with pump and motor shafts horizontal. Rate pump for 175-psig minimum working pressure and a continuous water temperature of 225 deg F.
- B. Pump Construction:
1. Casing: Radially split, cast iron, with threaded gage tappings at inlet and outlet, drain plug at bottom and air vent at top of volute, and flanged connections.
 2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. Trim impeller to match specified performance.
 3. Pump Shaft: Steel, with copper-alloy shaft sleeve.
 4. Mechanical Seal: Internally flushed carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N bellows and gasket.
 5. Packing Seal: Stuffing box, with a minimum of four rings of graphite-impregnated braided yarn with bronze lantern ring between center two graphite rings, and bronze packing gland.
 6. Pump Bearings: Grease-lubricated ball bearings contained in cast-iron housing with grease fittings.
- C. Shaft Coupling: Flexible type spacer coupler capable of absorbing torsional vibration. Couplings shall be drop-out type to allow disassembly and removal without removing pump shaft or motor, EPDM coupling sleeve for variable-speed applications. Manufacturer shall align coupler before shipment.
- D. Coupling Guard: Dual rated; ANSI B15.1, Section 8; OSHA 1910.219 approved; steel; removable; attached to mounting frame.
- E. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM A 36/A 36M channels and angles. Fabricate to mount pump casing, coupling guard, and motor. Bases shall have closed ends and wide open grouting areas.
- F. Premium efficiency motor: Single speed, with grease-lubricated ball bearings, unless otherwise indicated; secured to mounting frame, with adjustable alignment. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
- G. Capacities and Characteristics: As indicated on the drawings.

2.3 WET-ROTOR PUMPS (CIRCULATORS)

- A. Source Limitations: Obtain pumps from single source from single manufacturer.
- B. Description: Factory-assembled and -tested, wet-rotor pump. Pump and motor to form an integral unit with bearings lubricated by the pumped liquid.
- C. Pump Construction:
 - 1. Body: Cast iron.
 - 2. Impeller: Type 304 stainless steel.
 - 3. Pump Shaft: Type 304 stainless steel.
 - 4. Bearings: Double-sintered carbon.
- D. Motor: **Single** speed.
 - 1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and use.
 - 2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230500 "Common Work Results for HVAC."
 - a. Efficiency: Premium Efficiency.
 - 3. Integral pump motor variable-speed control.
 - 4. ECM.

2.4 PUMP SPECIALTY FITTINGS

- A. Suction Diffuser: Angle pattern, 175-psig pressure rating, cast -iron body and end cap, pump-inlet fitting; with bronze startup and bronze or stainless-steel permanent strainers; bronze or stainless-steel straightening vanes; drain plug; and factory-fabricated support.
- B. Triple-Duty Valve: Angle or straight pattern, 175-psig pressure rating, cast-iron body, pump-discharge fitting; with drain plug and bronze-fitted shutoff, balancing, and check valve features. Brass gage ports with integral check valve, and orifice for flow measurement.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.
- C. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CONCRETE BASES

- A. Install concrete bases of dimensions indicated for pumps and controllers. Refer to Division 23 Section "Common Work Results for HVAC."
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of base.
 - 2. For supported 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 embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- B. Cast-in-place concrete materials and placement requirements are specified in Division 03.

3.3 PUMP INSTALLATION

- A. Comply with HI 1.4.
- B. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.
- C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.
- D. Install continuous-thread hanger rods and spring hangers with vertical-limit stop of sufficient size to support pump weight. Vibration isolation devices are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment." Fabricate brackets or supports as required. Hanger and support materials are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- E. Suspend vertically mounted, in-line centrifugal pumps independent of piping. Install pumps with motor and pump shafts vertical. Use continuous-thread hanger rods and spring hangers with vertical-limit stop of sufficient size to support pump weight. Vibration isolation devices are specified in Division 21 Section "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment." Hanger and support materials are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment/Hangers and Supports for HVAC Piping and Equipment."
- F. Set base-mounted pumps on concrete foundation. Disconnect coupling before setting. Do not reconnect couplings until alignment procedure is complete.
 - 1. Support pump baseplate on rectangular metal blocks and shims, or on metal wedges with small taper, at points near foundation bolts to provide a gap of 3/4 to 1-1/2 inches between pump base and foundation for grouting.
 - 2. Adjust metal supports or wedges until pump and driver shafts are level. Check coupling faces and suction and discharge flanges of pump to verify that they are level and plumb.

3.4 ALIGNMENT

- A. Align pump and motor shafts and piping connections after setting on foundation, grout has been set and foundation bolts have been tightened, and piping connections have been made.
- B. Comply with pump and coupling manufacturers' written instructions.

- C. Adjust pump and motor shafts for angular and offset alignment by methods specified in HI 1.1-1.5, "Centrifugal Pumps for Nomenclature, Definitions, Application and Operation, HI 2.1-2.5, " Vertical Pumps for Nomenclature, Definitions, Application and Operation."
- D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.5 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.
- D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.
- E. Install check valve and throttling or triple-duty valve on discharge side of pumps as indicated on the drawings.
- F. Install Y-type strainer or suction diffuser and shutoff valve on suction side of pumps as indicated on the drawings.
- G. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.
- H. Install pressure gages on pump suction and discharge, at integral pressure-gage tapping, or install single gage with multiple input selector valve.
- I. Install check valve and gate or ball valve on each condensate pump unit discharge.
- J. Install electrical connections for power, controls, and devices.
- K. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- L. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.6 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 piping connections for tightness.
 - 3. Clean strainers on suction piping.
 - 4. Perform the following startup checks for each pump before starting:
 - a. Verify bearing lubrication.
 - b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.

- c. Verify that pump is rotating in the correct direction.
- 5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
- 6. Start motor.
- 7. Open discharge valve slowly.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

SECTION 23 23 00
REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes refrigerant piping used for air-conditioning applications.

1.2 PERFORMANCE REQUIREMENTS

- A. Line Test Pressure for Refrigerant R-407C:
 - 1. Suction Lines for Air-Conditioning Applications: 230 psig.
 - 2. Suction Lines for Heat-Pump Applications: 380 psig.
 - 3. Hot-Gas and Liquid Lines: 380 psig.
- B. Line Test Pressure for Refrigerant R-410A:
 - 1. Suction Lines for Air-Conditioning Applications: 300 psig.
 - 2. Suction Lines for Heat-Pump Applications: 535 psig.
 - 3. Hot-Gas and Liquid Lines: 535 psig.

1.3 QUALITY ASSURANCE

- A. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.4 PRODUCT STORAGE AND HANDLING

- A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Copper Tube: ASTM B 88, Type K or L
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.

- D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
- E. Brazing Filler Metals: AWS A5.8.
- F. Flexible Connectors:
 - 1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
 - 2. End Connections: Socket ends.
 - 3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch- long assembly.
 - 4. Pressure Rating: Factory test at minimum 500 psig.
 - 5. Maximum Operating Temperature: 250 deg F.

2.2 VALVES AND SPECIALTIES

- A. Diaphragm Packless Valves:
 - 1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
 - 2. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
 - 3. Operator: Rising stem and hand wheel.
 - 4. Seat: Nylon.
 - 5. End Connections: Socket, union, or flanged.
 - 6. Working Pressure Rating: 500 psig.
 - 7. Maximum Operating Temperature: 275 deg F.
- B. Packed-Angle Valves:
 - 1. Body and Bonnet: Forged brass or cast bronze.
 - 2. Packing: Molded stem, back seating, and replaceable under pressure.
 - 3. Operator: Rising stem.
 - 4. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
 - 5. Seal Cap: Forged-brass or valox hex cap.
 - 6. End Connections: Socket, union, threaded, or flanged.
 - 7. Working Pressure Rating: 500 psig.
 - 8. Maximum Operating Temperature: 275 deg F.
- C. Check Valves:
 - 1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
 - 2. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
 - 3. Piston: Removable polytetrafluoroethylene seat.
 - 4. Closing Spring: Stainless steel.
 - 5. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
 - 6. End Connections: Socket, union, threaded, or flanged.
 - 7. Maximum Opening Pressure: 0.50 psig.
 - 8. Working Pressure Rating: 500 psig.
 - 9. Maximum Operating Temperature: 275 deg F.

D. Service Valves:

1. Body: Forged brass with brass cap including key end to remove core.
2. Core: Removable ball-type check valve with stainless-steel spring.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Copper spring.
5. Working Pressure Rating: 500 psig.

E. Solenoid Valves: Comply with ARI 760 and UL 429; listed and labeled by an NRTL.

1. Body and Bonnet: Plated steel.
2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and 24 V ac coil.
6. Working Pressure Rating: 400 psig.
7. Maximum Operating Temperature: 240 deg F.
8. Manual operator.

F. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.

1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
2. Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Seat Disc: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Working Pressure Rating: 400 psig.
6. Maximum Operating Temperature: 240 deg F.

G. Thermostatic Expansion Valves: Comply with ARI 750.

1. Body, Bonnet, and Seal Cap: Forged brass or steel.
2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Packing and Gaskets: Non-asbestos.
4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
5. Suction Temperature: 40 deg .
6. Superheat: Adjustable.
7. Reverse-flow option (for heat-pump applications).
8. End Connections: Socket, flare, or threaded union.
9. Working Pressure Rating: 450 psig

H. Straight-Type Strainers:

1. Body: Welded steel with corrosion-resistant coating.
2. Screen: 100-mesh stainless steel.
3. End Connections: Socket or flare.
4. Working Pressure Rating: 500 psig.
5. Maximum Operating Temperature: 275 deg F.

I. Angle-Type Strainers:

1. Body: Forged brass or cast bronze.
2. Drain Plug: Brass hex plug.
3. Screen: 100-mesh monel.
4. End Connections: Socket or flare.
5. Working Pressure Rating: 500 psig.
6. Maximum Operating Temperature: 275 deg F.

J. Moisture/Liquid Indicators:

1. Body: Forged brass.
2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
3. Indicator: Color coded to show moisture content in ppm.
4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
5. End Connections: Socket or flare.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 240 deg F.

K. Replaceable-Core Filter Dryers: Comply with ARI 730.

1. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated charcoal.
4. Designed for reverse flow (for heat-pump applications).
5. End Connections: Socket.
6. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
7. Maximum Pressure Loss: 2 psig.
8. Rated Flow: as indicated on the drawings.
9. Working Pressure Rating: 500 psig.
10. Maximum Operating Temperature: 240 deg F.

L. Permanent Filter Dryers: Comply with ARI 730.

1. Body and Cover: Painted-steel shell.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated charcoal.
4. Designed for reverse flow (for heat-pump applications).
5. End Connections: Socket.
6. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
7. Maximum Pressure Loss: 2 psig.
8. Rated Flow: tons as indicated on the drawings
9. Working Pressure Rating: 500 psig.
10. Maximum Operating Temperature: 240 deg F.

M. Liquid Accumulators: Comply with ARI 495.

1. Body: Welded steel with corrosion-resistant coating.
2. End Connections: Socket or threaded.

3. Working Pressure Rating: 500 psig.
4. Maximum Operating Temperature: 275 deg F.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Suction Lines NPS 1-1/2 and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.
- B. Suction Lines NPS 4 and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
- C. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.
- D. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with soldered joints.
- E. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications:
 1. NPS 1-1/2 and Smaller: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.
 2. NPS 1-1/2 and Smaller: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
 3. NPS 2 to NPS 3: Copper, Type K, annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
 4. NPS 4: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with soldered joints.
- F. Safety-Relief-Valve Discharge Piping: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with soldered joints.
- G. Safety-Relief-Valve Discharge Piping:
 1. NPS 1-1/2 and Smaller: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.
 2. NPS 1-1/2 and Smaller: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.
 3. NPS 2 to NPS 3: Copper, Type K, annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
 4. NPS 4: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with soldered joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

- A. Install diaphragm packless valves in suction and discharge lines of compressor.
- B. Install service valves for gage taps at strainers if they are not an integral part of strainers.

- C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.
- D. Except as otherwise indicated, install diaphragm packless valves on inlet and outlet side of filter dryers.
- E. Install a full-sized, three-valve bypass around filter dryers.
- F. Install solenoid valves upstream from each expansion valve. Install solenoid valves in horizontal lines with coil at top.
- G. Install thermostatic expansion valves as close as possible to distributors on evaporators.
 - 1. Install valve so diaphragm case is warmer than bulb.
 - 2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
 - 3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
- H. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.
- I. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.
- J. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for device being protected:
 - 1. Solenoid valves.
 - 2. Thermostatic expansion valves.
 - 3. Compressor.
- K. Install filter dryers in liquid line between compressor and thermostatic expansion valve.
- L. Install flexible connectors at compressors.

3.3 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.
- B. Install refrigerant piping in accordance with the equipment manufacturer's recommendations.
- C. Install refrigerant piping according to ASHRAE 15.
- D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Install piping adjacent to machines to allow service and maintenance.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Division 08 Section "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
- M. Install refrigerant piping in protective conduit where installed belowground.
- N. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- O. Slope refrigerant piping as follows:
 - 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
 - 2. Install horizontal suction lines with a uniform slope downward to compressor.
 - 3. Install traps and double risers to entrain oil in vertical runs.
 - 4. Liquid lines may be installed level.
- P. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- Q. Install pipe sleeves at penetrations in exterior walls and floor assemblies.
- R. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- S. Install sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.

3.4 PIPE JOINT CONSTRUCTION

- A. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."
- B. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
 - 1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
 - 2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.

3.5 HANGERS AND SUPPORTS

- A. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
 - 2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
 - 4. Spring hangers to support vertical runs.
 - 5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- B. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:
 - 1. NPS 1/2: Maximum span, 60 inches minimum rod size, 1/4 inch
 - 2. NPS 5/8 Maximum span, 60 inches minimum rod size, 1/4 inch
 - 3. NPS 1 Maximum span, 72 inches minimum rod size, 1/4 inch
 - 4. NPS 1-1/4 Maximum span, 96 inches minimum rod size, 3/8 inch
 - 5. NPS 1-1/2 Maximum span, 96 inches minimum rod size, 3/8 inch
 - 6. NPS 2 Maximum span, 96 inches minimum rod size, 3/8 inch
 - 7. NPS 2-1/2 Maximum span, 108 inches minimum rod size, 3/8 inch
 - 8. NPS 3 Maximum span, 10 feet minimum rod size, 3/8 inch
 - 9. NPS 4 Maximum span, 12 feet minimum rod size, 1/2 inch
- C. Support multifloor vertical runs at least at each floor.

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
 - 1. Comply with ASME B31.5, Chapter VI.
 - 2. Test refrigerant piping and specialties. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
 - 3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.

- a. Fill system with nitrogen to the required test pressure.
- b. System shall maintain test pressure at the manifold gage throughout duration of test.
- c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
- d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.7 SYSTEM CHARGING

- A. Charge system using the following procedures:
 1. Install core in filter dryers after leak test but before evacuation.
 2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
 3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
 4. Charge system with a new filter-dryer core in charging line.

3.8 ADJUSTING

- A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.
- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- C. Adjust set-point temperature of air-conditioning controllers to the system design temperature.
- D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
 1. Verify that compressor oil level is correct.
 2. Open compressor suction and discharge valves.
 3. Open refrigerant valves except bypass valves that are used for other purposes.
 4. Check open compressor-motor alignment and verify lubrication for motors and bearings.
- E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION

SECTION 23 31 13

METAL DUCTS

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 rectangular ducts and fittings.
 - 2. Single-wall round ducts and fittings.
 - 3. Double-wall round ducts and fittings.
 - 4. Sheet metal materials.
 - 5. Duct liner.
 - 6. Sealants and gaskets.
 - 7. Hangers and supports.
- B. Related Sections:
 - 1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
 - 2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."
 - 1. Seismic Hazard Level A: Seismic force to weight ratio, 0.48.
 - 2. Seismic Hazard Level B: Seismic force to weight ratio, 0.30.
 - 3. Seismic Hazard Level C: Seismic force to weight ratio, 0.15.

- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2007.

1.4 SUBMITTALS

- A. Product Data: For each type of the following products:
 - 1. Liners and adhesives.
 - 2. Sealants and gaskets.
 - 3. Seismic-restraint devices.
- B. Shop Drawings:
 - 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 equipment being used on Project.
 - 11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
 - 12. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.
- C. 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: Calculations, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation for selecting hangers and supports and seismic restraints.
- D. 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 in congested spaces, 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.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Perimeter moldings.
- E. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
- 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
 - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
 - 3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2007, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."
- D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2007, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable

sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
 - 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. Lindab Inc.
 - b. McGill AirFlow LLC.
 - c. SEMCO Incorporated.
 - d. Sheet Metal Connectors, Inc.
 - e. Spiral Manufacturing Co., Inc.
 - f. Hamlin Sheet Metal
 - g. Turn Key Duct Systems
- B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).
- C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
 - 2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
- E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 DOUBLE-WALL ROUND DUCTS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Lindab Inc.
 - 2. McGill AirFlow LLC.
 - 3. SEMCO Incorporated.
 - 4. Sheet Metal Connectors, Inc.
- B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct.
- C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.
 - 1. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - a. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
 - 2. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - a. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
 - b. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
 - 3. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Inner Duct: Minimum 0.028-inch perforated galvanized sheet steel having 3/32-inch- diameter perforations, with overall open area of 23 percent.
- E. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
 - 1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
 3. Coat insulation with antimicrobial coating.
 4. Cover insulation with polyester film complying with UL 181, Class 1.
- F. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A or NFPA 90B.
1. Maximum Thermal Conductivity: 0.25 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

2.4 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
1. Galvanized Coating Designation: G60.
 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.
- D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.
- E. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- F. Reinforcement Shapes and Plates: ASTM A 36/A 36M, 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.
- G. 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.

2.5 DUCT LINER

- A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
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:

2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. CertainTeed Corporation; Insulation Group.
 - b. Johns Manville.
 - c. Knauf Insulation.
 - d. Owens Corning.
 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 or NFPA 90B and with ASTM C 916.
 - a. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C 534, Type II, Grade 1; and with NFPA 90A or NFPA 90B.
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Aeroflex USA Inc.
 - b. Armacell LLC.
 - c. K-Flex USA.
 2. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
 3. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
 - a. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Insulation Pins and Washers:
1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-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; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- D. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-19, "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. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.
7. 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.
8. Secure transversely oriented liner edges facing the airstream with metal nosings 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.
 - c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
9. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts 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, use sealant that has 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:

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. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Solvent-Based Joint and Seam Sealant:

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. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
9. VOC: Maximum 395 g/L.
10. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
11. Service: Indoor or outdoor.
12. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

E. 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, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

G. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. 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.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.7 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- F. 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.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. 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.

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 according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- 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 ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, 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.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

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. 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 ADDITIONAL INSTALLATION REQUIREMENTS FOR COMMERCIAL KITCHEN HOOD EXHAUST DUCT

- A. Install commercial kitchen hood exhaust ducts without dips and traps that may hold grease, and sloped a minimum of 2 percent to drain grease back to the hood.
- B. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of 20 feet in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings. Locate access panel on top or sides of duct a minimum of 1-1/2 inches from bottom of duct.
- C. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

3.4 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
 - 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 2. Outdoor, Supply-Air Ducts: Seal Class A.
 - 3. Outdoor, Exhaust Ducts: Seal Class C.
 - 4. Outdoor, Return-Air Ducts: Seal Class C.
 - 5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
 - 6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
 - 7. Unconditioned Space, Exhaust Ducts: Seal Class C.
 - 8. Unconditioned Space, Return-Air Ducts: Seal Class B.
 - 9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
 - 10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
 - 11. Conditioned Space, Exhaust Ducts: Seal Class B.
 - 12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
 - 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "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 intervals 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.

3.6 SEISMIC-RESTRAINT-DEVICE INSTALLATION

- A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."
 - 1. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
 - 2. Brace a change of direction longer than 12 feet.
- B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Install cable restraints on ducts that are suspended with vibration isolators.
- E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.
- F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.
- G. Drilling for and Setting Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect 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. Wedge Anchors: 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. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - 5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.7 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.8 PAINTING

- A. Paint interior of metal ducts that are visible through 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 painting Sections.

3.9 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Leakage Tests:
 - 1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
 - 2. Test the following systems:
 - a. All medium pressure supply mains from built-up Air Handling Units to the terminal box connections.
 - b. All concealed low pressure supply mains from built up Air Handling Units.
 - c. Low pressure supply ducts (single zone units and supply ductwork downstream of terminal boxes): Test representative duct sections, totaling no less than 10 percent of total installed duct area for each designated pressure class.
 - 3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
 - 4. Test for leaks before applying external insulation.
 - 5. 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.
 - 6. Give seven days' advance notice for testing.
- C. Duct System Cleanliness Tests:
 - 1. Visually inspect duct system to ensure that no visible contaminants are present.
 - 2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
 - a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.
- D. Duct system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.10 DUCT CLEANING

- A. Clean new duct system(s) before testing, adjusting, and balancing.
- B. Use service openings for entry and inspection.
 - 1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Division 23 Section "Air Duct Accessories" for access panels and doors.
 - 2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
 - 3. Remove and reinstall ceiling to gain access during the cleaning process.
- C. Particulate Collection and Odor Control:
 - 1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
 - 2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.
- D. Clean the following components by removing surface contaminants and deposits:
 - 1. Air outlets and inlets (registers, grilles, and diffusers).
 - 2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
 - 3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
 - 4. Coils and related components.
 - 5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
 - 6. Supply-air ducts, dampers, actuators, and turning vanes.
 - 7. Dedicated exhaust and ventilation components and makeup air systems.
- E. Mechanical Cleaning Methodology:
 - 1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
 - 2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
 - 3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
 - 4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
 - 5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.

6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.11 START UP

- A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.12 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel unless noted otherwise.
- B. Supply Ducts:
 1. Ducts Connected to Indoor Units, Packaged Heat Pumps, and Downstream of Terminal Boxes:
 - a. Pressure Class: Positive 2-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: Per current SMACNA standards based on specified pressure class.
 - d. SMACNA Leakage Class for Round and Flat Oval: Per current SMACNA standards based on specified pressure class.
 2. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive 3-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: Per current SMACNA standards based on specified pressure class.
 - d. SMACNA Leakage Class for Round and Flat Oval: Per current SMACNA standards based on specified pressure class.
- C. Return Ducts:
 1. Ducts Connected to Indoor Units and Packaged Heat Pumps:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: Per current SMACNA standards based on specified pressure class.
 - d. SMACNA Leakage Class for Round and Flat Oval: Per current SMACNA standards based on specified pressure class.
 2. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive or negative 3-inch wg.
 - b. Minimum SMACNA Seal Class: A.

- c. SMACNA Leakage Class for Rectangular: Per current SMACNA standards based on specified pressure class.
- d. SMACNA Leakage Class for Round and Flat Oval: Per current SMACNA standards based on specified pressure class.

D. Exhaust Ducts:

- 1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
 - a. Pressure Class: Negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: Per current SMACNA standards based on specified pressure class.
 - d. SMACNA Leakage Class for Round and Flat Oval: Per current SMACNA standards based on specified pressure class.
- 2. Ducts Connected to Commercial Kitchen Hoods: Comply with NFPA 96.
 - a. Exposed to View: Type 304, stainless-steel sheet, No. 4 finish.
 - b. Concealed: Carbon-steel sheet.
 - c. Welded seams and joints.
 - d. Pressure Class: Positive or negative 3-inch wg.
 - e. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
 - f. SMACNA Leakage Class: Per current SMACNA standards based on specified pressure class.
- 3. Ducts Connected to Dishwasher Hoods:
 - a. Type 304, stainless-steel sheet.
 - b. Exposed to View: No. 4 finish.
 - c. Concealed: No. 2D finish.
 - d. Welded seams and flanged joints with watertight EPDM gaskets.
 - e. Pressure Class: Positive or negative 2-inch wg.
 - f. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
 - g. SMACNA Leakage Class: Per current SMACNA standards based on specified pressure class.
- 4. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive or negative 3-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: Per current SMACNA standards based on specified pressure class
 - d. SMACNA Leakage Class for Round and Flat Oval: Per current SMACNA standards based on specified pressure class.

E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:

- 1. Ducts Connected to Indoor Units or Packaged Heat Pumps:
 - a. Pressure Class: Positive or negative 2-inch wg.

- b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: Per current SMACNA standards based on specified pressure class.
 - d. SMACNA Leakage Class for Round and Flat Oval: Per current SMACNA standards based on specified pressure class.
 - 2. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: Per current SMACNA standards based on specified pressure class.
 - d. SMACNA Leakage Class for Round and Flat Oval: Per current SMACNA standards based on specified pressure class.
- F. Intermediate Reinforcement:
 - 1. Galvanized-Steel Ducts: Galvanized steel.
 - 2. Stainless-Steel Ducts:
 - a. Exposed to Airstream: Match duct material.
 - b. Not Exposed to Airstream: Match duct material.
 - 3. Aluminum Ducts: Aluminum.
- G. Double-Wall Duct Interstitial Insulation:
 - 1. Supply Air Ducts: 1 inch thick.
 - 2. Return Air Ducts: 1 inch thick.
- H. Elbow Configuration:
 - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
 - a. Velocity 1000 fpm or Lower:
 - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
 - 2) Mitered Type RE 4 without vanes.
 - b. Velocity 1000 to 1500 fpm:
 - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
 - c. Velocity 1500 fpm or Higher:

- 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
 2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
 - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
 3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
 - 2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
 - 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
 - 4) Radius-to Diameter Ratio: 1.5.
 - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.
- I. Branch Configuration:
 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Spin in.
 2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1000 fpm or Lower: 90-degree tap.
 - b. Velocity 1000 to 1500 fpm: Conical tap.
 - c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION

SECTION 23 31 16

NONMETAL DUCTS

PART 1-GENERAL

1.01 DESCRIPTION OF WORK:

- A. Extent of non-metal ductwork is indicated on drawings and by requirements of this section.
- B. Types of non-metal ductwork required for this project include the following:
 - 1. Fabric Air Dispersion Products.

1.02 QUALITY ASSURANCE:

- A. Building Codes and Standards:
 - 1. Product must be Classified by Underwriter's Laboratories in accordance with the 25/50 flame spread / smoke developed requirements of NFPA 90-A and are also classified in accordance with ICC Evaluation Service AC167 and UL 2518.. Product must meet UL-C (Canada), BS 5867, part 2, 1980 and GB8624-2006 B-s1, d0, t1 level.
 - 2. All product sections must be labeled with the logo and classification marking of Underwriter's Laboratories.
- B. Design & Quality Control
 - 1. Manufacturer must have documented design support information including duct sizing, vent and orifice location, vent and orifice sizing, length, and suspension. Parameters for design, including maximum air temperature, velocity, pressure and fabric permeability, shall be considered and documented.

1.03 SUBMITTALS:

- A. Product Data: Submit manufacturer's specifications on materials and manufactured products used for work of this section.
- B. Building Code Data: Submit UL file number under which product is Classified by Underwriter's Laboratories NFPA 90, ICC AC167 and UL 2518.

1.04 WARRANTY

- A. Manufacturer must provide a 5 Year Product Warranty for products supplied for the fabric portion of this system as well as a Design and Performance Warranty.

1.05 DELIVERY, STORAGE AND HANDLING:

- A. Protect fabric air dispersion systems from damage during shipping, storage and handling.
- B. Where possible, store products inside and protect from weather. Where necessary to store outside, store above grade and enclose with a vented waterproof wrapping.

PART 2 – PRODUCTS

2.01 MANUFACTURERS:

Subject to compliance with requirements, choose one of the following:

- A. DuctSox® Corporation
Phone: (866) DUCTSOX or (563) 589-2777
FAX: (866) 398-1646 or (563) 589-2754
www.DuctSox.com
- B. Airmax International, Inc.
- C. Fabric Duct Systems, Inc.
- D. KE Fibertec.
- E. Prihoda.
- F. NanoSox

2.02 FABRIC AIR DISPERSION SYSTEM:

- A. Verona Fabric: Air diffusers shall be constructed of a woven fire retardant fabric complying with the following physical characteristics:
 - 1. Fabric Construction: 100% Flame Retardant
 - 2. Weight: 6.2 oz. /yd² per ASTM D3776
 - 3. Color: (MUST SPECIFY- red, white, blue, green, gray, tan or black)
 - 4. Fabric Porosity: 2 (+2/-1) cfm/ft² per ASTM D737, Frazier. Custom Porosity 6, 13 & 29 CFM cfm/ft² available.
 - 5. Temperature Range: 0 degrees F to 180 degrees F
 - 6. Fire Retardancy: Classified by Underwriters Laboratories in accordance with the requirements of NFPA 90-A and AC-167 (noted above).
- B. SYSTEMS FABRICATION REQUIREMENTS:
 - 1. Air dispersion accomplished by linear vent and permeable fabric. Linear vents must be sized in 1 CFM per linear foot increments (based on .5" SP), starting a 1 CFM through 90 CFM per linear foot. Linear vent is to consist of an array of open orifices rather than a mesh style vent to reduce maintenance requirements of mesh style vents. Linear vents should also be designed to minimize dusting on fabric surface.
 - 2. Size of and location of linear vents to be specified and approved by manufacturer.
 - 3. Inlet connection to metal duct via fabric draw band with anchor patches as supplied by manufacturer. Anchor patches to be secured to metal duct via zip screw fastener – supplied by contractor.
 - 4. Inlet connection includes zipper for easy removal / maintenance.
 - 5. Lengths to include required zippers as specified by manufacturer.
 - 6. System to include Adjustable Flow Devices to balance turbulence, airflow and distribution as needed. Flow restriction device shall include ability to adjust the airflow resistance from 0.06 – 0.60 in w.g. static pressure.
 - 7. Fabric system shall include connectors to accommodate suspension system listed below.
 - 8. Any deviation from a straight run shall be made using a gored elbow or an efficiency tee. Normal 90 degree elbows are 5 gores and the radius of the elbow is 1.5 times the diameter of the DuctSox.
- C. DESIGN PARAMETERS:
 - 1. Fabric air diffusers shall be designed from 0.25" water gage minimum to 3.0" maximum, with 0.5" as the standard.
 - 2. Fabric air diffusers shall be limited to design temperatures between 0 degrees F and 180 degrees F (-17.8 degrees C and 82 degrees C).
 - 3. Design CFM, static pressure and diffuser length shall be designed or approved by the manufacturer.

4. Do not use fabric diffusers in concealed locations.
5. Use fabric diffusers only for positive pressure air distribution components of the mechanical ventilation system.

D. SUSPENSION HARDWARE:

1. One row suspension
 - a. U-Track suspension hardware to include 8' sections of aluminum track, aluminum splice connectors, track endcaps and vertical cable support kits – consisting of a length of cable with cable connectors. Radius aluminum track must be included for all horizontal/flat radius sections.
 1. U-Track suspension options
 - a. Galvanized steel cable
 - b. Stainless steel cable
 2. Support lengths available in 5' (standard), 10', 15', & 30'

PART 3 – INSTALLATION

3.01 INSTALLATION OF FABRIC AIR DISPERSION SYSTEM:

- A. Install chosen suspension system in accordance with the requirements of the manufacturer. Instructions for installation shall be provided by the manufacturer with product.

3.02 CLEANING AND PROTECTION:

- A. Clean air handling unit and ductwork prior to the DuctSox system unit-by-unit as it is installed. Clean external surfaces of foreign substance which may cause corrosive deterioration of facing.
- B. Temporary Closure: At ends of ducts which are not connected to equipment or distribution devices at time of ductwork installation, cover with polyethylene film or other covering which will keep the system clean until installation is completed.
- C. If DuctSox systems become soiled during installation, they should be removed and cleaned following the manufacturers standard terms of laundry.

END OF SECTION

SECTION 23 33 00

AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Backdraft and pressure relief dampers.
 - 2. Barometric relief dampers.
 - 3. Manual volume dampers.
 - 4. Control dampers.
 - 5. Fire dampers.
 - 6. Ceiling dampers.
 - 7. Smoke dampers.
 - 8. Combination fire and smoke dampers.
 - 9. Corridor dampers.
 - 10. Flange connectors.
 - 11. Duct silencers.
 - 12. Turning vanes.
 - 13. Remote damper operators.
 - 14. Duct-mounted access doors.
 - 15. Flexible connectors.
 - 16. Flexible ducts.
 - 17. Duct security bars.
 - 18. Duct accessory hardware.
 - 19. Airflow Monitoring Stations
- B. Related Sections:
 - 1. Division 23 Section "HVAC Gravity Ventilators" for roof-mounted ventilator caps.
 - 2. Division 28 Section "Fire Detection and Alarm" for duct-mounted fire and smoke detectors.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.

- B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
 - 1. Detail 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. Duct security bars.
 - f. Wiring Diagrams: For power, signal, and control wiring.
- C. Source quality-control reports.
- D. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with AMCA 500-D testing for damper rating.

1.5 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. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G90.
 - 2. Exposed-Surface Finish: Mill phosphatized.

- C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304.
- D. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- E. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.
- F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 BACKDRAFT AND PRESSURE RELIEF DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Air Balance Inc.; a division of Mestek, Inc.
 - 2. American Warming and Ventilating; a division of Mestek, Inc.
 - 3. Greenheck Fan Corporation.
 - 4. Nailor Industries Inc.
 - 5. Pottorff; a division of PCI Industries, Inc.
 - 6. Ruskin Company.
 - 7. SEMCO Incorporated.
- B. Description: Gravity balanced.
- C. Maximum Air Velocity: 1500 fpm.
- D. Maximum System Pressure: 2-inch wg.
- E. Maximum Leakage: 40" wide, 1% of max. flow.
- F. Frame: 0.09-inch- thick extruded aluminum, with welded corners.
- G. Blades: Multiple single-piece blades, maximum 6-inch width, 0.050-inch- thick aluminum sheet with sealed edges.
- H. Blade Action: Parallel.
- I. Blade Seals: Extruded vinyl, mechanically locked.
- J. Blade Axles:
 - 1. Material: Aluminum.
 - 2. Diameter: 0.20 inch.
- K. Tie Bars and Brackets: Aluminum.
- L. Return Spring: Adjustable tension.

- M. Bearings: Steel ball or synthetic pivot bushings.
- N. Accessories: (as noted on plans or required by installation)
 - 1. Electric actuators.
 - 2. Chain pulls.
 - 3. Screen Mounting: Front mounted in sleeve.
 - a. Sleeve Thickness: 20-gage minimum.
 - b. Sleeve Length: 6 inches minimum.
 - 4. Screen Mounting: Rear mounted.
 - 5. Screen Material: Aluminum.
 - 6. Screen Type: Bird or Insect (as noted on drawings)
 - 7. 90-degree stops.

2.3 BAROMETRIC RELIEF DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Air Balance Inc.; a division of Mestek, Inc.
 - 2. American Warming and Ventilating; a division of Mestek, Inc.
 - 3. Greenheck Fan Corporation.
 - 4. Nailor Industries Inc.
 - 5. Pottorff; a division of PCI Industries, Inc.
 - 6. Ruskin Company.
 - 7. SEMCO Incorporated.
- B. Suitable for horizontal or vertical mounting.
- C. Maximum Air Velocity: 1000 fpm..
- D. Maximum System Pressure: 2-inch wg.
- E. Maximum Leakage: 40" wide, 1% of max. flow.
- F. Frame: 0.09-inch- thick extruded aluminum, with welded corners.
- G. Blades:
 - 1. Multiple, 0.025-inch- thick, roll-formed aluminum.
 - 2. Maximum Width: 2 inches.
 - 3. Action: Parallel.
 - 4. Balance: Gravity.
 - 5. Eccentrically pivoted.
- H. Blade Seals: Vinyl.
- I. Blade Axles: ½" diameter synthetic

- J. Tie Bars and Brackets:
 - 1. Material: Aluminum.
 - 2. Rattle free with 90-degree stop.
- K. Return Spring: Adjustable tension.
- L. Bearings: Synthetic.
- M. Accessories: (as noted on plans or required by installation)
 - 1. Adjustment device to permit setting for varying differential static pressure.
 - 2. Counterweights and spring-assist kits for vertical airflow installations.
 - 3. Flange on intake.

2.4 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Air Balance Inc.; a division of Mestek, Inc.
 - b. American Warming and Ventilating; a division of Mestek, Inc.
 - c. METALAIRE, Inc.
 - d. Nailor Industries Inc.
 - e. Ruskin Company.
 - 2. Suitable for horizontal or vertical applications.
 - 3. Frames:
 - a. Hat-shaped, galvanized-steel channels, 16-gauge minimum thickness.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
 - 4. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized-steel, 16-gauge thick.
 - 5. Blade Axles: Galvanized steel.
 - 6. Bearings:
 - a. Molded synthetic.
 - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 - 7. Tie Bars and Brackets: Galvanized steel.

2.5 CONTROL DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. American Warming and Ventilating; a division of Mestek, Inc.
 - 2. Greenheck Fan Corporation.
 - 3. METALAIR, Inc.
 - 4. Metal Form Manufacturing, Inc.
 - 5. Nailor Industries Inc.
 - 6. Ruskin Company.
- B. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
- C. Frames:
 - 1. Hat shaped.
 - 2. Galvanized-steel channels, 0.064 inch thick.
 - 3. Mitered and welded corners.
- D. Blades:
 - 1. Multiple blade with maximum blade width of 8 inches, airfoil design.
 - 2. Opposed-blade design.
 - 3. Galvanized steel.
 - 4. 14-gauge thickness.
 - 5. Blade Edging: Closed-cell neoprene edging.
 - 6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.
- E. Blade Axles: 1/2-inch- diameter; galvanized steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.
 - 1. Operating Temperature Range: From minus 40 to plus 200 deg F.
- F. Bearings:
 - 1. Stainless-steel sleeve.
 - 2. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 - 3. Thrust bearings at each end of every blade.

2.6 FIRE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Air Balance Inc.; a division of Mestek, Inc.
 - 2. Greenheck Fan Corporation.
 - 3. Nailor Industries Inc.

4. Pottorff; a division of PCI Industries, Inc.
 5. NCA Manufacturing.
 6. Ruskin Company.
- B. Type: Static and dynamic; rated and labeled according to UL 555 by an NRTL.
- C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.
- D. Fire Rating: 1-1/2 and 3 hours.
- E. Frame: Curtain type with blades outside airstream except when located behind grille where blades may be inside airstream; fabricated with roll-formed, 20-gauge galvanized steel; with mitered and interlocking corners.
- F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
1. Minimum Thickness: 0.052 or 0.138 inch thick, as indicated, and of length to suit application.
 2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.
- G. Mounting Orientation: Vertical or horizontal as indicated.
- H. Blades: Roll-formed, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.
- I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- J. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links (unless noted otherwise).

2.7 SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Air Balance Inc.; a division of Mestek, Inc.
 2. Greenheck Fan Corporation.
 3. Nailor Industries Inc.
 4. NCA Manufacturing.
 5. Ruskin Company.
- B. General Requirements: Label according to UL 555S by an NRTL.
- C. Frame: Multiple-blade type; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.
- D. Blades: Roll-formed, horizontal, interlocking, 16-gauge thickness, galvanized sheet steel. Blades shall be true airfoil blades.
- E. Leakage: Class I.

- F. Rated pressure and velocity to exceed design airflow conditions.
- G. Mounting Sleeve: Factory-installed, 20-gauge thickness, galvanized sheet steel; length to suit wall or floor application.
- H. Damper Motors: two-position action, electric 120V or 24V as noted on the plans.
- I. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 23 Section "Instrumentation and Control for HVAC." and Division 26 Sections.
 - 3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
 - 4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
 - 5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
 - 6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
 - 7. Electrical Connection: 120V or 24V as noted on the drawings.
- J. Accessories: (as indicated on the drawings)
 - 1. Auxiliary switches for or position indication.
 - 2. Momentary test switch, damper mounted.

2.8 COMBINATION FIRE AND SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Air Balance Inc.; a division of Mestek, Inc.
 - 2. Greenheck Fan Corporation.
 - 3. Nailor Industries Inc.
 - 4. NCA Manufacturing.
 - 5. Ruskin Company.
- B. Type: Dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.
- C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.
- D. Fire Rating: 1-1/2 and 3 hours.

- E. Frame: Multiple-blade type; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.
- F. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links (unless noted otherwise).
- G. Heat-Responsive Device: Electric resettable link and switch package, factory installed, rated.
- H. Blades: Roll-formed, horizontal, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.
- I. Leakage: Class I.
- J. Rated pressure and velocity to exceed design airflow conditions.
- K. Mounting Sleeve: Factory-installed, 20-gauge thickness, galvanized sheet steel; length to suit wall or floor application.
- L. Master control panel for use in dynamic smoke-management systems.
- M. Damper Motors: Modulating or two-position action.
- N. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 23 Section "Instrumentation and Control for HVAC." and Division 26 Sections.
 - 3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
 - 4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
 - 5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
 - 6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
 - 7. Electrical Connection: 120V or 24V as noted on the drawings.
- O. Accessories: (as indicated on the drawings)
 - 1. Auxiliary switches for position indication.
 - 2. Momentary test switch, damper mounted.

2.9 CORRIDOR DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Air Balance Inc.; a division of Mestek, Inc.
 - 2. Greenheck Fan Corporation.
 - 3. Nailor Industries Inc.
 - 4. NCA Manufacturing.
 - 5. Ruskin Company.
- B. General Requirements: Label combination fire and smoke dampers according to UL 555 for 1-1/2-hour rating by an NRTL.
- C. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links (unless noted otherwise).
- D. Heat-Responsive Device: Electric resettable link and switch package, factory installed, rated.
- E. Frame: Multiple-blade type; fabricated with roll-formed, 16-gauge galvanized steel; with mitered and interlocking corners.
- F. Blades: Roll-formed, horizontal, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.
- G. Mounting Sleeve: Factory-installed, 0.052-inch- thick, galvanized sheet steel; length to suit wall or floor application.
- H. Damper Motors: Modulating or two-position action.
- I. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 23 Section "Instrumentation and Control for HVAC." and Division 26 Sections.
 - 3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
 - 4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
 - 5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
 - 6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
 - 7. Electrical Connection: 120V or 24V as noted on the drawings.

2.10 DUCT SILENCERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Industrial Noise Control, Inc.
 - 2. McGill AirFlow LLC.
 - 3. Ruskin Company.
 - 4. Vibro-Acoustics.
- B. General Requirements:
 - 1. Factory fabricated.
 - 2. Fire-Performance Characteristics: Adhesives, sealants, packing materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84.
 - 3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2007.
- C. Shape:
 - 1. Rectangular straight with splitters or baffles.
 - 2. Round straight with center bodies or pods.
 - 3. Rectangular elbow with splitters or baffles.
 - 4. Round elbow with center bodies or pods.
 - 5. Rectangular transitional with splitters or baffles.
- D. Rectangular Silencer Outer Casing: ASTM A 653/A 653M, G60, galvanized sheet steel, 0.034 inch thick.
- E. Round Silencer Outer Casing: ASTM A 653/A 653M, G60, galvanized sheet steel.
 - 1. Sheet Metal Thickness for Units up to 24 Inches in Diameter: 0.034 inch thick.
 - 2. Sheet Metal Thickness for Units 26 through 40 Inches in Diameter: 0.040 inch thick.
 - 3. Sheet Metal Thickness for Units 42 through 52 Inches in Diameter: 0.052 inch thick.
 - 4. Sheet Metal Thickness for Units 54 through 60 Inches in Diameter: 0.064 inch thick.
- F. Inner Casing and Baffles: ASTM A 653/A 653M, G60 galvanized sheet metal, 0.034 inch thick, and with 1/8-inch- diameter perforations.
- G. Special Construction:
 - 1. Suitable for outdoor use.
 - 2. High transmission loss to achieve STC 45.
- H. Connection Sizes: Match connecting ductwork unless otherwise indicated.
- I. Principal Sound-Absorbing Mechanism:
 - 1. Controlled impedance membranes and broadly tuned resonators without absorptive media.

2. Dissipative type with fill material.
 - a. Fill Material: Moisture-proof nonfibrous material.
 - b. Erosion Barrier: Polymer bag enclosing fill, and heat sealed before assembly.
3. Lining: Mylar bag.
- J. Fabricate silencers to form rigid units that will not pulsate, vibrate, rattle, or otherwise react to system pressure variations. Do not use mechanical fasteners for unit assemblies.
 1. Lock form and seal or continuously weld joints.
 2. Suspended Units: Factory-installed suspension hooks or lugs attached to frame in quantities and spaced to prevent deflection or distortion.
 3. Reinforcement: Cross or trapeze angles for rigid suspension.
- K. Source Quality Control: Test according to ASTM E 477.
 1. Testing in accordance with ASTM E-477.
 2. Record acoustic ratings, including dynamic insertion loss and generated-noise power levels with an airflow of at least 2000-fpm face velocity.
 3. Leak Test: Test units for airtightness at 200 percent of associated fan static pressure or 6-inch wg static pressure, whichever is greater.
- L. Capacities and Characteristics: As indicated on the drawings.

2.11 TURNING VANES

- A. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
 1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- B. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."
- D. Vane Construction: Single wall for ducts up to 30 inches wide and double wall for larger dimensions.

2.12 REMOTE DAMPER OPERATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Pottorff; a division of PCI Industries, Inc.
 2. Ventfabrics, Inc.

- 3. Young Regulator Company.
- 4. Metropolitan.
- B. Description: Cable system designed for remote manual damper adjustment.
- C. Tubing: Brass.
- D. Cable: Stainless steel.
- E. Wall-Box Mounting: Recessed, 3/4 inches deep.
- F. Wall-Box Cover-Plate Material: Stainless steel.

2.13 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. American Warming and Ventilating; a division of Mestek, Inc.
 - 2. Ductmate Industries, Inc.
 - 3. Greenheck Fan Corporation.
 - 4. McGill AirFlow LLC.
 - 5. Nailor Industries Inc.
 - 6. Pottorff; a division of PCI Industries, Inc.
 - 7. Ruskin
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."
 - 1. Door:
 - a. Double wall, rectangular.
 - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
 - c. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
 - d. Fabricate doors airtight and suitable for duct pressure class.
 - 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 - 3. Number of Hinges and Locks:
 - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
 - b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
 - c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches.
 - d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.
- C. Pressure Relief Access Door:
 - 1. Door and Frame Material: Galvanized sheet steel.
 - 2. Door: Single wall, 12-gauge.

3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
4. Factory set at 2" to 10" for positive pressure and -4" to -10" for negative pressure.
5. Doors close when pressures are within set-point range.
6. Hinge: Continuous piano.
7. Latches: Cam.
8. Seal: Neoprene or foam rubber.
9. Insulation Fill: 1-inch- thick, fibrous-glass or polystyrene-foam board.

2.14 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Ductmate Industries, Inc.
 2. Duro Dyne Inc.
 3. Ventfabrics, Inc.
 4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to 2 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.
- E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
 1. Minimum Weight: 26 oz./sq. yd..
 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 3. Service Temperature: Minus 40 to plus 200 deg F.
- F. 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. 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.
- G. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
 1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
 2. Outdoor 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.
7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.15 FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Flexmaster U.S.A., Inc.
 2. McGill AirFlow LLC.
 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Noninsulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire.
 1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
 2. Maximum Air Velocity: 4000 fpm.
 3. Temperature Range: Minus 10 to plus 160 deg F.
- C. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.
 1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
 2. Maximum Air Velocity: 4000 fpm.
 3. Temperature Range: Minus 20 to plus 250 deg F.
 4. Insulation R-value: Comply with ASHRAE/IESNA 90.1-2007.
- D. Flexible Duct Connectors:
 1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action or nylon strap in sizes 3 through 18 inches, to suit duct size.

2.16 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.

2.17 AIRFLOW MONITORING STATIONS

- A. Air Measuring Stations to be furnished under this section of specification and installed under Division 23 Section. Provide where indicated and scheduled, an airflow measuring element assembly capable of continuously monitoring the airflow capacity in the duct.

1. The airflow sensing elements shall be constructed of 6000 Series extruded aluminum, forming two (2) integral chambers for Total and Static pressure averaging, without the physical presence of forward projecting sensors. Individual Total and Static pressure sensing elements are not acceptable.
 2. The number of sensing ports on each element, and the quantity of elements utilized at each installation, shall comply with the ASHRAE Standard #111 for duct traversing. The airflow traverse elements shall be capable of producing steady, non-pulsating signals of standard total and static pressure, without amplification nor flow correction (K factors), or field calibration, with an accuracy of 2% of actual flow for operating velocities as low as 100 feet per minute.
 3. The airflow elements shall not induce a pressure drop greater than .03" Water Column at 2000 FPM, nor shall the sound level within the duct be amplified by its presence in the air stream. Each airflow measuring element shall contain multiple Total and Static pressure sensors.
 4. Where primary flow elements are located outside of the manufacturers published installation guidelines the manufacturer shall be consulted, and approve of any special configurations, such as air equalizers and/or additional and strategically placed measuring points as may be required.
 5. Where the stations are installed in insulated ducts, the airflow passage of the station shall be the same size as the inside airflow dimension of the duct. Station flanges shall be two inch to three inch to facilitate matching connecting ductwork.
 6. The main take-off point from both the total pressure and the static pressure elements MUST be symmetrical. The probes shall be mounted in an eight inch deep, 16 gauge galvanized steel casing with 90 degree undrilled flanges, fabricated to the duct size, and shall contain multiple airflow traverse elements interconnected as herein before described.
 7. An identification label shall be placed on each element listing the Model No., System Served, Size and Identifying Tag Number.
 8. The airflow measuring element shall be the FE-1500 as manufactured by Paragon Controls Incorporated (or approval equal).
- B. Airflow Indicating Transducers to be furnished and installed under this section of the specification.
1. Provide individual airflow transducers, especially selected for the required design operating spans of each of the above primary elements.
 2. The electronic flow transducer(s) shall be solid-state analog type, with infinite resolution to facilitate volume tracking control functions. Microprocessor based transducers with time-sharing of multiple square root extractors and/or controllers are not acceptable.

3. The transducer(s) shall be housed in a NEMA 1 enclosure with integral terminal strip for field wiring, and power and output signal conduit connection port.
4. Each transducer's output shall not be affected by direction of mounting (attitude) or external vibrations, and shall be furnished with a factory calibrated span. The analog output signal shall be linear to air volume, which is factory set for a full scale value equal to 110% of the maximum design capacity of the flow measuring element served for variable air volume applications, or 200% of the design operating value for constant volume applications.
5. Electronic transducers shall operate on 16 to 36 VDC: Transducer(s) shall have outputs of 4 to 20 mA/2-wire or 0-10VDC/3-wire.
6. Each transducer shall be provided with a local indicating meter. The local digital indicating meter shall be one half-inch high, three and one half digit liquid crystal display (LCD) type. The LCD shall indicate the measured air volume in engineering units of cubic feet per minute (CFM). The meter shall be calibrated to an accuracy of + 1 count.
7. Transducer performance shall be equal or better than the following:
 - Hysteresis: +0.05%
 - Linearity: +0.4%
 - Repeatability: +0.1%
 - Temperature Effects: <+0.03% F.S./°F
 - Over-pressure: 5 PSIG Proof
 - Response: <0.25 seconds for full span input
 - Noise Filtration: Low Pass Filter, factory set @ 3.2Hz
 - Transducer Span: < 2 times the design velocity pressure @ maximum flow
 - Accuracy: +0.5% F.S. (Terminal Point) / +0.35% F.S. (BFSL)
8. The airflow indicating transducers shall be the FIT-1001D as manufactured by Paragon Controls Incorporated (or approval equal).

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. 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 and manufacturer's instructions.
- H. Connect ducts to duct silencers with flexible duct connectors.
- 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 from duct filters.
 - 3. At duct mounted smoke detectors for inspection.
 - 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. Control devices requiring inspection.
 - 8. Elsewhere as indicated.
- J. Install access doors with swing against duct static pressure.
- K. Access Door Sizes:
 - 1. One-Hand or Inspection Access: 8 by 5 inches.
 - 2. Two-Hand Access: 12 by 6 inches.
 - 3. Head and Hand Access: 18 by 10 inches.
 - 4. Head and Shoulders Access: 21 by 14 inches.
 - 5. Body Access: 25 by 14 inches.
 - 6. Body plus Ladder Access: 25 by 17 inches.
- L. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- M. Install flexible connectors to connect ducts to equipment.
- N. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

- O. Connect terminal units to supply ducts directly or with maximum 6-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- P. Connect diffusers or light troffer boots to ducts with maximum 48-inch lengths of flexible duct clamped or strapped in place.
- Q. Connect flexible ducts to metal ducts with approved strap and sealant.
- R. Install duct test holes where required for testing and balancing purposes.
- S. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

- A. 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 turning vanes for proper and secure installation.
 - 5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION

SECTION 23 34 23

HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. See fan schedule on drawings for additional requirements and specific options required for each fan.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Utility set fans.
 - 2. Centrifugal roof ventilators.
 - 3. Axial roof ventilators.
 - 4. Upblast propeller roof exhaust fans.
 - 5. Centrifugal wall ventilators.
 - 6. Ceiling-mounting ventilators.
 - 7. In-line centrifugal fans.
 - 8. Propeller fans.

1.3 PERFORMANCE REQUIREMENTS

- A. Project Altitude: Base fan-performance ratings on sea level.
- B. Operating Limits: Classify according to AMCA 99.

1.4 ACCEPTABLE MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Greenheck
 - 2. Loren Cook Company
 - 3. Penn Ventilation
 - 4. Twin City Fans
- B. Listing of manufacturers name does not guarantee approval. All equipment must meet or exceed quality and capacities of specified equipment. Final approval will be based on equipment submittals. Any manufacturer not listed but wishing to bid this project shall submit a

written request 14 days prior to bid date, prior approval is required for all manufacturers not listed.

1.5 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
 - 1. Certified fan performance curves with system operating conditions indicated.
 - 2. Certified fan sound-power ratings.
 - 3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 - 4. Material thickness and finishes, including color charts.
 - 5. Dampers, including housings, linkages, and operators.
 - 6. Roof curbs.
 - 7. Fan speed controllers.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, wiring diagrams, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
- C. Operation and Maintenance Data: For power ventilators to include operation and maintenance manuals.

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.
- B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.
- C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.
- D. UL Standard: Power ventilators shall comply with UL 705.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.
- B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.
- C. Lift and support units with manufacturer's designated lifting or supporting points.

1.8 COORDINATION

- A. Coordinate size and location of structural-steel support members.
- B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 UTILITY SET FANS

- A. Description: Direct- or Belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and accessories.
- B. Housing: Fabricated of galvanized steel with side sheets fastened with a deep lock seam or welded to scroll sheets.
 - 1. Housing Discharge Arrangement: Adjustable to eight standard positions.
- C. Fan Wheels: Single-width, single inlet; welded to cast-iron or cast-steel hub and spun-steel inlet cone, with hub keyed to shaft.
 - 1. Blade Materials: Steel.
 - 2. Blade Type: Backward inclined (unless noted otherwise on the fan schedule).
- D. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
- E. Shaft Bearings: Prelubricated and sealed, self-aligning, pillow-block-type ball bearings with ABMA 9, L₅₀ of 500,000 hours or L₁₀ of 100,000 hours.
- F. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation.
 - 1. Service Factor Based on Fan Motor Size: 1.5.
 - 2. Motor Pulleys: Adjustable pitch for use with motors through 10 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
 - 3. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
 - 4. Belt Guards: Fabricate of steel for motors mounted on outside of fan cabinet.
- G. Accessories: (See drawings for required accessories).
 - 1. Inlet and Outlet: Flanged.
 - 2. Companion Flanges: Rolled flanges for duct connections of same material as housing.
 - 3. Backdraft Dampers: Gravity actuated with counterweight and interlocking aluminum blades with felt edges in steel frame installed on fan discharge.
 - 4. Access Door: Gasketed door in scroll with latch-type handles.
 - 5. Scroll Dampers: Single-blade damper installed at fan scroll top with adjustable linkage.

6. Inlet Screens: Removable wire mesh.
 7. Drain Connections: NPS 3/4 threaded coupling drain connection installed at lowest point of housing.
 8. Weather Hoods: Weather resistant with stamped vents over motor and drive compartment.
 9. Discharge Dampers: Assembly with opposed blades constructed of two plates formed around and to shaft, channel frame, sealed ball bearings, with blades linked outside of airstream to single control lever of same material as housing.
 10. Variable Inlet Vanes: With blades supported at both ends with two permanently lubricated bearings of same material as housing. Variable mechanism terminating in single control lever with control shaft for double-width fans.
 11. Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
- H. Coatings: As indicated on the drawings.
- I. Capacities and Characteristics: As indicated on the drawings.

2.2 CENTRIFUGAL ROOF VENTILATORS

- A. Description: Direct- or belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.
- B. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.
1. Upblast Units: Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains and grease collector for UL 762 kitchen hood exhaust fans.
 2. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.
- C. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.
- D. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:
1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
 2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
 3. Pulleys: Cast-iron, adjustable-pitch motor pulley.
 4. Fan and motor isolated from exhaust airstream.
- E. Accessories: (See drawings for required accessories).
1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
 2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
 3. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
 4. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.

5. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops. Backdraft dampers on all roof mounted supply fans shall be motorized.
- F. Roof Curbs: Galvanized steel; welded corners; 1-1/2-inch- thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to suit roof opening and fan base.
1. Configuration: Self-flashing without a cant strip, with mounting flange.
 2. Overall Height: 8 inches (unless noted otherwise).
 3. Pitch Mounting: Manufacture curb for roof slope.
 4. Metal Liner: Galvanized steel.
 5. Burglar Bars: 1/2-inch- thick steel bars welded in place to form 6-inch squares (where indicated on the drawings).
 6. Vented Curb: Unlined with louvered vents in vertical sides (where indicated on the drawings).
- G. Capacities and Characteristics: As indicated on the drawings.

2.3 AXIAL ROOF VENTILATORS

- A. Description: Direct- or belt-driven axial fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.
- B. Housing: Heavy-gage, removable, spun-aluminum, dome top and outlet baffle; square, one-piece, hinged, aluminum base.
1. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.
- C. Fan Wheel: Aluminum hub and blades.
- D. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:
1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
 2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
 3. Pulleys: Cast-iron, adjustable-pitch motor pulley.
- E. Accessories: (See drawings for required accessories).
1. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
 2. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
 3. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
 4. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.

- F. Roof Curbs: Galvanized steel; welded corners; 1-1/2-inch- thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to suit roof opening and fan base.
 - 1. Configuration: Self-flashing without a cant strip, with mounting flange.
 - 2. Overall Height: 8 inches (unless noted otherwise).
 - 3. Sound Curb: Curb with sound-absorbing insulation matrix.
 - 4. Pitch Mounting: Manufacture curb for roof slope.
 - 5. Metal Liner: Galvanized steel.
 - 6. Burglar Bars: 1/2-inch- thick steel bars welded in place to form 6-inch squares (where indicated on the drawings).
- G. Capacities and Characteristics: As indicated on the drawings.

2.4 UPBLAST PROPELLER ROOF EXHAUST FANS

- A. Description: Direct- or belt-driven propeller fans consisting of housing, wheel, butterfly-type discharge damper, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.
- B. Wind Band, Fan Housing, and Base: Reinforced and braced galvanized steel, containing butterfly dampers and rain trough, motor and drive assembly, and fan wheel.
 - 1. Damper Rods: Steel with bronze bearings.
 - 2. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.
- C. Fan Wheel: Replaceable, extruded-aluminum, airfoil blades fastened to cast-aluminum hub; factory set pitch angle of blades.
- D. Belt-Driven Drive Assembly: Resiliently mounted to housing; weatherproof housing of same material as fan housing with the following features:
 - 1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
 - 2. Shaft Bearings: Prelubricated and sealed, self-aligning, pillow-block-type ball bearings.
 - 3. Pulleys: Cast-iron, adjustable-pitch motor pulley.
 - 4. Motor Mount: On outside of fan cabinet, adjustable base for belt tensioning.
- E. Roof Curbs: Galvanized steel; welded corners; 1-1/2-inch- thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to suit roof opening and fan base.
 - 1. Configuration: Self-flashing without a cant strip, with mounting flange.
 - 2. Overall Height: 8 inches (unless noted otherwise).
 - 3. Sound Curb: Curb with sound-absorbing insulation matrix.
 - 4. Pitch Mounting: Manufacture curb for roof slope.
 - 5. Metal Liner: Galvanized steel.
 - 6. Burglar Bars: 1/2-inch- thick steel bars welded in place to form 6-inch squares Where indicated on the plans).

- F. Capacities and Characteristics: As indicated on the drawings.

2.5 CENTRIFUGAL WALL VENTILATORS

- A. Description: Direct- or belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and accessories.
- B. Housing: Heavy-gage, removable, spun-aluminum, dome top and outlet baffle; venturi inlet cone.
- C. Fan Wheel: Aluminum hub and wheel with backward-inclined blades.
- D. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:
 - 1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
 - 2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
 - 3. Pulleys: Cast-iron, adjustable-pitch motor pulley.
 - 4. Fan and motor isolated from exhaust airstream.
- E. Accessories: (See drawings for required accessories).
 - 1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
 - 2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through internal aluminum conduit.
 - 3. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
 - 4. Wall Grille: Ring type for flush mounting.
 - 5. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in wall sleeve; factory set to close when fan stops.
 - 6. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.
- F. Capacities and Characteristics: As indicated on the drawings.

2.6 CEILING-MOUNTING VENTILATORS

- A. Description: Centrifugal fans designed for installing in ceiling or wall or for concealed in-line applications.
- B. Housing: Steel, lined with acoustical insulation.
- C. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.
- D. Grille: Plastic, louvered grille with flange on intake and thumbscrew attachment to fan housing.
- E. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.
- F. Accessories: (See drawings for required accessories).

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Manual Starter Switch: Single-pole rocker switch assembly with cover and pilot light.
3. Time-Delay Switch: Assembly with single-pole rocker switch, timer, and cover plate.
4. Motion Sensor: Motion detector with adjustable shutoff timer.
5. Ceiling Radiation Damper: Fire-rated assembly with ceramic blanket, stainless-steel springs, and fusible link.
6. Filter: Washable aluminum to fit between fan and grille.
7. Isolation: Rubber-in-shear vibration isolators.
8. Manufacturer's standard roof jack or wall cap, and transition fittings.

G. Capacities and Characteristics: As indicated on the drawings.

2.7 IN-LINE CENTRIFUGAL FANS

- A. Description: In-line, direct- or belt-driven centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, motor and disconnect switch, drive assembly, mounting brackets, and accessories.
- B. Housing: Split, spun aluminum with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.
- C. Direct-Driven 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, enclosure 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. Accessories:
1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
 2. Volume-Control Damper: Manually operated with quadrant lock, located in fan outlet.
 3. Companion Flanges: For inlet and outlet duct connections.
 4. 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.
 5. Motor and Drive Cover (Belt Guard): Galvanized steel.
- G. Capacities and Characteristics: As indicated on the drawings.

2.8 PROPELLER FANS

- A. Description: Direct- or belt-driven propeller fans consisting of fan blades, hub, housing, orifice ring, motor, drive assembly, and accessories.

- B. Housing: Galvanized-steel sheet with flanged edges and integral orifice ring with baked-enamel finish coat applied after assembly.
- C. Steel Fan Wheels: Formed-steel blades riveted to heavy-gage steel spider bolted to cast-iron hub.
- D. Fan Wheel: Replaceable, extruded-aluminum, airfoil blades fastened to cast-aluminum hub; factory set pitch angle of blades.
- E. Belt-Driven Drive Assembly: Resiliently mounted to housing, statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.
 - 1. Service Factor Based on Fan Motor Size: 1.4.
 - 2. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
 - 3. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
 - a. Ball-Bearing Rating Life: ABMA 9, L_{10} of 100,000 hours.
 - 4. Pulleys: Cast iron with split, tapered bushing; dynamically balanced at factory.
 - 5. Motor Pulleys: Adjustable pitch for use with motors through 10 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
 - 6. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
 - 7. Belt Guards: Fabricate of steel for motors mounted on outside of fan cabinet.
- F. Accessories: (See drawings for required accessories).
 - 1. Gravity Shutters: Aluminum blades in aluminum frame; interlocked blades with nylon bearings.
 - 2. Motor-Side Back Guard: Galvanized steel, complying with OSHA specifications, removable for maintenance.
 - 3. Wall housing: Galvanized steel to match fan and accessory size.
 - 4. Weathershield Hood: Galvanized steel to match fan and accessory size.
 - 5. Weathershield Front Guard: Galvanized steel with expanded metal screen.
 - 6. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
 - 7. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
- G. Capacities and Characteristics: As indicated on the drawings.

2.9 MOTORS

- A. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
- B. Enclosure Type: Totally enclosed, fan cooled.

2.10 SOURCE QUALITY CONTROL

- A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install power ventilators level and plumb.
- B. Support units using spring isolators having a static deflection of 1 inch. Vibration- and seismic-control devices are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
 - 1. Secure vibration and seismic controls to concrete bases using anchor bolts cast in concrete base.
- C. Secure roof-mounting fans to roof curbs with cadmium-plated hardware. Refer to Division 07 Section "Roof Accessories" for installation of roof curbs.
- D. Ceiling Units: Suspend units from structure; use steel wire or metal straps.
- E. Support suspended units from structure using threaded steel rods and spring hangers having a static deflection of 1 inch. Vibration-control devices are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- F. Install units with clearances for service and maintenance.
- G. Label units according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."
- B. Install ducts adjacent to power ventilators to allow service and maintenance.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 3. Verify that cleaning and adjusting are complete.
 - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 - 5. Adjust belt tension.
 - 6. Adjust damper linkages for proper damper operation.
 - 7. Verify lubrication for bearings and other moving parts.
 - 8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
 - 9. Disable automatic temperature-control operators, energize motor and 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.
- B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.
- C. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
- D. Replace fan and motor pulleys as required to achieve design airflow.
- E. Lubricate bearings.

END OF SECTION

SECTION 23 37 13

DIFFUSERS, REGISTERS, AND GRILLES

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. Round ceiling diffusers.
 - 2. Rectangular and square ceiling diffusers.
 - 3. Perforated diffusers.
 - 4. Louver face diffusers.
 - 5. Linear bar diffusers.
 - 6. Linear slot diffusers.
 - 7. Adjustable Bar Register
 - 8. Fixed face registers.
 - 9. Linear bar grilles.
- B. Related Sections:
 - 1. Division 08 Section "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
 - 2. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.3 ACCEPTABLE MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Carnes
 - 2. METALAIRE, Inc.
 - 3. Nailor industries
 - 4. Price
 - 5. Titus
 - 6. Tuttle & Bailey
 - 7. Krueger
- B. Listing of manufacturers name does not guarantee approval. All equipment must meet or exceed quality and capacities of specified equipment. Final approval will be based on

equipment submittals. Any manufacturer not listed but wishing to bid this project shall submit a written request 14 days prior to bid date, prior approval is required for all manufacturers not listed.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated, include the following:
 - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
 - 2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.
- B. Samples for Initial Selection: For diffusers, registers, and grilles with factory-applied color finishes.
- C. Samples for Verification: For diffusers, registers, and grilles, in manufacturer's standard sizes to verify color selected.
- D. Coordination Drawings: Reflected ceiling 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. Ceiling suspension assembly members.
 - 2. Method of attaching hangers to building structure.
 - 3. Size and location of initial access modules for acoustical tile.
 - 4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
 - 5. Duct access panels.
- E. Source quality-control reports.

PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS

- A. Round Ceiling Diffuser:
 - 1. Devices shall be specifically designed for variable-air-volume flows.
 - 2. Material: Steel or Aluminum as indicated on the drawings.
 - 3. Finish: Baked enamel, white unless noted otherwise.
 - 4. Face Style: Three cone.
 - 5. Mounting: Duct connection.
 - 6. Pattern: Fully adjustable.
 - 7. Dampers: Radial opposed blade.
- B. Rectangular and Square Ceiling Diffusers:
 - 1. Devices shall be specifically designed for variable-air-volume flows.
 - 2. Material: Steel or Aluminum as indicated on the drawings.

3. Finish: Baked enamel, white unless noted otherwise.
4. Face Size: 24 by 24 inches or as indicated on the drawings.
5. Face Style: Four cone.
6. Mounting: As required.
7. Pattern: Fixed.
8. Dampers: Radial opposed blade.

C. Perforated Diffuser:

1. Devices shall be specifically designed for variable-air-volume flows.
2. Material: Steel backpan and pattern controllers, with steel or aluminum face as indicated on the drawings.
3. Finish: Baked enamel, white unless noted otherwise.
4. Face Size: 24 by 24 inches or as indicated on the drawings.
5. Duct Inlet: Round or Square as indicated on the drawings.
6. Face Style: Flush.
7. Mounting: T-bar.
8. Pattern Controller: Adjustable with louvered pattern modules at inlet.
9. Dampers: Radial opposed blade.

D. Louver Face Diffuser:

1. Devices shall be specifically designed for variable-air-volume flows.
2. Material: Steel or Aluminum as indicated on the drawings.
3. Finish: Baked enamel, white unless noted otherwise.
4. Face Size: As indicated on the drawings.
5. Mounting: As required.
6. Pattern: Four-way core style, unless noted otherwise.
7. Dampers: Radial opposed blade.

2.2 REGISTERS AND GRILLES

A. Adjustable Bar Register:

1. Material: Steel or Aluminum as indicated on the drawings.
2. Finish: Baked enamel, white unless noted otherwise.
3. Face Blade Arrangement: Horizontal spaced 3/4 inch apart.
4. Core Construction: Integral.
5. Rear-Blade Arrangement: Vertical spaced 3/4 inch apart.
6. Frame: 1-1/4 inches wide.
7. Mounting: Concealed.
8. Damper Type: Adjustable opposed blade.
9. Accessories:
 - a. Rear-blade gang operator.
 - b. Filter.

B. Fixed Face Register:

1. Material: Steel or Aluminum as indicated on the drawings.

2. Finish: Baked enamel, white unless noted otherwise.
3. Face Arrangement: 1/2-by-1/2-by-1/2-inch grid core.
4. Core Construction: Integral.
5. Frame: 1 inch wide.
6. Mounting: Concealed.
7. Damper Type: Adjustable opposed blade.
8. Accessory: Filter.

C. Linear Bar Grille:

1. Material: Aluminum.
2. Finish: Baked enamel, white unless noted otherwise.
3. Face Arrangement: 1/2-by-1/2-by-1/2-inch grid core.
4. Distribution plenum.
 - a. Internal insulation.
 - b. Inlet damper.
5. Frame: 1-1/4 inches wide.
6. Mounting: Concealed.
7. Damper Type: Adjustable opposed blade.

2.3 CEILING LINEAR SLOT OUTLETS

A. Linear Slot Diffuser:

1. Devices shall be specifically designed for variable-air-volume flows.
2. Material - Shell: Steel or Aluminum as indicated on the drawings.
3. Material - Pattern Controller and Tees: Aluminum.
4. Finish - Face and Shell: Baked enamel, white exterior with black interior, unless noted otherwise.
5. Finish - Pattern Controller: Baked enamel, black.
6. Finish - Tees: Baked enamel, white.
7. Slot Width: As indicated on the drawings.
8. Number of Slots: as indicated on the drawings.
9. Length: as indicated on the drawings.
10. Accessories:
 - a. End caps in lay-in ceilings.
 - b. End Borders where not installed in lay-in ceilings.
 - c. Insulated plenum: By manufacturer black finish unless otherwise noted.

2.4 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as 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.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

SECTION 23 37 23

HVAC GRAVITY VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following types of roof-mounting intake and relief ventilators:
 - 1. Louver penthouses.
 - 2. Roof hoods.
 - 3. Goosenecks.
- B. Related Sections include the following:
 - 1. Division 08 Section "Louvers and Vents" for ventilator assemblies provided as part of the general construction.
 - 2. Division 23 Section "HVAC Power Ventilators" for roof-mounting exhaust fans.

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Intake and relief ventilators shall be capable of withstanding the effects of gravity loads, wind loads, seismic loads (if required), and thermal movements without permanent deformation of components, noise or metal fatigue, or permanent damage to fasteners and anchors.
- B. Water Entrainment: Limit water penetration through unit to comply with ASHRAE 62.1-2007.

1.4 ACCEPTABLE MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Acme Corp.
 - 2. Greenheck
 - 3. Loren Cook Co.
 - 4. Penn Ventilation
 - 5. Ruskin

- B. Listing of manufacturers name does not guarantee approval. All equipment must meet or exceed quality and capacities of specified equipment. Final approval will be based on equipment submittals. Any manufacturer not listed but wishing to bid this project shall submit a written request 14 days prior to bid date, prior approval is required for all manufacturers not listed.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.
- B. Shop Drawings: For intake and relief ventilators. Include details and ventilator attachments to curbs and curb attachments to roof structure.
- C. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain ventilators through one source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of intake and relief ventilators and are based on the specific equipment indicated. Refer to Division 01 Section "Product Requirements."
 - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- C. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.2, "Structural Welding Code--Aluminum."
 - 2. AWS D1.3, "Structural Welding Code--Sheet Steel."

1.7 COORDINATION

- A. Coordinate installation of roof curbs and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5 or T-52.

- B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming or as otherwise recommended by metal producer for required finish.
- C. Galvanized-Steel Sheet: ASTM A 653/A 653M, G90 zinc coating, mill phosphatized.
- D. Fasteners: Same basic metal and alloy as fastened metal or 300 Series stainless steel, unless otherwise indicated. Do not use metals that are incompatible with joined materials.
 - 1. Use types and sizes to suit unit installation conditions.
 - 2. Use hex-head or Phillips pan-head screws for exposed fasteners, unless otherwise indicated.
- E. Post-Installed Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed, for masonry, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
- F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187, when noted on the drawings.

2.2 FABRICATION, GENERAL

- A. Factory or shop fabricate intake and relief ventilators to minimize field splicing and assembly. Disassemble units to the minimum extent as necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.
- B. Fabricate frames, including integral bases, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
- C. Fabricate units with closely fitted joints and exposed connections accurately located and secured.
- D. Fabricate supports, anchorages, and accessories required for complete assembly.
- E. Perform shop welding by AWS-certified procedures and personnel.

2.3 LOUVER PENTHOUSES

- A. Construction: All-welded assembly with 4-inch-deep louvers, mitered corners, and aluminum sheet roof.
- B. Frame and Blade Material and Nominal Thickness: Galvanized-steel sheet, of thickness required to comply with structural performance requirements, but not less than 0.052 inch for frames and 0.052 inch for blades.
 - 1. Blade Spacing: 4".
 - 2. Blade Angle: 45 degrees.
 - 3. Air Performance: Not more than 0.10-inch wg static pressure drop at 750-fpm free-area velocity.

4. AMCA Seal: Mark units with the AMCA Certified Ratings Seal.
 5. Exterior Corners: Prefabricated corner units with mitered and welded blades and with fully recessed mullions at corners.
- C. Roof Curbs: Galvanized-steel sheet; with mitered and welded corners; 1-1/2-inch- thick, rigid fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to fit roof opening and ventilator base.
1. Configuration: Self-flashing without a cant strip, with mounting flange.
 2. Overall Height: 12 inches unless noted otherwise.
- D. Insect Screening: Aluminum, 18-by-16 mesh, 0.012-inch wire.
- E. Galvanized-Steel Sheet Finish:
1. Surface Preparation: Clean surfaces of dirt, grease, and other contaminants. Clean welds, mechanical connections, and abraded areas and repair galvanizing according to ASTM A 780. Apply a conversion coating suited to the organic coating to be applied over it.
 2. Factory Priming for Field-Painted Finish: Where field painting after installation is indicated, apply an air-dried primer immediately after cleaning and pretreating.
 3. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil for topcoat and an overall minimum dry film thickness of 2 mils.
 - a. Color and Gloss: As selected by Architect from manufacturer's full range.

2.4 ROOF HOODS

- A. Factory or shop fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figures 5-6 and 5-7.
- B. Materials: Galvanized-steel sheet, minimum 0.064-inch- thick base and 0.040-inch- thick hood; suitably reinforced.
- C. Roof Curbs: Galvanized-steel sheet; with mitered and welded corners; 1-1/2-inch- thick, rigid fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to fit roof opening and ventilator base.
1. Configuration: Self-flashing without a cant strip, with mounting flange.
 2. Overall Height: 12 inches unless noted otherwise.
- D. Insect Screening: Aluminum, 18-by-16 mesh, 0.012-inch wire.
- E. Galvanized-Steel Sheet Finish:
1. Surface Preparation: Clean surfaces of dirt, grease, and other contaminants. Clean welds, mechanical connections, and abraded areas and repair galvanizing according to ASTM A 780. Apply a conversion coating suited to the organic coating to be applied over it.

2. Factory Priming for Field-Painted Finish: Where field painting after installation is indicated, apply an air-dried primer immediately after cleaning and pretreating.
3. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil for topcoat and an overall minimum dry film thickness of 2 mils.
 - a. Color and Gloss: As selected by Architect from manufacturer's full range.

2.5 GOOSENECKS

- A. Factory or shop fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 5-5; with a minimum of 0.052-inch- thick, galvanized-steel sheet.
- B. Roof Curbs: Galvanized-steel sheet; with mitered and welded corners; 1-1/2-inch- thick, rigid fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to fit roof opening and ventilator base.
 1. Configuration: Self-flashing without a cant strip, with mounting flange.
 2. Overall Height: 12 inches.
- C. Insect Screening: Aluminum, 18-by-16 mesh, 0.012-inch wire.
- D. Galvanized-Steel Sheet Finish:
 1. Surface Preparation: Clean surfaces of dirt, grease, and other contaminants. Clean welds, mechanical connections, and abraded areas and repair galvanizing according to ASTM A 780. Apply a conversion coating suited to the organic coating to be applied over it.
 2. Factory Priming for Field-Painted Finish: Where field painting after installation is indicated, apply an air-dried primer immediately after cleaning and pretreating.
 3. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil for topcoat and an overall minimum dry film thickness of 2 mils.
 - a. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install intake and relief ventilators level, plumb, and at indicated alignment with adjacent work.
- B. Secure intake and relief ventilators to roof curbs with cadmium-plated hardware. Use concealed anchorages where possible. Refer to Division 07 Section "Roof Accessories" for installation of roof curbs.
- C. Install goosenecks on curb base where throat size exceeds 9 by 9 inches.
- D. Install intake and relief ventilators with clearances for service and maintenance.

- E. Install perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- F. Install concealed gaskets, flashings, joint fillers, and insulation as installation progresses. Comply with Division 07 Section "Joint Sealants" for sealants applied during installation.
- G. Label intake and relief ventilators according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."
- H. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.
- I. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

3.2 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories.

3.3 ADJUSTING

- A. Adjust damper linkages for proper damper operation.

END OF SECTION

SECTION 23 81 26

SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes split-system air-conditioning and heat pump units consisting of separate evaporator-fan and compressor-condenser components. Units are designed for exposed or concealed mounting, and may be connected to ducts.

1.2 SUBMITTALS

- A. Product Data: For each unit indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. Operation and maintenance data.

1.3 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. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2007, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- C. ASHRAE/IESNA 90.1-2007 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2007, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.4 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace split-system air-conditioning units that fail in materials and workmanship within five years from date of Substantial Completion.

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:

- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Carrier
 - 2. Lennox
 - 3. Trane
 - 4. York

2.2 EVAPORATOR-FAN UNIT

- A. Concealed Unit Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
 - 1. Insulation: Faced, glass-fiber duct liner.
 - 2. Drain Pans: Galvanized steel, with connection for drain; insulated and complying with ASHRAE 62.1-2007.
 - 3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2007.
- B. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with thermal-expansion valve.
- C. Evaporator Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
- D. Fan Motor: Multispeed.
- E. Filters: 1 inch thick, in fiberboard frames.

2.3 AIR-COOLED, COMPRESSOR-CONDENSER UNIT

- A. Casing steel, finished with baked enamel, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
- B. Compressor: Hermetically sealed reciprocating type with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
 - 1. Refrigerant: R-454b or R-32 (unless otherwise indicated on the drawings).
- C. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with liquid subcooler.
- D. Fan: Aluminum-propeller type, directly connected to motor.
- E. Motor: Permanently lubricated, with integral thermal-overload protection.
- F. Low Ambient Kit: Permits operation down to 45 deg F.

- G. Mounting Base: Polyethylene.
- H. Minimum Energy Efficiency: Comply with ASHRAE/IESNA 90.1-2007, "Energy Standard for Buildings except Low-Rise Residential Buildings."

2.4 ACCESSORIES

- A. Thermostat: Low voltage with subbase to control compressor and evaporator fan.
- B. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.
 - 1. Minimum Insulation Thickness: 1/2 inch thick.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- B. Install ground-mounted, compressor-condenser components on 4-inch- thick, reinforced concrete base; 4 inches larger on each side than unit. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete." Coordinate anchor installation with concrete base.
- C. Install ground-mounted, compressor-condenser components on polyethylene mounting base.
- D. Install roof-mounted, compressor-condenser components on equipment supports specified in Division 07 Section "Roof Accessories." Anchor units to supports with removable, cadmium-plated fasteners.
- E. Install compressor-condenser components on restrained, spring isolators with a minimum static deflection of 1 inch. Refer to Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

3.2 CONNECTIONS

- A. Connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.
- B. Connect supply and return condenser connections with shutoff-duty valve and union or flange on the supply connection and with throttling-duty valve and union or flange on the return connection.
- C. Install piping adjacent to unit to allow service and maintenance.

3.3 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 connection, and to assist in field testing. Report results in writing.
- B. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
- C. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new components, and retest.
- D. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

END OF SECTION

SECTION 23 81 46
WATER-SOURCE UNITARY HEAT PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following types of water-source heat pumps:
 - 1. Concealed horizontal or vertical units, 15 tons and smaller.

1.3 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each model.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Wiring Diagrams: Power, signal, and control wiring.
- C. Product Certificates: For each type of water-source heat pump, signed by product manufacturer. All equipment listed in this section must be rated and certified in accordance with American Refrigeration Institute / International Standards Organization (ARI / ISO) and Canadian Standards Association (CSA-US). The units shall have ARI / ISO and CSA-US labels
- D. Operation and Maintenance Data: For water-source heat pumps to include in emergency, operation, and maintenance manuals.
- E. Warranty: Special warranty specified in this Section.

1.4 ACCEPTABLE MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following.
 - 1. Climate Master
 - 2. Enertech/Tetco
 - 3. Water Furnace
 - 4. Daikin
 - 5. Trane
 - 6. Carrier

- B. Listing of manufacturers name does not guarantee approval. All equipment must meet or exceed quality and capacities of specified equipment. Final approval will be based on equipment submittals. Any manufacturer not listed but wishing to bid this project shall submit a written request 10 days prior to bid date, prior approval is required for all manufacturers not listed.

1.5 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of water-source heat pumps and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
 - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- 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. ASHRAE Compliance:
 - 1. ASHRAE 15.
 - 2. Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- D. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- E. Comply with NFPA 70.
- F. Comply with safety requirements in UL 484 for assembly of free-delivery water-source heat pumps.
- G. Comply with safety requirements in UL 1995 for duct-system connections.

1.6 COORDINATION

- A. Coordinate layout and installation of water-source heat pumps and suspension components with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system components, and partition assemblies.
- B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of water-source heat pumps that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, refrigeration components.
 - 2. Warranty Period: Manufacturer shall warranty all parts one year from start-up or 18 months from shipment. The compressor shall have a 5 year warranty. Installing contractor shall provide warranty labor for a period on one year.

PART 2 - PRODUCTS

2.1 WATER-SOURCE HEAT PUMPS

- A. Description: Packaged water-source heat pump with temperature controls; factory assembled, tested, and rated according to ARI-ISO-13256-1.
- B. Cabinet and Chassis: Galvanized-steel casing, powder coated on both sides, with the following features:
 - 1. Minimum of three (3) Access panels for serviceability of internal components.
 - 2. Knockouts for electrical and piping connections.
 - 3. Flanged duct connections.
 - 4. Compressor Section Cabinet Insulation: Glass-fiber liner, minimum 1/2 inch thick, dual density, 1 ¾lb.
 - 5. Air Handling Section Cabinet Insulation: Glass-fiber liner, minimum 1/2 inch thick, single density, foil backed 1 ¾lb.
 - 6. Standard cabinet panel insulation must meet NFPA 90A requirements, air erosion and mold growth limits of UL-181, stringent fungal resistance test per ASTM-C1071 and ASTM G21, and shall meet zero level bacteria growth per ASTM G22.
 - 7. Condensate Drainage: HDPE or stainless-steel drain pan with condensate drain piping projecting through unit cabinet and complying with ASHRAE 62.1-2004.
 - 8. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.
 - 9. All units must have an insulated panel separating the fan compartment from the compressor compartment. The compressor shall be located outside the air stream.
- C. Fan and Motor:
 - 1. General requirements for motors are specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - 2. Blower shall have inlet rings to allow removal of wheel and motor from one side without removing housing. Units shall have a direct-drive centrifugal fan. The fan motor shall be 3-speed, permanently lubricated, PSC or ECM type, with internal thermal overload protection. Units supplied without permanently lubricated motors must provide external oilers for easy service. The fan motor shall be isolated from the fan housing by a torsionally flexible motor mounting system with rubber type grommets to inhibit vibration induced high noise levels associated with "hard wire belly band" motor mounting. The fan and motor assembly must be capable of overcoming the external static

pressures as shown on the schedule. Airflow / Static pressure rating of the unit shall be based on a dry coil and a clean filter in place.

D. Water Circuit:

1. Refrigerant-to-Water Heat Exchangers:

- a. Coaxial heat exchangers with copper water tube with enhanced heat-transfer surfaces inside a steel shell; both shell and tube leak tested to 500 psig on refrigerant side and 400 psig on water side. Factory mount heat exchanger in unit on resilient rubber vibration isolators.
- b. Stainless-steel, brazed-plate heat exchanger leak tested to 450 psig for refrigerant side and 400 psig for water side. Factory mount heat exchanger in unit on resilient rubber vibration isolators.

2. Motorized Water Valve: Stop water flow through the unit when compressor is off.

E. Refrigerant-to-Air Coils: Copper tubes with aluminum fins, leak tested to 450 psig.

F. Refrigerant Circuit Components:

1. Sealed Refrigerant Circuit: Charge with R-32 or R-454B refrigerant.

- a. Provide units with applicable factory refrigerant monitoring devices and BAS point monitoring.

2. Filter-Dryer: Factory installed to clean and dehydrate the refrigerant circuit.

3. Charging Connections: Service fittings on suction and liquid for charging and testing.

4. Reversing Valve: Pilot-operated sliding-type valve designed to be fail-safe in heating position with replaceable magnetic coil.

5. Compressor: Hermetic rotary or scroll compressor installed on vibration isolators and housed in an acoustically treated enclosure with factory-installed safeties. Activation of any safety device shall prevent compressor operation via a microprocessor lockout circuit. The lockout circuit shall be reset at the thermostat or at the contractor supplied disconnect switch. Factory installed safeties required as follows:

- a. Anti- short cycle timer.
- b. High-pressure cutout.
- c. Low-pressure cutout or loss of charge switch.
- d. Water coil low temperature sensor
- e. Air coil low temperature sensor
- f. Condensate overflow sensor

6. Refrigerant Piping Materials: ASTM B 743 copper tube with wrought-copper fittings and brazed joints.

7. Pipe Insulation: Refrigerant minimum 3/8-inch- thick, flexible elastomeric insulation on piping exposed to airflow through the unit. Maximum 25/50 flame-spread/smoke-development indexes according to ASTM E 84.

8. Refrigerant Metering Device: Thermal expansion valve to allow specified operation with entering-water temperatures from 40 to 100 deg F.

G. Filters:

1. Where indicated with Dynamic Air Cleaners/Filtration provide Polarized-Media Electronic Air Cleaners 1" Panel Air Cleaners, Dynamic Model P1000 or equivalent

polarized media filtration system compliant to meet UL Standard 867. Filter system must have capability to reduce OA ventilation per IAQ procedure of ASHRAE Standard 62 to OA values noted in equipment schedules. Provide with unit integrated low-voltage connection, wire/connect to unit control transformer.

- H. Sound Attenuation (required for classroom units only):
 - 1. Ultra quiet package shall consist of high technology sound attenuating material that is strategically applied to the compressor and air handling compartment casings and fan scroll in addition to the standard system design, to further dampen and attenuate sound transmissions.
- I. Hot gas reheat (where indicated)
 - 1. Dehumidification (where indicated) is provided through a hot gas reheat option. The coil shall consist of 3/8"/1/2" copper tubes mechanically expanded into evenly spaced aluminum fins. All coils shall be proof and leak tested. The proof test must be performed at 1.5 times the maximum operating pressure and the leak test performed at the maximum operating pressure.
- J. Drain Pan: the drain pan shall be constructed of 304 Stainless Steel to inhibit corrosion. This corrosion protection system shall meet the stringent 1000 hour salt spray test per ASTM B117. If plastic type material is used, it must be HDPE (High Density Polyethylene) to avoid thermal cycling shock stress failure over the lifetime of the unit. Drain pan shall be fully insulated. Drain outlet shall be located at pan as to allow complete and unobstructed drainage of condensate. Drain outlet for horizontal units shall be connected from pan directly to IPT fitting. The unit as standard will be supplied with solid-state electronic condensate overflow protection. Vertical units shall be furnished with a PVC slip condensate drain connection and an internal factory installed condensate trap.
- K. Control equipment is specified in Division 23 Sections "Instrumentation and Controls for HVAC." See plans for Sequence of Operation.
- L. Controls:

Solid state control system shall communicate with thermostat to display (at the thermostat) the unit status, fault status, and specific fault condition, as well as retrieve previously stored fault that caused unit shutdown. The Remote Service Sentinel allows building maintenance personnel or service personnel to diagnose unit from the wall thermostat. The control board shall provide a signal to the thermostat fault light, indicating a lockout. Upon cycling the G (fan) input 3 times within a 60 second time period, the fault light shall display the specific code as indicated by a sequence of flashes. A detailed flashing code shall be provided at the thermostat LED to display unit status and specific fault status such as over/under voltage fault, high pressure fault, low pressure fault, low water temperature fault, condensate overflow fault, etc. The control board will be supplied with a LONWORKS interface board, which is LONMark certified, or BACnet certified interface board. This will permit all units to be daisy chained via a 2-wire twisted pair shielded cable. The following points must be available at a central or remote computer location:

 - a. space temperature
 - b. leaving water temperature
 - c. discharge air temperature
 - d. command of space temperature setpoint
 - e. cooling status
 - f. heating status

- g. low temperature sensor alarm
- h. low pressure sensor alarm
- i. high pressure switch alarm
- j. condensate sensor alarm
- k. hi/low voltage alarm
- l. fan "ON/AUTO" position of space thermostat as specified above
- m. unoccupied / occupied command
- n. cooling command
- o. heating command
- p. fan "ON / AUTO" command
- q. fault reset command
- r. itemized fault code revealing reason for specific shutdown fault (any one of 7)

M. Electrical Connection: Single electrical connection.

N. Capacities and Characteristics: As indicated on the drawings.

2.2 HOSE KITS

- A. General: Hose kits shall be designed for minimum 400 psig working pressure, and operating temperatures from 33 to 211 deg F. Tag hose kits to equipment designations.
- B. Hose: Length 24 inches. Minimum diameter, equal to water-source heat-pump connection size.
- C. Isolation Valves: Two-piece bronze-body ball valves with stainless-steel ball and stem and galvanized-steel lever handle. Provide valve for supply and return. If balancing device is combination shutoff type with memory stop, the isolation valve may be omitted on the return.
- D. Strainer: Y-type with blowdown valve in supply connection.
- E. Balancing Device: Mount in return connection. Include meter ports to allow flow measurement with differential pressure gage.
 - 1. Automatic balancing valve, factory set to operate within +/-5% of gpm rating. Cartridge must be accessible without removing valve from piping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of water-source heat pumps.
- B. Examine roughing-in for piping and electric installations for water-source heat pumps to verify actual locations of piping connections and electrical conduit before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Concrete Bases: Install floor mounted units on 4-inch- high concrete bases. See Division 23 Section "Common Work Results for HVAC" for concrete base materials and fabrication requirements.
- B. Unless otherwise noted, mount horizontal and vertical water-source heat pumps on concrete base with vibration isolators. Vibration isolators are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
 - 1. Units with Internally Isolated Fans and Compressors: Support on concrete bases using neoprene pads with minimum 0.125-inch static deflection. Secure units to anchor bolts installed in concrete bases.
 - 2. Units without Internally Isolated Fans and Compressors: Support on concrete bases using housed-spring isolators with minimum 1-inch static deflection. Secure units to anchor bolts installed in concrete bases.
 - 3. Install units level.

3.3 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:
 - 1. Connect supply and return hydronic piping to heat pump with hose kits.
 - 2. Connect heat-pump condensate drain pan to indirect waste connection with condensate trap of adequate depth to seal against the pressure of fan. Install cleanouts in piping at changes of direction.
- B. Duct installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts. Specific connection requirements are as follows:
 - 1. Connect supply and return ducts to water-source heat pumps with flexible duct connectors specified in Division 23 Section "Air Duct Accessories."
- C. Install electrical devices furnished by manufacturer but not specified to be factory mounted.
- D. Install piping adjacent to machine to allow service and maintenance.
- E. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- F. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. After installing water-source heat pumps and after electrical circuitry has been energized, test units for compliance with requirements.
 - 2. Inspect for and remove shipping bolts, blocks, and tie-down straps.

3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Remove and replace malfunctioning units and retest as specified above.

3.5 STARTUP SERVICE (Provided by Installing Contractor)

A. Complete installation and startup checks according to manufacturer's written instructions and do the following:

1. Inspect for visible damage to unit casing.
2. Inspect for visible damage to compressor, coils, and fans.
3. Inspect internal insulation.
4. Verify that labels are clearly visible.
5. Verify that clearances have been provided for servicing.
6. Verify that controls are connected and operable.
7. Verify that filters are installed.
8. Adjust vibration isolators.
9. Inspect operation of barometric dampers.
10. Verify bearing lubrication on fan.
11. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
12. Adjust fan belts to proper alignment and tension.
13. Start unit according to manufacturer's written instructions.
14. Complete startup sheets and attach copy with Contractor's startup report.
15. Inspect and record performance of interlocks and protective devices; verify sequences.
16. Operate unit for an initial period as recommended or required by manufacturer.
17. Verify thermostat and humidistat calibration.
18. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
19. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
20. Start refrigeration system and measure and record the following:
 - a. Coil leaving-air, dry- and wet-bulb temperatures.
 - b. Coil entering-air, dry- and wet-bulb temperatures.
 - c. Outdoor-air, dry-bulb temperature.
 - d. Outdoor-air-coil, discharge-air, dry-bulb temperature.
21. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.
 - a. Supply-air volume.
 - b. Return-air volume.
 - c. Relief-air volume.
 - d. Outdoor-air intake volume.

3.6 ADJUSTING

A. Adjust initial temperature and humidity set points.

- B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.

3.7 CLEANING

- A. Replace filters used during construction prior to air balance or substantial completion.
- B. After completing installation of exposed, factory-finished water-source heat pumps, inspect exposed finishes and repair damaged finishes.

3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water-source heat pumps. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

