

according to 40 CFR 59, Subpart D (EPA Method 24):

3. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.

#### PART 1.3 EXECUTION

##### A. Preparation

1. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

2. Concrete Substrates: Prepare according to ASTM F 710.

a. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.

b. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.

c. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.

d. Moisture Testing: Perform tests recommended by manufacturer and as follows. Proceed with installation only after substrates pass testing.

1) Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.

2) Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75% relative humidity level measurement.

3. Access Flooring Panels: Remove protective film of oil or other coating using method recommended by access flooring manufacturer.

4. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

5. Do not install floor tiles until they are same temperature as space where they are to be installed.

a. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

6. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

##### B. Floor Tile Installation

1. Comply with manufacturer's written instructions for installing floor tile.

2. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

a. Lay tiles square with room axis.

3. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
  - a. Lay tiles with grain direction alternating in adjacent tiles (basket-weave pattern).
4. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
5. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
6. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.
7. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.
8. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

#### C. Cleaning and Protection

1. Comply with manufacturer's written instructions for cleaning and protection of floor tile.
2. Perform the following operations immediately after completing floor tile installation:
  - a. Remove adhesive and other blemishes from exposed surfaces.
  - b. Sweep and vacuum surfaces thoroughly.
  - c. Damp-mop surfaces to remove marks and soil.
3. Protect floor tile products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
4. Floor Polish: Remove soil, visible adhesive, and surface blemishes from floor tile surfaces before applying liquid floor polish.
  - a. Apply one coat.
5. Joint Sealant: Apply sealant to resilient terrazzo floor tile perimeter and around columns, at doorframes, and at other joints and penetrations.
6. Cover floor tile until Substantial Completion.

END OF SECTION 09620

## SECTION – 09680 – CARPET

**SECTION 09680****CARPET**

## PART 1. - GENERAL

## 1.1 SUMMARY

A. This Section includes the following:

1. Tufted carpet tiles and installation.

## 1.2 SUBMITTALS

A. Product Data:

1. For each type of product indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance. Include installation recommendations for each type of substrate required. Should carpet manufacturer not publish detailed installation data, installer shall submit detailed proposed procedures for Architect's approval.

B. Shop Drawings: Indicate the following.

1. Locations where cutouts are required in carpet, i.e. columns, doorways, built-in cabinets, etc.
2. Starting point for carpet tile pattern repeat.
3. Type, color, and location of inserts and borders (if any).
4. Type, location, and location of edge, transition, and other accessory strips required.
5. Transition details to other flooring materials.
6. Use same room and product designations indicated on Drawings and in schedules.

C. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings.

1. Carpet Tile: Two (2), full-size carpet tiles of each different color and pattern.
2. Submit all exposed edge stripping and accessories with carpet sample submittal.

D. Maintenance Data: For carpet to include in maintenance manuals Include the following:

1. Methods for maintaining carpet, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to carpet.

E. Certificates: Carpet shall be certified for compliance with specification requirements. Submit certificates from carpet manufacturer at time of carpet delivery to project site. Each certificate shall be signed by authorized officer of carpet manufacturing company

## SECTION – 09680 – CARPET

and shall contain the name and address of the Contractor, the project location and the quantities and date or dates of shipment or delivery to which certificates apply.

## 1.3 QUALITY ASSURANCE

- A. Applicable Standards: Standards of the following, as referenced herein:
1. American Association of Textile Chemists and Colorists (AATCC).
  2. American Society for Testing and Materials (ASTM).
  3. National Fire Protection Association (NFPA).
- B. Design Criteria: Carpet shall meet the following as determined by testing identical products by an independent testing and inspecting agency acceptable to the Architect:
1. Refer to the GSFIC specimen language for Testing of Carpet at the end of PART 3.
  2. Flame spread, fuel contribution and smoke development: Class B when tested in accord with ASTM E84 and NFPA 101.
  3. Critical radiant flux: Class I, when tested in accord with ASTM E648.
  4. Optical density of smoke (flaming): Not more than 250 per ASTM E662-97.
  5. Electrostatic propensity: No greater than 3.0 when tested in per AATCC 134-1991.
  6. Colorfastness to Crocking: Not less than 4, wet and dry, per AATCC-165.
  7. Colorfastness to Light: Not less than 4 after 40 AFU (AATCC fading units) per ATCC-16.
  8. Flammability of carpet: Pass methenamine pill test when tested in accord with ASTM D2859.
  9. Carpet systems shall meet or exceed the Carpet and Rug Institute's Green Label Indoor Air Quality Test Program.
- C. Installer Qualifications:
1. Installer shall provide written documentation from the carpet manufacturer that they are certified to install products indicated.
  2. Installer shall be certified by the Floor Covering Installation Board or can demonstrate compliance with its certification program requirements.

## 1.4. DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's original mill wrappings, with carpet having register tag number attached. Deliver only after building is enclosed and spaces have controlled temperature and humidity.
- B. Store materials under cover, off floor, in ventilated space. Protect from damage, staining and moisture. Stand no roll material on end.

## 1.5. PROJECT CONDITIONS

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- A. General: Comply with CRI 104, Section 6.1, "Site Conditions; Temperature and Humidity."
- B. Environmental Limitations: Do not install carpet until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- C. Do not install carpet over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet manufacturer.
- D. Where furniture or other items are indicated for installation on top of carpet, install carpet before installing these items.

## 1.6 EXTRA MATERIALS

- A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- B. Carpet Tile: Equal to 5-percent of amount installed.

## PART 2. - PRODUCTS

## 2.1 CARPET TILE

- A. Colors, Textures, and Patterns:
  - 1. Refer to Finish Schedule and Finish Legend located on the Drawings for selections and installation locations.

## 2.2 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided by or recommended by the carpet manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, non-staining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet and that is recommended by the carpet manufacturer. Adhesive shall be release type, allow removal of carpet without damage to carpet or substrate. Adhesives shall be release type, allow removal of carpet without damage to carpet or substrate.
- C. Seaming Cement: Hot-melt adhesive tape or similar product recommended by carpet manufacturer for taping seams and butting cut edges at backing to form secure seams and to prevent pile loss at seams.

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- D. Leveling Compound
  - 1. Acceptable Products
    - a. Euclid EUCO Polypatch
    - b. Flintkote Latex Underlayment
    - c. GAF Leveling and Patching Compound
    - d. TAMMS Floorstone with Latex Liquid
- E. Carpet edge strip shall be resilient base type.

## PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet performance. Verify that substrates and conditions are satisfactory for carpet installation and comply with requirements specified.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:
- C. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by the carpet manufacturer.
- D. Subfloor finishes comply with requirements specified in Division 3 Section Cast-in-Place Concrete for slabs receiving carpet.
- E. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 PREPARATION

- A. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and carpet manufacturer's written installation instructions for preparing substrates indicated to receive carpet installation.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.
- C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by the carpet manufacturer.

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- D. Broom and vacuum clean substrates to be covered immediately before installing carpet. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.3. WORKMANSHIP

- A. Maintain edges and seams straight and square with adjacent surfaces.

## 3.4. INSTALLATION, GENERAL

- A. Comply with carpet manufacturer's written recommendations for seam locations and direction of carpet; maintain uniformity of carpet direction and lay of pile. At doorways, center seams under the door in closed position.
- B. Lay out carpeting materials in accord with approved seaming drawings.
- C. Cut and fit carpet to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet manufacturer.
- D. Extend carpet into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- E. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
- F. Install pattern, where applicable, parallel to wall and borders.
- G. Direct-Glue-Down Installation: Comply with CRI 104, Section 8, "Direct Glue-Down Installation."

## 3.5. CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet:
- B. Remove excess adhesive, seam sealer, and other surface blemishes and stains using cleaner recommended by carpet manufacturer.
- C. Remove yarns that protrude from carpet surface.
- D. Thoroughly vacuum carpet using commercial machine with face-beater element.
- E. Protect carpet against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet manufacturer.

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- F. Just prior to Date of Substantial Completion, remove protective covering and vacuum carpet. Steam clean areas if required to remove stains.
  
- G. Remove and replace carpet tiles which cannot be cleaned.

END OF SECTION

**SECTION 09912**  
**INTERIOR PAINTING**

PART 1 - GENERAL

1.1 DESCRIPTION

This Section specifies surface preparation and the application of paint systems on the following interior substrates:

Concrete.  
Concrete masonry units (CMU).  
Steel.  
Galvanized metal.  
Wood.  
Gypsum board

1.2 RELATED DOCUMENTS

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

1.3 SUBMITTALS

A. The following information shall be provided.

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined shall signify compliance on the part of the Contractor with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

1.4 PRODUCT DATA:

For each type of product indicated.

1.5 SAMPLES FOR INITIAL SELECTION:

For each type of topcoat product indicated.

1.6 SAMPLES FOR VERIFICATION:

A. For each type of paint system and in each color and gloss of topcoat indicated.

1. Submit Samples on rigid backing, 8 inches square.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

1.7 PRODUCT LIST:

A. For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.
3. Product Data for Credit EQ 4.2: For paints, including printed statement of VOC content and chemical components.

1.8 QUALITY ASSURANCE

A. MPI Standards:

- 1) Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."

Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

1.9 MOCKUPS:

- A. Apply benchmark samples of each paint system indicated and each color and finish selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
- B. Construction Manager will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
- C. Final approval of color selections will be based on benchmark samples.
- D. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by Construction Manager at no added cost to Owner.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
- B. Maintain containers in clean condition, free of foreign materials and residue.
- C. Remove rags and waste from storage areas daily.

1.11 PROJECT CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

1.12 EXTRA MATERIALS

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
- B. Quantity: Furnish an additional 5 percent, but not less than 1 gal. of each material and color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. AVAILABLE MANUFACTURERS:

1. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

Benjamin Moore & Co.  
Duron, Inc.  
Envirocoat Technologies Inc.  
ICI Paints.  
Parker Paint Mfg. Co. Inc.  
Porter Paints.  
PPG Architectural Finishes, Inc.  
Sherwin-Williams Company (The).

2.2 PAINT, GENERAL

A. MATERIAL COMPATIBILITY:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. VOC CONTENT OF FIELD-APPLIED INTERIOR PAINTS AND COATINGS:

1. Provide products that comply with the following limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24); these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:
  - a. Flat Paints, Coatings, and Primers: VOC content of not more than 50 g/L.
  - b. Nonflat Paints, Coatings, and Primers: VOC content of not more than 150 g/L.
  - c. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
  - d. Floor Coatings: VOC not more than 100 g/L.
  - e. Shellacs, Clear: VOC not more than 730 g/L.
  - f. Shellacs, Pigmented: VOC not more than 550 g/L.
  - g. Flat Topcoat Paints: VOC content of not more than 50 g/L.
  - h. Nonflat Topcoat Paints: VOC content of not more than 150 g/L.
  - i. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
  - j. Floor Coatings: VOC not more than 100 g/L.
  - k. Shellacs, Clear: VOC not more than 730 g/L.
  - l. Shellacs, Pigmented: VOC not more than 550 g/L.
  - m. Primers, Sealers, and Undercoaters: VOC content of not more than 200 g/L.
  - n. Dry-Fog Coatings: VOC content of not more than 400 g/L.
  - o. Zinc-Rich Industrial Maintenance Primers: VOC content of not more than 340 g/L.
  - p. Pre-Treatment Wash Primers: VOC content of not more than 420 g/L.

C. CHEMICAL COMPONENTS OF FIELD-APPLIED INTERIOR PAINTS AND COATINGS:

1. Provide topcoat paints and anti-corrosive and anti-rust paints applied to ferrous metals that comply with the following chemical restrictions; these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:
2. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).

3. Restricted Components: Paints and coatings shall not contain any of the following:

- a. Acrolein.
- b. Acrylonitrile.
- c. Antimony.
- e. Benzene.
- f. Butyl benzyl phthalate.
- g. Cadmium.
- h. Di (2-ethylhexyl) phthalate.
- i. Di-n-butyl phthalate.
- j. Di-n-octyl phthalate.
- k. 1,2-dichlorobenzene.
- l. Diethyl phthalate.
- m. Dimethyl phthalate.
- n. Ethylbenzene.
- o. Formaldehyde.
- p. Hexavalent chromium.
- q. Isophorone.
- r. Lead.
- s. Mercury.
- t. Methyl ethyl ketone.
- u. Methyl isobutyl ketone.
- v. Methylene chloride.
- w. Naphthalene.
- x. Toluene (methylbenzene).
- y. 1,1,1-trichloroethane.
- z. Vinyl chloride.

D. COLORS:

- 1. As indicated in a color schedule

2.3 BLOCK FILLERS

A. INTERIOR/EXTERIOR LATEX BLOCK FILLER: MPI #4.

- 1. VOC Content: E Range of E3.

2.4 PRIMERS/SEALERS

A. INTERIOR LATEX PRIMER/SEALER: MPI #50.

- 1. VOC Content: E Range of E3.
- 2. Environmental Performance Rating: EPR 3.

B. INTERIOR ALKYD PRIMER/SEALER: MPI #45.

- 1. VOC Content: E Range of E2.

C. WOOD-KNOT SEALER:

1. Sealer recommended in writing by topcoat manufacturer for use in paint systems indicated.

2.5 METAL PRIMERS

A. ALKYD ANTICORROSIVE METAL PRIMER: MPI #79.

1. VOC Content: E Range of E2.

B. QUICK-DRYING ALKYD METAL PRIMER: MPI #76.

1. VOC Content: E Range of E3.

C. RUST-INHIBITIVE PRIMER (WATER BASED): MPI #107.

1. VOC Content: E Range of E3.
2. Environmental Performance Rating: EPR 3.

D. CEMENTITIOUS GALVANIZED-METAL PRIMER: MPI #26.

1. VOC Content: E Range of E1.

E. WATERBORNE GALVANIZED-METAL PRIMER: MPI #134.

1. VOC Content: E Range of E3.
2. Environmental Performance Rating: EPR 3.

F. VINYL WASH PRIMER: MPI #80.

1. VOC Content: E Range of E3.

G. QUICK-DRYING PRIMER FOR ALUMINUM: MPI #95.

1. VOC Content: E Range of E3.

2.6 WOOD PRIMERS

A. INTERIOR LATEX-BASED WOOD PRIMER: MPI #39.

1. VOC Content: E Range of E3.
2. Environmental Performance Rating: EPR 3.

2.7 LATEX PAINTS

A. INTERIOR LATEX (EGGSHELL): MPI #52 (GLOSS LEVEL 3).

1. VOC Content: E Range of E3.

2. Environmental Performance Rating: EPR 3.
  - B. INTERIOR LATEX (SEMIGLOSS): MPI #54 (GLOSS LEVEL 5).
    1. VOC Content: E Range of E3.
    2. Environmental Performance Rating: EPR 4.
    3. Environmental Performance Rating: EPR 4.5.
- 2.8 QUICK-DRYING ENAMELS
- A. QUICK-DRYING ENAMEL (SEMIGLOSS): MPI #81 (GLOSS LEVEL 5).
    1. VOC Content: E Range of E3.
- 2.9 TEXTURED COATING
- A. LATEX STUCCO AND MASONRY TEXTURED COATING: MPI #42.
    1. VOC Content: E Range of E3.
- 2.10 FLOOR COATINGS
- A. INTERIOR CONCRETE FLOOR STAIN: MPI #58.
    1. VOC Content: E Range of E3.
    2. Environmental Performance Rating: EPR 2.
  - B. INTERIOR/EXTERIOR CLEAR CONCRETE FLOOR SEALER (WATER BASED): MPI #99.
    1. VOC Content: E Range of E3.
  - C. INTERIOR/EXTERIOR CLEAR CONCRETE FLOOR SEALER (SOLVENT BASED): MPI #104.
    1. VOC Content: E Range of E2.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. GENERAL:
  1. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

B. MAXIMUM MOISTURE CONTENT OF SUBSTRATES:

1. When measured with an electronic moisture meter as follows:
  - a. Concrete: 12 percent.
  - b. Masonry (Clay and CMU): 12 percent.
  - c. Wood: 15 percent.
  - d. Gypsum Board: 12 percent.

C. SUBSTRATE CONDITION:

1. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
2. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
3. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. GENERAL:

1. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
2. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
3. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
4. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
5. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
6. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.

B. CONCRETE SUBSTRATES:

1. Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

C. CONCRETE MASONRY SUBSTRATES:

1. Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

D. STEEL SUBSTRATES:

1. Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.

E. GALVANIZED-METAL SUBSTRATES:

1. Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

F. ALUMINUM SUBSTRATES:

1. Remove surface oxidation.

G. WOOD SUBSTRATES:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
2. Sand surfaces that will be exposed to view, and dust off.
3. Prime edges, ends, faces, undersides, and backsides of wood.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

H. GYPSUM BOARD SUBSTRATES:

1. Do not begin paint application until finishing compound is dry and sanded smooth.

3.3 APPLICATION

A. GENERAL:

1. Apply paints according to manufacturer's written instructions.
2. Use applicators and techniques suited for paint and substrate indicated.
3. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
4. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
5. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

6. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

B. PAINTING MECHANICAL AND ELECTRICAL WORK:

7. Paint items exposed in equipment rooms and occupied spaces including, but not limited to, the following:

- a. Mechanical Work:

Uninsulated metal piping.  
Uninsulated plastic piping.  
Pipe hangers and supports.  
Tanks that do not have factory-applied final finishes.  
Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.  
Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.  
Mechanical equipment that is indicated to have a factory-primed finish for field painting.

- B. Electrical Work:

Panelboards.  
Electrical equipment that is indicated to have a factory-primed finish for field painting.

3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Construction Manager, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 INTERIOR PAINTING SCHEDULE

A. CONCRETE SUBSTRATES, NONTRAFFIC SURFACES:

1. Latex System: MPI INT 3.1E.

- a. Prime Coat: Interior latex matching topcoat.
  - b. Intermediate Coat: Interior latex matching topcoat.
  - c. Topcoat: Interior latex (satin).
2. Latex Over Sealer System: MPI INT 3.1A.
    - a. Prime Coat: Interior latex primer/sealer.
    - b. Intermediate Coat: Interior latex matching topcoat.
    - c. Topcoat: Interior latex (satin).
  2. Latex Over Latex Aggregate System: MPI INT 3.1B.
    - a. Prime Coat: Latex stucco and masonry textured coating.
    - b. Intermediate Coat: Exterior latex matching topcoat.
    - c. Topcoat: Exterior latex (semigloss).
  3. Institutional Low-Odor/VOC Latex System: MPI INT 3.1M.
    - a. Prime Coat: Institutional low-odor/VOC interior latex matching topcoat.
    - b. Intermediate Coat: Institutional low-odor/VOC interior latex matching topcoat.
    - c. Topcoat: Institutional low-odor/VOC interior latex (semigloss).
  4. High-Performance Architectural Latex System: MPI INT 3.1C.
    - a. Prime Coat: Interior latex primer/sealer.
    - b. Intermediate Coat: High-performance architectural latex matching topcoat.
    - c. Topcoat: High-performance architectural latex (satin).
- B. CONCRETE SUBSTRATES, TRAFFIC SURFACES:
1. Alkyd Floor Enamel System: MPI INT 3.2B.
    - a. Prime Coat: Exterior/interior alkyd floor enamel (semigloss).
    - b. Intermediate Coat: Exterior/interior alkyd floor enamel (semigloss).
    - c. Topcoat: Exterior/interior alkyd floor enamel (semigloss).
  2. Concrete Stain System: MPI INT 3.2E.
    - a. First Coat: Interior concrete floor stain.
    - b. Topcoat: Interior concrete floor stain.
  3. Clear Sealer System: MPI INT 3.2F.
    - a. First Coat: Interior/exterior clear concrete floor sealer (solvent based).
    - b. Topcoat: Interior/exterior clear concrete floor sealer (solvent based).
  4. Water-Based Clear Sealer System: MPI INT 3.2G.
    - a. First Coat: Interior/exterior clear concrete floor sealer (water based).
    - b. Topcoat: Interior/exterior clear concrete floor sealer (water based).
  5. Latex Aggregate System: MPI INT 4.1B.

- a. Prime Coat: As recommended in writing by topcoat manufacturer.
  - b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
  - c. Topcoat: Latex stucco and masonry textured coating.
- C. CMU SUBSTRATES:
- 1. Latex System: MPI INT 4.2A.
    - a. Prime Coat: Interior/exterior latex block filler.
    - b. Intermediate Coat: Interior latex matching topcoat.
    - c. Topcoat: Interior latex (semigloss).
- D. STEEL SUBSTRATES:
- 1. Latex Over Alkyd Primer System: MPI INT 5.1Q.
    - a. Prime Coat: Alkyd anticorrosive metal primer.
    - b. Intermediate Coat: Interior latex matching topcoat.
    - c. Topcoat: Interior latex (eggshell).
- E. GALVANIZED-METAL SUBSTRATES:
- 1. Latex System: MPI INT 5.3A.
    - a. Prime Coat: Cementitious galvanized-metal primer.
    - b. Intermediate Coat: Interior latex matching topcoat.
    - c. Topcoat: Interior latex (eggshell).
- F. ALUMINUM (NOT ANODIZED OR OTHERWISE COATED) SUBSTRATES:
- 1. Latex System: MPI INT 5.4H.
    - a. Prime Coat: Quick-drying primer for aluminum.
    - b. Intermediate Coat: Interior latex matching topcoat.
    - c. Topcoat: Interior latex (eggshell).
  - 2. Aluminum Paint System: MPI INT 5.4D.
    - a. Prime Coat: Vinyl wash primer.
    - b. Intermediate Coat: Aluminum paint.
    - c. Topcoat: Aluminum paint.
- G. DRESSED LUMBER SUBSTRATES: INCLUDING DOORS.
- 1. Alkyd System: MPI INT 6.3B.
    - a. Prime Coat: Interior alkyd primer/sealer.
    - b. Intermediate Coat: Interior alkyd matching topcoat.
    - c. Topcoat: Interior alkyd (eggshell).
- H. WOOD PANEL SUBSTRATES: INCLUDING PAINTED PLYWOOD.

1. Latex System: MPI INT 6.4R.
  - a. Prime Coat: Interior latex-based wood primer.
  - b. Intermediate Coat: Interior latex matching topcoat.
  - c. Topcoat: Interior latex (semigloss).

I. GYPSUM BOARD SUBSTRATES:

1. Latex System: MPI INT 9.2A.
  - a. Prime Coat: Interior latex primer/sealer.
  - b. Intermediate Coat: Interior latex matching topcoat.
  - c. Topcoat: Interior latex (eggshell).
  - d. Intermediate Coat: High-performance architectural latex matching topcoat.
  - e. Topcoat: High-performance architectural latex (eggshell).

END OF SECTION

**SECTION 10160**  
**TOILET COMPARTMENTS**

1.1 GENERAL

A. Description of Work:

1. This specification covers the furnishing and installation of materials for toilet compartments. Product shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
  - a. Solid-polymer toilet compartments configured as toilet enclosures, entrance screens, and urinal screens.

C. Submittals

1. Product Data: For each type of product indicated.
2. Shop Drawings: For toilet compartments. Include plans, elevations, sections, details, and attachments to other work.
3. Samples for each exposed product and for each color and texture specified.
4. Maintenance data.

D. Quality Assurance

1. Comply with requirements in GSA's CID-A-A-60003, "Partitions, Toilets, Complete".
2. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84, or another standard acceptable to authorities having jurisdiction, by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - a. Flame-Spread Index: 2, or less.
  - b. Smoke-Developed Index: 450 or less.
3. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities" and ICC/ANSI A117.1 for toilet compartments designated as accessible.

1.2 PRODUCTS

A. Solid-Polymer Units

1. Toilet-Enclosure Style: Floor and ceiling anchored.
  2. Entrance-Screen Style: Floor and ceiling anchored.
  3. Urinal-Screen Style: Wall hung
  4. Door, Panel, Screen, and Pilaster Construction: Solid, high-density polyethylene (HDPE), panel material, not less than 1 inch thick, seamless, with eased edges, no-sightline system, and with homogenous color and pattern throughout thickness of material.
    - a. Integral Hinges: Configure doors and pilasters to receive integral hinges.
    - b. Heat-Sink Strip: Manufacturer's standard continuous, stainless steel, strip fastened to exposed bottom edges of solid-polymer components to prevent burning.
    - c. Color and Pattern: One color and pattern, as selected from manufacturer's full range.
  5. Pilaster Shoes and Sleeves (Caps): Manufacturer's standard stainless steel design.
    - a. Polymer Color and Pattern: Matching pilaster as selected from manufacturer's full range.
  6. Brackets (Fittings):
    - a. Stirrup Type: Ear or U-brackets, stainless steel.
    - b. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel.
  7. Overhead Cross Bracing for Ceiling-Hung Units: As recommended by manufacturer and fabricated from solid polymer.
- B. Accessories
1. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.
    - a. Material: Stainless steel.
    - b. Hinges: Manufacturer's standard paired, continuous, cam type that swings to a closed or partially open position.
    - c. Latch and Keeper: Manufacturer's standard recessed latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.
    - d. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories.
    - e. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors and entrance-screen doors.
    - f. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.

2. Overhead Bracing: Manufacturer's standard continuous, extruded aluminum head rail with anti-grip profile and in manufacturer's standard finish.
3. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match the items they are securing, with theft-resistant type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel.

C. Fabrication

1. Floor-and-Ceiling-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment at tops and bottoms of pilasters. Provide shoes and sleeves (caps) at pilasters to conceal anchorage.
2. Door Size and Swings: Unless otherwise indicated, provide 24-inch- (610-mm-) wide, in-swinging doors for standard toilet compartments and 36-inch- (914-mm-) wide, out-swinging doors with a minimum 32-inch- (813-mm-) wide, clear opening for compartments designated as accessible.

1.3 EXECUTION

A. Installation

1. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
  - a. Maximum Clearances:
    - 1) Pilasters and Panels: 1/2 inch (13 mm).
    - 2) Panels and Walls: 1 inch (25 mm).
  - b. Stirrup Brackets: Secure panels to walls and to pilasters with no fewer than two three brackets attached at midpoint and, near top and bottom of panel.
    - 1) Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
    - 2) Align brackets at pilasters with brackets at walls.
2. Floor-and-Ceiling-Anchored Units: Secure pilasters to supporting construction and level, plumb, and tighten. Hang doors and adjust so doors are level and aligned with panels when doors are in closed position.
3. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

B. Adjusting

1. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors and doors in entrance screens to return doors to fully closed position.

END OF SECTION 10160

**SECTION 10261**

**WALL AND CORNER GUARDS**

1.1 GENERAL

- A. DESCRIPTION OF WORK: This standard covers interior protection systems including: high impact vinyl corner guards and handrails. Wood blocking and grounds for surface mounting are included in Division 6 - Section Rough Carpentry.
- B. PERFORMANCE REQUIREMENTS: Provide wall protection system tested in accordance with ASTM E84, NFPA 255 and UL 723 for fire performance characteristics. Flame spread shall be 25 or less and Smoke Development 450 or less. Wall protection system shall be determined to be self extinguishing in accordance with ASTM D 635.
- C. QUALITY ASSURANCE: Furnish all wall protection system components from a single source manufacturer.
- D. SUBMITTALS:
  - 1. Product data: manufacturer's product specifications, installation and maintenance instructions.
  - 2. Shop Drawings: Shall indicate locations, mounting heights, back-up fastening, returns and end caps, color and extent and installation details of each system.
  - 3. Product samples: Samples for verification shall be not less than 12" length of each vinyl protection system component including corners and end caps in selected colors, textures and patterns.
  - 4. Maintenance Manuals: Manufacturer's instructions for maintenance of installed work.
- E. MATERIALS:
  - 1. Project conditions: Do not install wall protection systems until the installation area is enclosed and waterproofed and until the ambient temperature within the building is maintained at not less than 70 deg. F for not less than 72 hours prior to installation.
  - 2. Furnish to Fulton County at least 2% of each type of color and pattern of wall protection system components used on the project over and above the amount installed as "attic stock".
  - 3. Deliver "attic stock" to Fulton County at time of Substantial Completion and store as directed.

1.2 PRODUCTS

A. MANUFACTURER

1. ARDEN Architectural Specialties, Inc. 1947 West County Road C-2, St. Paul, Minnesota 55113, 800/521-1826 or 612/631-1607 (FAX).
2. Snap-On-Covers: Chemical and stain resistant, high impact vinyl compound with an anti-microbial additive and extruded in the longest lengths practicable for each system. Finish to be embossed pebble grain, matte surface. Color shall be determined from manufacturer's standard colors.
3. Corner Guard System shall be Surface Mounted vinyl snap-on cover and continuous aluminum retainer, Series CGS-@S, 90 degree square corner with 2" wings.

1.3 EXECUTION

A. EXECUTION

1. Install work in accordance with approved shop drawings and manufacturer's printed instruction.
2. Install work plumb and straight, securely attached and adjusted for proper operation as Applicable

END OF SECTION 10261

## SECTION 10431

### SIGNAGE

#### 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:
  - 1. Interior panel signs.
  - 2. Temporary exterior direction signs
  - 3. Exterior permanent signs
- B. Related Sections include the following:
  - 1. Division 1 Section "Temporary Facilities and Controls" for temporary Project identification signs and for temporary information and directional signs.
  - 2. Division 15 Sections for labels, tags, and nameplates for mechanical equipment.
  - 3. Division 16 Sections for electrical service and connections for illuminated signs.
  - 4. Division 16 Sections for labels, tags, and nameplates for electrical equipment.
  - 5. Division 16 Sections for illuminated Exit signs and LED signs.

##### 1.3 DEFINITIONS

- A. ADA-ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines."

##### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details for signs.
  - 1. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
  - 2. Provide message list, typestyles, graphic elements, including tactile characters and Braille, and layout for each sign.
- C. Sign Schedule: Use same designations indicated on Drawings.

- D. Qualification Data: For Installer and fabricator.
- E. Maintenance Data: For signs to include in maintenance manuals.
- F. Warranty: Special warranty specified in this Section.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products, An employer of workers trained and approved by manufacturer.
- B. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
- C. Source Limitations for Signs: Obtain each sign type indicated from one source from a single manufacturer.
- D. Regulatory Requirements: Comply with applicable provisions in ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

#### 1.6 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit installation of signs in exterior locations to be performed according to manufacturers' written instructions and warranty requirements.
- B. Field Measurements: Verify recess openings by field measurements before fabrication and indicate measurements on Shop Drawings.

#### 1.7 COORDINATION

- A. Coordinate placement of anchorage devices with templates for installing signs.

#### 1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Deterioration of metal and polymer finishes beyond normal weathering.
    - b. Deterioration of embedded graphic image colors and] sign lamination.

2. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Aluminum Castings: ASTM B 26/B 26M, of alloy and temper recommended by sign manufacturer for casting process used and for use and finish indicated.
- B. Aluminum Sheet and Plate: ASTM B 209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with at least the strength and durability properties of Alloy 5005-H32.
- C. Aluminum Extrusions: ASTM B 221, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with at least the strength and durability properties of Alloy 6063-T5.
- D. Steel Members Fabricated from Plate or Bar Stock: ASTM A 529/A 529M or ASTM A 572/A 572M, 42,000-psi minimum yield strength
  1. For steel exposed to view on completion, provide materials having flat, smooth surfaces without blemishes. Do not use materials whose surfaces exhibit pitting, seam marks, roller marks, rolled trade names, or roughness.
- E. Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), Type UVA (UV absorbing).
- F. Polycarbonate Sheet: Of thickness indicated, manufactured by extrusion process, coated on both surfaces with abrasion-resistant coating:
  1. Impact Resistance: 16 ft-lbf/in. per ASTM D 256, Method A.
  2. Tensile Strength: 9000 lbf/sq. in. per ASTM D 638.
  3. Flexural Modulus of Elasticity: 340,000 lbf/sq. in. per ASTM D 790.
  4. Heat Deflection: 265 deg F at 264 lbf/sq. in. per ASTM D 648.
  5. Abrasion Resistance: 1.5 percent maximum haze increase for 100 revolutions of a Taber abraser with a load of 500 g per ASTM D 1044.
- G. Applied Vinyl: Die-cut characters from vinyl film of nominal thickness of 3 mils with pressure-sensitive adhesive backing, suitable for exterior applications.

### 2.2 PLAQUES

- 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 product by one of the following:

1. Image Makers Marketing, Inc. (Elaine Gossett, 770-926-9552)
  2. ASI Sign Systems (Scott Wheeler, 770-448-2026)
  3. The Southwell Co. (Scott Southwell, 210-223-1831)
- C. Cast Plaques: Provide castings free of pits, scale, sand holes, and other defects, as follows:
1. Plaque Material: Aluminum.
  2. Background Texture: Manufacturer's standard leatherette texture.
  3. Border Style: Plain bevel, polished.
  4. Mounting: Concealed studs, noncorroding for substrates encountered.
- D. Plaque Schedule:
1. Plaque Type: Aluminum
    - a. Plaque Size: 22"x34"
    - b. Character Size: Provided by the Owner and Construction Manager.
    - c. Character Finish/Color: Provided by the Owner and Construction Manager.
    - d. Text/Message: Provided by the Owner and Construction Manager.
    - e. Location: Operations Building Lobby
    - f. Room: 1-01
    - g. Quantity: 1

### 2.3 INTERIOR PANEL SIGNS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. ACE Sign Systems, Inc.
  2. Advance Corporation; Braille-Tac Division.
  3. Allen Industries Architectural Signage
  4. Allenite Signs; Allen Marking Products, Inc.
  5. APCO Graphics, Inc.
  6. ASI-Modulex, Inc.
  7. Best Sign Systems Inc.
  8. Bunting Graphics, Inc.
  9. Fossil Industries, Inc.
  10. Gemini Incorporated.
  11. Grimco, Inc.
  12. Innerface Sign Systems, Inc.
  13. InPro Corporation
  14. Matthews International Corporation; Bronze Division.
  15. Mills Manufacturing Company.
  16. Mohawk Sign Systems.
  17. Nelson-Harkins Industries.
  18. Seton Identification Products.
  19. Signature Signs, Incorporated.
  20. Supersine Company (The)

- B. Interior Panel Signs: Provide smooth sign panel surfaces constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch measured diagonally from corner to corner, complying with the following requirements:
1. Acrylic Sheet: 0.080 inch thick.
  2. Laminated Sheet: High-pressure engraved stock with contrasting color face laminated to acrylic core as selected by Construction Manager from manufacturer's full range.
  3. Edge Condition: Square cut.
  4. Corner Condition: Rounded to radius indicated.
  5. Mounting: Unframed.
    - a. Wall mounted with concealed anchors.
    - b. Manufacturer's standard anchors for substrates encountered.
  6. Color: As selected by Construction Manager from manufacturer's full range.
  7. Tactile Characters: Characters and Grade 2 Braille raised 1/32 inch above surface with contrasting colors.
- C. Laminated Interior Signs: Solid polycarbonate panel core with graphic image covered with thermosetting resin face layer.
1. Surface Finish: Mat.
  2. Edge Condition: Square cut.
  3. Corner Condition: Rounded to radius indicated.
  4. Thickness: 1/4 inch.
- D. Tactile and Braille Sign: Manufacturer's standard process for producing text and symbols complying with ADA-ABA Accessibility Guidelines and with ICC/ANSI A117.1. Text shall be accompanied by Grade 2 Braille. Produce precisely formed characters with square-cut edges free from burrs and cut marks; Braille dots with domed or rounded shape.
1. Panel Material: Clear acrylic sheet with opaque color coating, subsurface applied.
  2. Raised-Copy Thickness: Not less than 1/32 inch.
- E. Engraved Copy: Machine engrave letters, numbers, symbols, and other graphic devices into panel sign on face indicated to produce precisely formed copy, incised to uniform depth.
1. Engraved Plastic Laminate: Engrave through exposed face ply of plastic-laminate sheet to expose contrasting core ply.
  2. Engraved Metal: Fill engraved copy with enamel.
  3. Face-Engraved Clear Acrylic Sheet: Fill engraved copy with enamel. Apply opaque background color coating to back face of acrylic sheet.
- F. Subsurface Copy: Apply minimum 4-mil- thick vinyl copy to back face of clear acrylic sheet forming panel face to produce precisely formed opaque image. Image shall be free of rough edges.

- G. Subsurface Engraved Acrylic Sheet: Reverse-engage back face of clear acrylic sheet. Fill resulting copy with enamel. Apply opaque background color coating over enamel-filled copy.
- H. Colored Coatings for Acrylic Sheet: For copy colors, provide colored coatings, including inks, dyes, and paints, that are recommended by acrylic manufacturers for optimum adherence to acrylic surface and are UV and water resistant for five years for application intended.
- I. Panel Sign Schedule:
  - 1. See drawings for panel sign types, sizes and locations.
  - 2. : Pole mounting, noncorroding fasteners for substrates encountered.

#### 2.4 ACCESSORIES

- A. Anchors and Inserts: Provide nonferrous-metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion-bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.

#### 2.5 FABRICATION

- A. General: Provide manufacturer's standard signs of configurations indicated.
  - 1. Welded Connections: Comply with AWS standards for recommended practices in shop welding. Provide welds behind finished surfaces without distortion or discoloration of exposed side. Clean exposed welded surfaces of welding flux and dress exposed and contact surfaces.
  - 2. Mill joints to tight, hairline fit. Form joints exposed to weather to exclude water penetration.
  - 3. Preassemble signs in the shop to greatest extent possible. Disassemble signs only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation, in location not exposed to view after final assembly.
  - 4. Conceal fasteners if possible; otherwise, locate fasteners where they will be inconspicuous.

#### 2.6 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other

components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 2.7 ALUMINUM FINISHES

- A. Baked-Enamel Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Apply baked enamel complying with paint manufacturer's written instructions for cleaning, conversion coating, and painting.
  - 1. Organic Coating: Thermosetting, modified-acrylic enamel primer/topcoat system complying with AAMA 2603 except with a minimum dry film thickness of 1.5 mils, medium gloss.

## 2.8 ACRYLIC SHEET FINISHES

- A. Colored Coatings for Acrylic Sheet: For copy and background and frame colors, provide colored coatings, including inks, dyes, and paints, that are recommended by acrylic manufacturers for optimum adherence to acrylic surface and that are UV and water resistant for five years for application intended.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Verify that items[, including anchor inserts, and electrical power are sized and located to accommodate signs.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Locate signs and accessories where indicated, using mounting methods of types described and complying with manufacturer's written instructions.
  - 1. Install signs level, plumb, and at heights indicated, with sign surfaces free of distortion and other defects in appearance.
  - 2. Interior Wall Signs: Install signs on walls adjacent to latch side of door where applicable. Where not indicated or possible, such as double doors, install signs on nearest adjacent walls. Locate to allow approach within 3 inches of sign without encountering protruding objects or standing within swing of door.

- B. Wall-Mounted Signs: Comply with sign manufacturer's written instructions except where more stringent requirements apply.
1. Two-Face Tape: Mount signs to smooth, nonporous surfaces. Do not use this method for vinyl-covered or rough surfaces.
  2. Hook-and-Loop Tapes: Mount signs to smooth, nonporous surfaces.
  3. Magnetic Tape: Mount signs to smooth, nonporous surfaces.
  4. Silicone-Adhesive Mounting: Attach signs to irregular, porous, or vinyl-covered surfaces.
  5. Shim Plate Mounting: Provide 1/8-inch- thick, concealed aluminum shim plates with predrilled and countersunk holes, at locations indicated, and where other mounting methods are not practicable. Attach plate with fasteners and anchors suitable for secure attachment to substrate. Attach panel signs to plate using method specified above.
  6. Mechanical Fasteners: Use nonremovable mechanical fasteners placed through predrilled holes. Attach signs with fasteners and anchors suitable for secure attachment to substrate as recommended in writing by sign manufacturer.
  7. Signs Mounted on Glass: Provide matching opaque plate on opposite side of glass to conceal mounting materials.
- C. Dimensional Characters: Mount characters using standard fastening methods to comply with manufacturer's written instructions for character form, type of mounting, wall construction, and condition of exposure indicated. Provide heavy paper template to establish character spacing and to locate holes for fasteners.
1. Flush Mounting: Mount characters with backs in contact with wall surface.
  2. Projected Mounting: Mount characters at projection distance from wall surface indicated.
- D. Cast-Metal Plaques: Mount plaques using standard fastening methods to comply with manufacturer's written instructions for type of wall surface indicated.
1. Concealed Mounting: Mount plaques by inserting threaded studs into tapped lugs on back of plaque. Set in predrilled holes filled with quick-setting cement.

### 3.3 CLEANING AND PROTECTION

- A. After installation, clean soiled sign surfaces according to manufacturer's written instructions. Protect signs from damage until acceptance by Owner.

END OF SECTION 10431

**SECTION 10523**  
**FIRE EXTINGUISHERS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

This section specifies recharging portable, hand-carried fire extinguishers.

A. OWNER-FURNISHED MATERIAL - HAND-CARRIED FIRE EXTINGUISHERS.

B. NFPA COMPLIANCE:

Label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

**1.2 SUBMITTALS**

A. GENERAL

Information shall be provided in accordance with the General Conditions.

**PART 2 - PRODUCTS**

**2.1 LABELS**

A.. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B and bar coding for documenting fire extinguisher location, inspections, maintenance, and recharging.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

A. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective and missing fire extinguishers.

B. Recharge all under-charged fire extinguishers.

**3.2 INSTALLATION**

A. GENERAL:

Install properly recharged fire extinguishers in locations indicated and in compliance with requirements of authorities having jurisdiction.

1. Bracket mounting height: 54”aff.

END OF SECTION

**SECTION 10801**

**TOILET AND BATH ACCESSORIES**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

**1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Public-use washroom accessories.

**1.3 SUBMITTALS**

- A. Product Data: For each type of product indicated. Include the following:
  - 1. Construction details and dimensions.
  - 2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
  - 3. Material and finish descriptions.
  - 4. Features that will be included for Project.
  - 5. Manufacturer's warranty.
- B. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

**1.4 QUALITY ASSURANCE**

- A. Source Limitations: For products listed together in the same articles in Part 2, provide products of same manufacturer unless otherwise approved by Architect.
- 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.

**1.5 COORDINATION**

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

## 1.6 WARRANTY

- A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.

- 1. Warranty Period: 15 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, 0.0312-inch minimum nominal thickness, unless otherwise indicated.
- B. Brass: ASTM B 19 flat products; ASTM B 16, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.
- C. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.0359-inch minimum nominal thickness.
- D. Galvanized Steel Sheet: ASTM A 653/A 653M, with G60 hot-dip zinc coating.
- E. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- F. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- G. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).
- H. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.
- I. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

### 2.2 PUBLIC-USE WASHROOM ACCESSORIES

- 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:

- C. Basis-of-Design Product: The design for accessories is based on products indicated. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:
1. A & J Washroom Accessories, Inc.
  2. American Specialties, Inc.
  3. Bobrick Washroom Equipment, Inc.
  4. Bradley Corporation.
- D. Sanitary Napkin Disposal (TA-5)
1. Basis-of-Design Product: Bobrick B-4354
  2. Description: Partition mounted, removable, leak-proof, 0.7 gal., plastic receptacle
  3. Material: Stainless steel, No. 8 finish
- D. Toilet Tissue (Roll) Dispenser (TA-2):
1. Basis-of-Design Product: Bobrick B-4288.
  2. Description: Double-roll dispenser.
  3. Mounting: Surface mounted.
  4. Operation: Noncontrol delivery with standard spindle. Capacity: Designed for 5 1/2-inch diameter tissue rolls.
  5. Material and Finish: Stainless steel, No. 8 finish (polished).
  6. Mounting Height: 28"
- E. Paper Towel (Folded) Dispenser (TA-9):
1. Basis-of-Design Product: Bobrick B-396034 .
  2. Mounting: Semi-recessed.
  3. Minimum Capacity: 800 ft. roll paper capacity.
  4. Material and Finish: Stainless steel, No. 4 finish (satin).
  5. Lockset: Tumbler type.
- F. Liquid-Soap Dispenser (TA-1):
1. Basis-of-Design Product: Bobrick B-132.
  2. Description: Designed for dispensing soap in liquid form.
  3. Mounting: Vertically oriented, surface mounted.
  4. Capacity: 32 oz.
  5. Materials: Stainless Steel
  6. Lockset: Tumbler type.
- G. Grab Bar (TA-3):
1. Basis-of-Design Product: Bobrick B6806.
  2. Mounting: Flanges with concealed fasteners.
  3. Material: Stainless steel, 0.05 inch thick.
    - a. Finish: Smooth, No. 4, satin finish on ends and slip-resistant texture in grip area.
  4. Outside Diameter: 1-1/2 inches.
  5. Configuration and Length: Straight, 36 inches long.

H. Grab Bar (TA-4):

1. Basis-of-Design Product: Bobrick B6806.
2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 0.05 inch thick.
  - a. Finish: Smooth, No. 4, satin finish on ends and slip-resistant texture in grip area.
4. Outside Diameter: 1-1/2 inches.
5. Configuration and Length: Straight, 42 inches long.

I. Mirror Unit (TA-6):

1. Basis-of-Design Product: Bobrick B166-1824
  - a. Corners: Manufacturer's standard
2. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.
  - a. One-piece, galvanized steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
3. Size: 18"x24".
4. Shelf: 5" deep

J. Coat Hook (TA-8):

1. Basis-of-Design Product: Bobrick B-2116.
2. Description: Projecting minimum of 3 7/16" inches from wall surface.
3. Material and Finish: Nickel-plated (satin) brass.

2.3 UNDERLAVATORY GUARDS

- 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:
- C. Basis-of-Design Product: The design for accessories is based on products indicated. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:
  1. Plumberex Specialty Products, Inc.
  2. TCI Products.
  3. Truebro, Inc.
- D. Underlavatory Guard :

1. Description: Insulating pipe covering for supply and drain piping assemblies, that prevent direct contact with and burns from piping, and allow service access without removing coverings.
2. Material and Finish: Antimicrobial, molded-plastic, white.

#### 2.4 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six (6) keys to Owner's representative.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to method in ASTM F 446.

#### 3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 10801

**SECTION 12520**

**SHADES**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

**1.2 SUMMARY**

- A. This Section includes Metal Slate shades to match existing.

**1.3 SUBMITTALS**

- A. Product Data: For each type of shade specified.
- B. Shop Drawings: Show location and extent of shades. Show installation details at and relationship to adjoining work. Include elevations indicating shade units. Indicate location of controls.
- C. Samples for Initial Selection: Manufacturer's color charts consisting of actual units or sections of units showing the full range of colors, textures, and patterns available for each type of shade material indicated.
- D. Samples for Verification: Full-size units of each type of shade material indicated; in sets for each color, texture, and pattern specified, showing the full range of variations expected in these characteristics.
  - 1. Shade Material: Manufacturer's standard-size unit, not less than 9 inches square.
- E. Schedule: Use same room designations indicated on Drawings in preparing schedule for shades.
- F. Maintenance Data: For shades and operating hardware to include in the maintenance manuals.

**1.4 QUALITY ASSURANCE**

- A. Installer Qualifications: Engage an experienced installer who has completed shade installations similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Source Limitations: Obtain shades through one source from a single manufacturer.

- C. Fire-Test-Response Characteristics: Provide shades that are identical to products that pass NFPA 701 Small Scale Test for flame-propagation resistance performed by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify shades with appropriate markings of applicable testing and inspecting agency.

#### 1.5 PROJECT CONDITIONS

- A. Field Measurements: Verify shade openings by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
  - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating shades without field measurements. Coordinate wall and ceiling construction to ensure actual opening dimensions correspond to established dimensions.

#### 1.6 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
  - 1. Shade Units: Full-size units equal to 5 percent of amount installed for each size indicated, but not less than 1 unit.

### PART 2 - PRODUCTS

#### 2.1 SHADES

- A. Products: Subject to compliance with requirements, provide one of the shades indicated below.
  - 1. Acceptable Manufacturers
    - a. Levolor – Cirrus Cellular
    - b. Graber – Crystal Pleat Cellular
    - c. Bali – Diamond Cell
    - d. Approved equal to

#### 2.2 ACCESSORIES

- A. Side and Sill Closure Channels: Between side of shade and opening jambs, and between hem bar and opening sill.
  - 1. Finish: Manufacturer's standard, to be chosen by Architect.
- B. Installation Fasteners: Fabricated from metal that is non-corrosive to shade hardware and adjoining construction and to support shades as required by manufacturer's written instructions.

### 2.3 FABRICATION

- A. Components: Noncorrosive, self-lubricating materials.
- B. Shade Units: Fill opening with not more than 1/4-inch clearance at jambs and 3/8-inch clearance at sill.
  - I. Fabricate end-to-end installations with terminations at mullions or other defined vertical separations.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of shades. Do not proceed with installation until unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install shades level and plumb, mounted not less than 1 inch from face of exterior glass.
- B. Install metal parts isolated from concrete or mortar to prevent corrosion.
- C. Install mounting brackets with not less than 2 fasteners per bracket.

### 3.3 CLEANING

- A. Clean shade surfaces after installation, according to manufacturer's written instructions.

### 3.4 SHADE SCHEDULE

Metal slat blinds throughout to replace existing shades that are damaged:

END OF SECTION 12520

**SECTION 15000**

**MECHANICAL GENERAL REQUIREMENTS**

PART 1 - GENERAL

1.1 CONTRACT CONDITIONS

- A. For conditions of the Contract, refer to the General Condition of the Contract for Construction, Standard Form of Agreement Between Owner and Contractor and Division 1 – General Requirements.
- B. For general requirements of the Contract, refer to Division 01 General Requirements. Refer to Division 16 Electrical and to Division 16, Section 16720 for Duct Smoke Detectors.
- C. The drawings and specifications are *performance based* and do not describe in detail, nor may not fully represent in detail all required work. The Contractor is fully responsible for the timely installation of all Mechanical and Plumbing systems and equipment in full compliance with the Local Authority having jurisdiction.
- D. Contractor Qualifications: only currently licensed Contractors who have been regularly engaged in the full time repair, reconstruction and installation of commercial and industrial HVAC and Plumbing systems of similar capacity and the installation of control systems of similar type, for a minimum period of five years shall be considered for this project.
- E. All work involving refrigerant and refrigerant piping shall be accomplished by EPA certified technicians, with current state refrigerant handling license.

1.2 WORK INCLUDED

- A. Description: The Work of this Section includes general provisions governing work under Division 15 Mechanical.
- B. Contractor's Responsibilities:
  - 1. Coordination. The Mechanical Subcontractor(s) are responsible for coordinating their work during bid phase, during shop drawing preparation and during construction. The Mechanical Subcontractor(s) shall closely coordinate the work with the Architectural, Electrical and Structural drawings, the local authorities having jurisdiction and with the work of other trades.
  - 2. Site visit and review of existing building mechanical & plumbing drawings ascertain existing conditions and extent of scope of work encompassed in these contract documents.
  - 3. The contractor shall arrange for, and pay for, all necessary fees, permits and inspections required to obtain a certificate of occupancy for the Mechanical and Plumbing portions of the work. This includes re-permitting of changes.
  - 4. Prepare shop drawings, fabrication drawings (as indicated), manufacturer's product and material data and samples for approval.

5. Receive and unload products and materials on site and inspect for completeness and correctness.
6. Handle, store and install products and materials.
7. Repair or replace items damaged after receipt and installation.
8. All rigging/hoisting.
9. The Contractor is responsible for clarifying his bid to ensure all items required for a complete and fully operational system are provided. The Contractor shall coordinate his work with the work of all trades to ensure all items requiring interconnection to the work of other trades are included.
10. Compliance with all State and Local Codes, latest editions.
11. Coordinate the Electrical work required for the Mechanical equipment and control systems with Division 16 – Electrical.
12. Confirm Seismic requirements with the Local Authority Having Jurisdiction and provide Seismic restraints per SMACNA Seismic Restraint Manual, Guidelines for Mechanical Systems, latest edition.
13. Coordinate the Electrical requirements for the Mechanical, Plumbing and Fire Protection systems and controls with Division 16 – Electrical to provide complete and fully operational Mechanical, Plumbing and Fire Protection systems, including alarms and control devices.
14. Preserve and protect all existing utilities to maintain uninterrupted services throughout the course of the construction. Provide temporary utilities as required to comply with this requirement.
15. Fan air quantities must add up. The Contractor must verify all floor plan and risers add up to scheduled fan quantities and that ductwork static pressure takes into account proposed ductwork routing and installed conditions – prior to bid.
16. The Contractor is responsible for installing the work as designed and permitted. Should changes be requested by the Architect, General Contractor or Owner, the Contractor shall submit a written request to have Engineering/Architectural design changes made. No work shall proceed until the Contractor has received Engineering/Architectural design and the changes have been resubmitted and approved by the Building Permitting Authority.
17. No Contractor, Architect, vendor or individual shall in any way make changes to the Engineer's drawings. Red marked As-Built shall be marked as such and the Contractor shall "X" out any PE stamp on As-Built markups. Should the Contractor need a background to sketch, contact the Architect.
18. Model numbers: are given as a convenience and applicable materials, performance, and ability for a complete and operational system/equipment govern. This includes coordination with other trades, fire integrity, code compliance and design intent.

1.3 RELATED WORK NOT IN DIVISION 15

- A. Cutting and repairing of walls, floors, ceilings, roofs, and structure, except as specified herein.
- B. Painting, except as specified herein.
- C. Providing electrical wiring for power, interlock, and certain parts of control systems as described herein.
- D. Providing flashing for roof-mounted equipment, and items penetrating the roof, except as specified herein.

1.4 CODES AND STANDARDS

- A. Codes cited herein represent minimum requirements. Express requirements of the contract documents are in excess of the minimum requirements. Conform to the Contract General, Special and Supplemental Conditions.
- B. The Mechanical, Plumbing and Fire Protection materials, equipment and systems installation shall conform to the Latest Editions, of all applicable State and Local Codes. Utilize the latest edition of any referenced code which is in effect, during date the original drawings were issued, and utilize all codes and standards as prescribed by the Local Authority having jurisdiction, including any referenced amendments. Contact the local Building Inspector to verify applicable codes or with code questions. In addition, unless otherwise referenced in the applicable code, conform to the requirements of:
1. ASHRAE Standard 90.1-2004 with latest Addenda(s).
  2. ASHRAE Standard 62.1-2004, with latest Addenda.
  3. Local, State and County Mechanical and Energy Codes, latest editions.
  4. State and Local Seismic Requirements: The Contractor shall verify seismic requirements for Mechanical systems with the Local Code Authority having jurisdiction. Provide necessary, piping and equipment supports, ductwork supports, hangers, sway braces and seismic restraints to ensure the mechanical systems installation are in strict compliance with the Local Code Authority having jurisdiction.
- C. The Mechanical materials, equipment and systems installation shall conform to the following minimum standards, latest editions:
1. NFPA 30 - Flammable and Combustible Liquids Code.
  2. NFPA 54 – National Fuel Gas Code.
  3. NFPA 70 – National Electric Code.
  4. NFPA 90A – Installation of Air Conditioning and Ventilating Systems.
  5. NFPA 90B – Warm Air Heating and Air Conditioning Systems.
  6. NFPA 96 – Ventilation Control and Fire Protection of Commercial Cooking Operations.
  7. NFPA 101 – Code for Safety to Life from Fire in Buildings and Structures.
  8. SMACNA Standards.
  9. ASHRAE Standards.
  10. The 2006 Georgia Minimum Codes including Amendments and Georgia Energy Code.
- D. Abbreviations for code-and standard making bodies used in Division 15:
- |        |   |
|--------|---|
| AGA    | American Gas Association  |
| AMCA   | Air Movement and Control Association, Inc.                                      |
| ASHRAE | American Society of Heating Refrigerating, and Air-Conditioning Engineers, Inc. |
| ASME   | American Society of Mechanical Engineers  |
| ASTM   | American Society for Testing and Materials                                      |
| IMC    | International Mechanical Codes  |
| IPC    | International Plumbing Codes  |
| IFGC   | International Fuel Gas Code   |
| NFPA   | National Fire Protection Association  |
| UL     | Underwriters Laboratories Inc.  |
| FM     | Factory Mutual  |
| OSHA   | Occupational Safety and Health Administration                                   |

1.5 LAYOUT BASIS

- A. The system layouts are based upon the use of particular items of equipment, with such items identified in the documents as "layout basis" by manufacturers make and model number. Physical characteristics of these equipment items, such as dimensions, arrangement, service connections, and structural supports required to install these particular items, have been considered in making the layout.
- B. The equipment of any listed "acceptable manufacturer" for that item of equipment may be submitted for substitution provided that all provisions of "Space Conditions" will be complied with, that all required service connections will be made, and all building and systems design modifications will be made at no additional cost to the Owner.
- C. The fact that a firm is named as an acceptable manufacturer is not to be implied as meaning that the stock product of that manufacturer will be an acceptable substitute. Any substitutions of products by named acceptable manufacturers must meet the express requirements of the documents.
- D. Should substitution of any equipment item for a named Layout Basis item require any redesign by Design Professionals, such as for structure, ductwork, piping, equipment or electrical service, Contractor will be held responsible for all extra charges incurred to accommodate that substitution, including general construction costs and added costs for design changes by Architect and by structural, mechanical, and electrical engineers.
- E. Should investigation of submittals disclose that the above mentioned requirements cannot be met on the basis of the proposed substitute equipment the Architect may require that the equipment be furnished as specified for "Layout Basis".

1.6 SUBMITTALS

- A. Refer to Section 01300 Submittals for additional requirements governing submittals under Division 15 - Mechanical.
- B. The Mechanical Subcontractor shall prepare, approve and submit for review by the Owner's Representative detailed shop drawings and manufacturer's product data for all materials and equipment to be incorporated into the Mechanical work. No material or equipment shall be delivered to the job site or installed before the Contractor has in his possession the approved shop drawings and manufacturer's product data for that particular material or equipment. Assemble into a single submittal, indicating coordination with all trades and ***bearing the stamp of approval of the Submitting Subcontractor and General Contractor***. Clearly mark that all Electrical characteristics have been coordinated and approved by the Electrical Contractor. Shop drawings not marked as reviewed and approved by the Submitting Subcontractor and the General Contractor, and that the Electrical Characteristics have not been coordinated with the Electrical Contractor – will be returned without review.
- C. All shop drawings and manufacturer's product data submittals shall include the specific service, equipment tag (i.e. VAV-1, EF-1, etc.) for which the material or equipment is to be used, and marked to show Specification section governing. Failure to mark submittals in accordance with the above format shall be considered due cause for rejection of shop drawings.

- D. Provide principal dimensions and details of construction.
- E. Indicate operating weights with necessary information to provide supports, hangers and foundations.
- F. Review rendered on shop drawings shall not be considered as a guarantee of measurements, job conditions nor performance. Said review does not mean that the shop drawings and data submitted have been checked in detail nor coordinated with the work of other trades. Review of shop drawings does not relieve the Contractor from his responsibility of performing the work and shall not relieve the Contractor from providing complete and fully operational Mechanical systems as required by the Contract Documents.
- G. Fabrication Drawings: Provide scaled and detailed Fabrication Drawings where any equipment or material appears not to fit within the area as indicated on the drawings. Fabrication drawings are herein defined as scaled and dimensioned drawings produced by the Contractor indicating the exact location, size and routing of ductwork, piping and equipment in conflict. Fabrication drawings shall be coordinated with the work of all trades. Fabrication drawings shall not deviate from the design intent as delineated on the drawings. Fabrication drawings shall be of sufficient detail to indicate the exact placement of materials and equipment and shall show materials and equipment of other trades for coordination purposes. Exact equipment dimensions of the equipment indicated on the approved shop drawings shall be used. Fabrication drawings shall specifically point out any equipment or materials which will not fit within available space. Installation, fabrication or equipment purchase shall not proceed until these Fabrication drawings are approved in writing.

#### 1.7 SPACE CONDITIONS

- A. The ceiling cavity of this project is extremely tight and occupied with existing equipment, ductwork, piping and conduits to remain. Field verify all clearances prior to submission of bid, fabrication of materials or purchase of equipment. Identify any areas which the drawings indicate materials to be installed where the existing and new conditions will not facilitate the installation as depicted on the Drawings. Obtain written instruction from the Architect prior to proceeding with any work. Observe general locations of fixtures, apparatus, ductwork (existing & new), and piping (existing & new) indicated on the drawings.
- B. Prior to submission of bid for projects consisting of existing conditions, visit the job site, observe and review existing conditions and become acquainted with all factors affecting the work, including required scheduling and delivery of materials, temporary utilities and services. Observe general locations of fixtures, apparatus, ductwork, and piping indicated on the drawings.
- C. Base all measurements, both horizontal and vertical, on actual field measurements. Verify all conditions at the site and check correctness of same.
- D. Any discrepancy between actual conditions and those indicated on the drawings or in the specifications, which prevents following the intent of the drawings and specifications, shall be immediately brought to the attention of the General Contractor and that phase of the work shall not proceed until written instructions are received.

- E. Make measurements on the site for locating fixtures, apparatus, ductwork, and piping. Do not rely on dimensions obtained by scaling the drawings.
- F. Install all equipment in strict accordance with the equipment manufacturer's published installation instructions, paying special attention for requirements for service access.

1.8 ELECTRIC CHARACTERISTICS

- A. Provide electrically operated equipment built for operation with electric current characteristics of the building service.
- B. All Electrical work furnished under Division 15 – Mechanical shall be performed by licensed electricians and shall conform to the requirements of Division 16 – Electrical.
- C. The Mechanical Contractor is responsible for coordinating all electrical characteristics for equipment with the Electrical Contractor prior to shop drawing preparation.
- D. Provide high efficiency type motors where horsepower is 1 hp or greater. All electric motors shall conform with latest NEMA, NEC and UL standards and shall operate within nominal nameplate amperage, not within the service factor.
- E. The Contractor shall coordinate HVAC controls, wiring, materials and equipment with the General and Electrical Contractor prior to submission of his bid to ensure the electrical components of the Mechanical equipment are coordinated with the Electrical requirements. All power to controllers, power to control transformers, control conduit and control wiring shall be included in the bid. The Mechanical Subcontractor must submit a statement in his bid clarifying responsibility of wiring with Division 16 – Electrical demonstrating there is no overlap nor gaps in the power and wiring requirements for all Mechanical systems.
- F. The Mechanical Contractor is responsible for ensuring the Mechanical Equipment submitted will conform to the Electrical Requirements stated on the Electrical Drawings, for voltage, phase, minimum circuit Ampacity and maximum Overcurrent protection size. Should the proposed Mechanical equipment require other than the electrical circuit and electrical equipment indicated on the Electrical Drawings, the Mechanical Contractor shall immediately submit a Request for Information prior to bid or in his submittal, state that the Mechanical Contractor is solely responsible for any necessary design or construction costs related to needed changes in the electrical system(s) to accommodate the change.
- G. KW (1,000 watts) indicated on the Mechanical Schedule is the actual output KW at the rated voltage, not the unit nominal KW.
- H. Motor starters are to be provided integral with Mechanical Equipment if the manufacturer can provide the motor starter. If not, the Electrical Contractor shall provide the motor starter for the equipment, in strict accordance with the motor manufacturer's recommendations and the NEC. Mechanical Contractor to provide Building Automation System or other necessary control relay or transformers, to interface starters into the control system.

1.9 DEFINITIONS

- A. To establish common meaning of terms in the mechanical work, the following definitions apply:
1. Furnish – “provide and install”, unless otherwise specifically indicated.
  2. Install – unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimensions, finishing, curing, protecting, cleaning and similar operations to facilitate complete and operable installation, including start up, testing and adjusting. Install means complete, plum, level, in a professional and craftsman like manner. Fittings must align pipe and duct systems, with even slope or level installation as applicable. Neat installation is required. The finished work product shall be free of deficiencies, without repairs, without patches. Remove items requiring repair, and completely reinstall.
  3. Complete - with all accessory items required for safe operation within the design intent.
  4. Temperature - reference to degrees or ° means degrees Fahrenheit (F).
  5. Pressure - reference to psi means pounds per square inch gage pressure; reference to " or inches means inches of water column (wc).
  6. Indicated – where the word “indicated” is used, it is to be understood that the reference is made to the drawings and specifications accompanying this Contract unless stated otherwise.
  7. Contractor – responsible party for the portions of the work herein specified in the Mechanical Divisions of the specifications and indicated on the “M”, “P” or “FP” drawings.
  8. Discrepancies – where work indicated on the Contract Drawings differs from the specifications or other drawings or drawing schedules or drawing details. The “work” described is fully included in the “Contract” and the Contractor is responsible for requesting clarification prior to bid, procurement and installation. No Change Order will be allowed for discrepancies which the Contractor has not requested clarification.

1.10 CONTRACTOR USE OF SITE AND PREMISES

- A. The Contractor’s personnel shall become familiar with and obey all General Contractor rules, procedures, safety rules, fire safety regulations and security regulations.
- B. The Contractor’s personnel shall keep within the limits of the work area (and within avenues of designated entrances and exits). The Contractor shall not enter any restricted areas unless specifically cleared for such entry by the General Contractor.
- C. All building emergency exits and pathways shall be maintained clear and unobstructed at all times.
- D. Coordinate the temporary use of restrooms, wash rooms and smoking facilities with the General Contractor.
- E. Protect all lawns, planting, trees, landscaping, walkways and drives from damage during construction. Any damage occurred is the responsibility of the Contractor. Repair to damaged items shall be repaired at the direction of the General Contractor and at the expense of the responsible party.
- F. The Contractor shall not interrupt or interfere with the main building utilities nor operations.
- G. The Contractor shall coordinate use of electricity and water with the General Contractor.

1.11 WORK SCHEDULE

- A. Prior to beginning the work, the Contractor shall prepare and submit for the General Contractor's approval, a detailed work schedule and sequence of performance of all work, including a description of all construction activities, phases, proposed dates of utility tie-ins, anticipated duration of any utility outages and any specific tasks requiring overtime or weekend work.
- B. The Contractor shall submit in writing to the General Contractor, request for utility tie-in, or utility outages 72 hours prior to anticipated work. The Contractor shall not proceed with any utility tie-in or utility outage until the written request is approved.

1.12 CLEAN UP

- A. The Contractor shall clean up his work area and remove all debris from site daily.

1.13 CONTRACTOR SITE STORAGE

- A. The Contractor shall coordinate all storage requirements with the General Contractor. The Contractor is responsible for receiving all delivered materials and immediately inventorying the delivery for accuracy. The Contractor shall immediately place all materials and equipment in the General Contractor's designated storage space, and provide weather protection, protection from physical damage and security.

1.14 DRAWINGS

- A. The Drawings are diagrammatic and indicate the general arrangement of the systems. Drawings shall not be scaled. Field verify all existing conditions prior to ordering materials, fabrication of materials and prior to proceeding with the work.
- B. Coordinate all mechanical work with the work of all trades to verify space availability where the equipment and materials are to be installed. Maintain maximum service clearances, space conditions, and adequate equipment access at all points. Where space conditions or equipment access appear inadequate, notify the General Contractor immediately and await direction prior to purchasing materials or equipment. Coordinate the layout of the Mechanical systems with the work of all trades.
- C. Drawing details are provided for the Contractor's convenience, further information and coordination. Lack of a detail for a scheduled or specified item is not considered as relief for the Contractor not to perform the work under the base contract. The Contractor shall submit a Request For Information (RFI) should he require additional information for an installation detail.
- D. All air flows (CFM's) must add up. The Contractor shall verify all air flow and select air terminals, fans and adjust air handling equipment to facilitate outlet totals, terminal totals or most stringent requirements, including adjustments in static pressure for proposed devices and proposed routing of ductwork.

1.15 PROTECTION

- A. Protect work, materials and equipment against theft, injury and damage until finally inspected, tested and accepted. Carefully store all materials and equipment received on site which is not immediately installed. Close all open ends of work, including ductwork and piping, with temporary covers or plugs during storage and construction to prevent the entry of obstructing materials, dirt and debris. Do not leave trenches or open excavations exceeding 2 feet in depth overnight. Backfill trenches as the work progresses. Provide visual protective barriers for pedestrians. Provide trench boxes and or shoring for all occupied excavations in excess of 4 feet depth.
- B. Protect all areas during welding operations, including provisions for a fire watch and vision screen for personnel. Notify the General Contractor 24 hours prior to welding operations. Provide fire watch personnel and fire extinguishers during all welding or cutting operations. Welding in occupied buildings is prohibited without written prior approval from the Owner, Architect and Local Code Official.

1.16 SUPERINTENDENCE, QUALITY CONTROL AND INSPECTIONS

- A. The Contractor is responsible for Superintendence and quality control for the installation of the Mechanical systems. The Contractor shall at all times provide experienced supervisory personnel on the job site to ensure the Mechanical systems installation is in strict compliance with the drawings, specifications and local codes. The Contractor is responsible for inspecting the work, performing and documenting the required tests and field coordination with the work of other trades and providing a complete and operational system.
- B. Prior to final acceptance, all equipment, piping and ductwork shall be operated and tested to ensure fully operational systems as specified and to the satisfaction of the Owner's representative. Written test reports shall be submitted to the Owner's representative for the following:
  - 1. Certification of startup and complete operational and safety testing of all Mechanical systems,
  - 2. Air Conditioning Testing, Adjusting and Balancing report, including seasonal performance testing.
  - 3. Certification of systems operation noise and vibration free.
  - 4. Fire damper and smoke detector testing.
  - 5. Certification of all control interlocks, emergency stop switches, valves, firestats and smoke detectors.
  - 6. Backflow preventer certifications.
- C. Ductwork systems shall circulate freely without noise, evidence of leaks or vibration.
- D. Ductwork insulation for existing and new shall be inspected for leaks, damage to vapor barrier and weather tight installation. Any subsequent leaks found shall be repaired.
- E. Defects and unacceptable performance demonstrated by the inspections and tests shall be corrected to the satisfaction of the Owner's representative at no additional cost to the Owner.

1.17 SCAFFOLDING, RIGGING AND HOISTING

- A. The Contractor shall furnish all cranes, hoisting, rigging and scaffolding as necessary to facilitate the installation of the Mechanical systems. Remove same from premise immediately after use.

1.18 PAINTING

- A. All painting shall be provided by the Contractor to match specified standards or existing adjacent surfaces. Touch up any marred surfaces or new equipment. Paint all miscellaneous steel ductwork supports which are not galvanized steel. Sand and wire brush clean all surfaces prior to painting. Provide two coats of applicable, weather resistant paint. Coordinate colors and paint specifications with the Architectural conditions of the specifications. Paint exterior steel gas piping with two coats of rust proof, black paint or as called for by owner.

1.19 CUTTING AND PATCHING

- A. Provide all cutting and patching necessary for the installation of the work as specified herein. No existing structural members shall be cut without the approval of the Architect and the General Contractor and all such cutting shall be as directed by the Architect and General Contractor.

1.20 ROOFING

- A. Any roofing work shall be accomplished by the General Contractor. This includes setting of plumbing vents, roof curbs for Mechanical equipment and stacks and roof supports for Mechanical equipment.
- B. All roof penetrations, for items such as conduit, pipe, refrigerant line sets, ductwork, etc., shall be incorporated within a factory prefabricated roof penetration assembly, such as a pipe curb, duct curb or as applicable. This prefabricated roof curb assembly shall be selected for each instance and each roof situation to ensure for weatherproof installation, plumb and level mechanical services and a warrantable roof. All roof curbs, roof pipe penetration assemblies and the like shall be purchased by the Mechanical Contractor and installed by the Roofing Contractor.

1.21 CLEANING, PURGING AND TESTING

- A. All ductwork, piping and miscellaneous steel shall be cleaned of grease, oil, paint spots, metal cuttings, dust, rust, scale, mortar and other construction debris. Clean all Mechanical equipment and leave free of tool marks, dents, mars, scratches, cracks, chips and other defects. Paint to match adjacent surfaces.
- B. Test all ductwork leak tight against the operational static pressure. Repair any noticeable leaks found. Leak tests shall be performed by the Contractor and witnessed by the Owner's representative.

- C. Test, Adjust and Balance HVAC systems in accordance with Section 15990.
- D. Plumbing system pressure leak testing as specified.
- E. Potable water disinfection per Federal Specification BB-C-120.

1.22 WELDERS CERTIFICATION

- A. All welding shall be performed by certified welders, in accordance with the American Welding Society (AWS) A5.1 and Local Authority having jurisdiction. Submit certifications of welder competency for each welder indication certification within one year of job start date. Documentation of the welding procedures and welder qualifications shall be presented in the form of a Welding Procedure Specification (PQS) and a Procedure for Qualification Record (PQR) for the procedure qualification. The Contractor shall submit certification of all welder qualifications for approval. This applies for all shop and field welds.

1.23 ASBESTOS

- A. Demolition and removal of existing materials pertaining to the Mechanical provisions of this Contract does NOT include the identification, removal or abatement of asbestos materials. Should the Contractor suspect or encounter any asbestos material, he is to immediately stop work in the vicinity of the suspect material, and inform the General Contractor. Await direction prior to proceeding.

1.24 WARRANTY

- A. Provide a written one year warranty for all labor, parts, materials and equipment from the date of beneficial occupancy as determined by the Architect.
- B. In addition, provide a five year Parts Only warranty for all refrigeration compressors with capacity greater than 2 tons.

1.25 AS BUILT DRAWINGS

- A. The Contractor shall maintain accurate measurements and record them on As Built drawings. Prior to final acceptance, the Contractor shall submit one set of As Built drawings to the Architect for approval. As Built drawings shall be full size, red marked to indicate conditions as installed. The Contractor is responsible for incorporating any comments/addenda/changes into the final As Built markups. The Contractor shall "X" out any PE stamp on his field marked up As-Built drawings.

1.26 FIRE SAFETY CONTROLS

- A. Install and test new ductwork mounted ionization type smoke detectors to ensure unit shut down and interconnection with fire alarm system in accordance with NFPA 90A and the latest edition of the State of Georgia Minimum Code and Amendments

- B. All smoke detectors are to be provided by the Electrical Contractor where a fire alarm system is present and provided and installed by the Mechanical Contractor and wired to fire alarm system by Fire Alarm subcontractor. Install in location(s) as dictated by Local Authority Having Jurisdiction, by the Mechanical Contractor.

1.27 FIRESTOPPING

- A. Acceptable Manufacturers: Dow Corning, 3M, Metacaulk, ProSet Systems.
- B. Description: Firestopping materials UL Listed silicone products for application in accordance with standard details published by manufacturer and listed in UL Fire Resistance Directory.
- C. Survey the Architectural Drawings and confirm with the Local Authority Having Jurisdiction the requirements for vertical and horizontal fire protection for all piping penetrations. This includes domestic hot/cold/recirculating piping, sanitary piping, condensate drain piping and all other piping systems provided herein under this contract. Provide fire stopping, fire resistive sleeves and/or manufactured fire penetration fittings to maintain the required fire separation integrity of the vertical or horizontal fire separation. The Contractor shall include in his bid the necessary fire stopping, sleeves, fittings and devices to ensure complete compliance for all penetrations as required by the Local Authority Having Jurisdiction. Fire stopping products shall be UL listed and Labeled and shall be as manufactured by ProSet Systems or approved equal.
- D. Provide UL Listed and Labeled fire dampers in strict accordance with the local code authority having jurisdiction. The Contractor is solely responsible for reviewing the plans and ascertaining the location and fire rating of all partitions, floors and assemblies and shall provide fire dampers and ductwork installation so as not to defeat the fire integrity of any partition, floor or assembly which the ductwork penetrates. Fire rated partitions, floors or assemblies known to the Engineer at the time of design are indicated on the drawings; however, the Contractor shall verify the location and fire rating of all partitions, floors and assemblies prior to submitting his bid - and shall incorporate all work required to completely comply with the requirements of the Local Code Authority having jurisdiction.

1.28 PIPING IN ELECTRICAL, ELECTRONIC & EQUIPMENT ROOMS AND ELEVATOR EQUIPMENT ROOMS:

- A. No water piping is allowed in Electrical Closets, Electrical Equipment Room, Telephone Room, Local Area Network (LAN) Rooms, or Elevator Equipment Rooms; or rooms specifically intended for use for centralized electrical or electronic equipment – unless the Contract Drawings specifically indicate piping in these areas. Fire sprinkler head, if required to be wet pipe sprinkler system, is an exception. This includes roof drain piping, roof drain horizontal and vertical leaders, sanitary waste lines, sanitary vent lines, condensate drain lines, steam and steam condensate piping, hot water heating and chilled water cooling piping, water service entry piping, fire service entry piping, domestic hot water, domestic cold water and domestic recirculation water.
- B. Any piping in Electrical or Electronic rooms must be approved in writing prior to installation.

1.29 CHANGES

- A. Changes involving time and money, must conform to the General and Supplementary conditions of the Contract. No changes shall be initiated from verbal communication. No changes shall commence without written directive from the Architect and the General Contractor.

1.30 THERMOSTATS

- A. Refer to Section 15900 Automatic Controls.

1.31 COMBUSTION AIR

- A. Provide high and low combustion air intakes in strict accordance with the Standard Mechanical Code, for all rooms which have fuel fired appliances, even if such are not specifically indicated on the drawings. Direct vented equipment do not require high and low combustion air intakes.

1.32 CONTRACT CONDITIONS

- A. For conditions of the Contract, refer to the General Condition of the Contract for Construction, Standard Form of Agreement Between Owner and Contractor and Division 1 – General Requirements.

PART 2 - PRODUCTS

2.1 ACCESS DOORS – BUILDING

- A. Coordinate number, size, style, and location of access doors with general construction work.
- B. Size doors to provide adequate clearance for access
- C. Normal door size is 24" x 24"; minimum door size is 12" x 12".(Applicable)
- D. Access doors or panels in fire rated construction shall bear the manufacturer's UL listing and number for fire rating of the construction. Verify that the fire rating of the access door or panel is commensurate with the adjacent surfaces.
- E. Provide access doors for shock absorbers, trap primers, valves or other items requiring servicing or replacing.

2.2 CORROSION RESISTANT COMPOUND

- A. Acceptable: Koppers Bitumastic Super Service Black, Transtex V-20, Royston Laboratories A-51, Tapecoat TC-20 hot applied coal tar epoxy coating.

2.3 ESCUTCHEON PLATES

- A. Chromium-plated plates formed from not less than 20 gauge steel, split pattern, set screws on ceiling plates, spring clips on others. Sized to fit over insulation and to cover sleeves, wall and floor openings completely. Provide for all supplies and drains, including beneath cabinets.

2.4 MATCHING PRODUCTS

- A. Provide matching products where more than one item exists, even though other manufacturers are listed in the specifications. For instance, all plumbing fixtures are to be of the same manufacturer, all ceiling diffusers are to be of the same manufacturer, all HVAC equipment of like types shall be of the same manufacturer, etc.
- B. When in doubt of manufacturer acceptance, clarify prior to bid.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install all equipment and materials in strict accordance with the manufacturers' published (applicable) installation instructions. Provide one copy of the manufacturers' installation, and maintenance instructions, marked with the appropriate model numbers and accessories, with the Operation and Maintenance Manuals at project close out.
- B. Provide wiring schematics and control wiring diagrams with the Operation and Maintenance manuals, including HVAC controls, Plumbing and Fire Protection system controls and alarms.
- C. Provide certificate of warranties.
- D. Provide daily job site clean up to ensure a safe workplace.
- E. Conform to the applicable standards and procedures outlined in 41 CFR Part 50-204 which requires Contractors to comply with the regulations and standards for construction outlined in the U.S. Department of Labor 29 CFR OSHA General Industry Standards and Regulations. All employees of the Contractor shall have one safety training session, specifically designed for the anticipated hazards of this project. Include weekly jobsite safety meets thereafter and document attendance. Conform to the General Contractor's published safety procedures and rules. Conform to OSHA 29 CFR 1910.147 Lockout/Tagout procedures. Provide MSDS sheets for any hazardous materials in accordance with OSHA 29 CFR 1910.1200.

3.2 COORDINATION OF INSTALLATION

- A. Coordinate work under this Division with work under other Divisions.
- B. Coordinate and schedule installation of ductwork, equipment, and piping as required to fit the work into the spaces provided in the building.

- C. Arrange work to provide maximum headroom and clearance consistent with requirements of the documents, and in order to maintain adequate personnel passage, access and maintenance clearances.
- D. Arrange parts of work requiring normal service to be readily accessible.
- E. Except where otherwise indicated, arrange piping to run symmetrical, either parallel or normal to building lines, and true to grade.
- F. Provide supports and anchors for work to avoid damage from movement caused by dynamic forces or by expansion and contraction.
- G. Arrange work to allow space for installation of insulation on equipment, piping, and ductwork.
- H. Where cutting and repairing is required due to defective or ill-timed work under this Division, pay all costs for cutting and repairing.
- I. Where work is installed above inaccessible ceilings or locations make provisions for items such as dampers, valves, control etc. to be made accessible by the installation of access panels or provide dampers, valves, controllers, etc. at another approved location which will facilitate the operational and service needs. One such example is provide duct equalizing grid and opposed blade damper at neck of ceiling diffuser where branch duct manual damper would be inaccessible.
- J. Where the Mechanical Work is installed and other trades place materials and equipment that interfere with service access or encroach on the service clearances, the Mechanical Contractor is responsible for reporting each instance in writing to the General Contractor requesting corrections be made. Ductwork will have priority over piping.

### 3.3 PROTECTION OF WORK DURING CONSTRUCTION

- A. Provide protective covers, skids, plugs, caps, and coating to protect equipment, materials from damage and deterioration during construction.
- B. Store equipment and material under cover and off the ground.
- C. When outdoor storage is necessary, provide protective covers of sheet plastic of gauge suitable for the area involved and reinforced to withstand wind and precipitation. Set equipment and material on skids or platforms of height sufficient to avoid deterioration from splattering and ground water.
- D. Protect finned surface coils against damage by installing temporary closure panels over coil surfaces and inlet openings.

### 3.4 CLOSURE AND WEATHERPROOFING

- A. Seal wall sleeves and floor penetrations with UL approved fire proof safig. Seal watertight and overlay with colored caulking to match adjacent surfaces where visible. Manufacturers:

Metacaulk, 3M, GS Nelson. Fully comply with the manufacturers' installation instructions to achieve UL listed conditions.

- B. Provide weather proof flashings and sealants for all roof and exterior wall penetrations.
- C. Provide fire stopping, fire resistive sleeves and/or manufactured fire penetration fittings to maintain the required fire separation integrity of the vertical or horizontal fire separation. The Contractor shall include in his bid the necessary fire stopping, sleeves, fittings and devices to ensure complete compliance for all penetrations as required by the Local Authority Having Jurisdiction. Fire stopping products shall be UL listed and Labeled and shall be as manufactured by ProSet Systems or approved equal.
- D. Freeze protection: the Contractor shall provide heat tracing on indoor piping subject to freezing. Provide written instructions to the Owner for draining water systems and freeze protecting the building water systems for areas subject to freezing when building utilities (electric power or natural gas) are interrupted. Provide specific instructions to protect the building water systems from freezing during ice storm and extreme cold weather conditions.

3.5 INSTALLATION - ACCESS OPENINGS IN ARCHITECTURAL SURFACES

- A. Where work of this Division is located concealed in building construction and otherwise inaccessible, furnish access doors of adequate size and coordinate with general construction work to establish locations for access doors to be installed to provide access to the concealed work.

END OF SECTION 15000

**SECTION 15060**  
**HANGERS AND SUPPORTS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes hangers and supports for mechanical system piping and equipment.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

- A. Design channel support systems for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design heavy-duty steel trapezes for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
- C. Design and obtain approval from authorities having jurisdiction for seismic restraint hangers and supports for piping and equipment.

1.5 SUBMITTALS

- A. Product Data: For each type of pipe hanger, channel support system component, and thermal-hanger shield insert indicated.
- B. Welding Certificates: Copies of certificates for welding procedures and operators.

1.6 QUALITY ASSURANCE

- A. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Pipe Hangers:
    - a. B-Line Systems, Inc.
    - b. Carpenter & Patterson, Inc.
    - c. Grinnell Corp.
    - d. Michigan Hanger Co., Inc.
  2. Channel Support Systems:
    - a. B-Line Systems, Inc.
    - b. Grinnell Corp.; Power-Strut Unit.
    - c. Michigan Hanger Co., Inc.; O-Strut Div.
    - d. Unistrut Corp.
  3. Roof Pipe Support Systems:
    - a. Firestone Building Products
    - b. PHP Pipe Hanger Supports
    - c. Miro Industries
  4. Thermal-Hanger Shield Inserts:
    - a. Carpenter & Patterson, Inc.
    - b. Michigan Hanger Co., Inc.
    - c. PHS Industries, Inc.
    - d. Pipe Shields, Inc.
  5. Powder-Actuated Fastener Systems:
    - a. Gunnebo Fastening Corp.
    - b. Hilti, Inc.
    - c. ITW Ramset/Red Head.
    - d. Masterset Fastening Systems, Inc.

### 2.2 MANUFACTURED UNITS

- A. Pipe Hangers, Supports, and Components: MSS SP-58, factory-fabricated components. Refer to "Hanger and Support Applications" Article in Part 3 for where to use specific hanger and support types.
  - 1. Galvanized, Metallic Coatings: For piping and equipment that will not have field-applied finish.
  - 2. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- B. Channel Support Systems: MFMA-2, factory-fabricated components for field assembly.
  - 1. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
  - 2. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- C. Thermal-Hanger Shield Inserts: 100-psi minimum compressive-strength insulation, encased in sheet metal shield.
  - 1. Material for Cold Piping: ASTM C 552, Type I cellular glass or water-repellent-treated, ASTM C 533, Type I calcium silicate with vapor barrier.
  - 2. Material for Heating Hot Piping: ASTM C 552, Type I cellular glass or water-repellent-treated, ASTM C 533, Type I calcium silicate.
  - 3. For Trapeze or Clamped System: Insert and shield cover entire circumference of pipe.
  - 4. For Clevis or Band Hanger: Insert and shield cover lower 180 degrees of pipe.
  - 5. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

### 2.3 MISCELLANEOUS MATERIALS

- A. Powder-Actuated Drive-Pin Fasteners: Powder-actuated-type, drive-pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- C. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized.
- D. Grout: ASTM C 1107, Grade B, factory-mixed and -packaged, nonshrink and nonmetallic, dry, hydraulic-cement grout.
  - 1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
  - 2. Properties: Nonstaining, noncorrosive, and nongaseous.
  - 3. Design Mix: 5000-psi, 28-day compressive strength.

### PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Specification Sections.
- B. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

1. Adjustable Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
2. U-Bolts (MSS Type 24): For support of heavy pipe, NPS 1/2 to NPS 30.
3. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
4. 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.
5. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
6. 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.
7. 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.
8. Spacing of hangers and supportors shall be as follows:

a) Copper Tubing

<u>Nominal Tubing Size</u>	<u>Maximum Spacing of</u>	
	<u>Supports (Feet)</u>	<u>Rod Size (in)</u>
3/4" & Smaller	5	1/4
1 in. through 3 in.	6	1/2
4 in. and larger	12	1/2

b) Steel Pipe

<u>Nominal Pipe Size</u>	<u>Maximum Spacing of</u>	
	<u>Supports (Feet)</u>	<u>Rod Size (in)</u>
Up Thru 1-1/4 in.	6	1/4
1-1/2 " thru 2-1/2"	8	3/8
3 in. and 4 in.	12	1/2
5 in. and 6 in.	16	5/8
8 in and 10 in	20	3/4
12 in.	30	7/8

Note: Additional hangers shall be provided adjacent to all valves and fittings size 8" and larger.

- C. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Specification 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.
- D. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
  2. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
  3. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
  4. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- E. Building Attachments: Unless otherwise indicated and except as specified in piping system Specification 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-joint 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 head room is limited.
- F. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Specification 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 by manufacturer to prevent crushing insulation.
  3. Thermal-Hanger Shield Inserts: For supporting insulated pipe, 360-degree insert of high-density, 100-psi minimum compressive-strength, water-repellent-treated calcium silicate or cellular-glass pipe insulation, same thickness as adjoining insulation with vapor barrier and encased in 360-degree sheet metal shield.
- G. Spring Hangers and Supports: In mechanical rooms and at top of pipe risers and where otherwise indicated and specified in piping system Specification Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where necessary 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.

### 3.2 HANGER AND SUPPORT INSTALLATION

- A. Pipe Hanger and Support 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. Channel Support System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems.
  1. Field assemble and install according to manufacturer's written instructions.
- C. Heavy-Duty Steel Trapeze Installation: Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated, heavy-duty trapezes.

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 D-1.1.
- D. Install building attachments within concrete slabs or attach to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, and expansion joints, 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.
- E. Install powder-actuated drive-pin fasteners 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.
- F. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- G. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- I. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- J. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping," is not exceeded.
- K. 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 B31.9.
  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.
  3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span arc of 180 degrees.
  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.
- 5. Insert Material: Length at least as long as protective shield.
  - 6. 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 above or to support equipment above floor.
- B. Install reinforcing bars, tied to frame, and place anchor bolts and sleeves to facilitate securing units. Place grout under supports for equipment and make smooth bearing surface. Use Portland cement conforming to ASTM C 150, 4000-psi compressive strength, and normal-weight aggregate.
- C. Factory supplied roof curbs for roof mounted Units with special options or arrangements will differ in dimensions, clearances, weights and roof opening dimensions and locations. The installation of the roof curb requires mounting on a flat surface so that the unit may be set level. This is necessary not only but also to ensure proper operation and coil condensate drainage.

### 3.4 METAL FABRICATION

- A. Cut, drill, and fit miscellaneous metal fabrications for heavy-duty steel trapezes 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 Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

### 3.6 PAINTING

- A. Touching 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 a minimum dry film thickness of 2.0 mils.
- B. Touching Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal items.
1. Pipe hangers
  2. Supports
  3. Accessory items
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.
- D. Ferrous-Metal Surfaces:
1. Cleaning: Clean ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with the Steel Structures Painting Council's (SSPC) recommendations.
    - a. Blast steel surfaces clean as recommended by paint system manufacturer and according to requirements of SSPC-SP 10.
    - b. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
    - c. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with the same primer as the shop coat.
  2. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by the manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn through or other defects due to insufficient sealing.

Primer: Rust-inhibitive metal primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.0 mils.

    - a) Devoe: 13101 Mirrolac Rust Penetrating Metal Primer.
    - b) Fuller: 621-04 Blox-Rust Alkyd Metal Primer.
    - c) Glidden: 5205 Glid-Guard Tank & Structural Primer, Red.
  3. First and Second Coats: Flat, exterior, alkyd enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 3.4 mils. Completely cover surfaces as necessary to provide a smooth, opaque surface of

uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

- a) Devoe: 564XX De-Vo-Ko Exterior Alkyd Flat House Paint.
- b) Fuller: 665-XX Ful-Stain Alkyd Solid Coat.
- c) Glidden: 10690 Series Spred Velvet Flat Oil House Paint.

E. Galvanized Surfaces:

1. Cleaning: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.
2. Primer: Galvanized metal primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.2 mils.
  - a) Devoe: 8502/8520 Mirrolac Interior/Exterior Waterborne Flat DTM Primer and Finish.
  - b) Fuller: 621-05 Blox-Rust Latex Metal Primer.
  - c) Glidden: 5205 Glid-Guard Tank & Structural Primer, Red.
3. First and Second Coat: Low-luster (eggshell or satin), exterior, acrylic-latex paint applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.8 mils.
  - a) Devoe: 16XX Wonder-Shield Exterior Acrylic Latex Satin House and Trim Paint.
  - b) Fuller: 261-XX Eggshell Sheen Latex House and Trim Paint.
  - c) Glidden: 6700 Series Spred Ultra Exterior Satin Latex House and Trim Paint.

END OF SECTION

**SECTION 15061**

**HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT**

**PART 1 - GENERAL**

**1.1 SUMMARY**

**A. Section Includes:**

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Fastener systems.
5. Pipe positioning systems.
6. Equipment supports.

**1.2 PERFORMANCE REQUIREMENTS**

- A. **Delegated Design:** Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. **Structural Performance:** Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to **ASCE/SEI 7**.
- C. Provide supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
  1. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

**1.3 SUBMITTALS**

- A. **Product Data:** For each type of product indicated.
- B. **Shop Drawings:** Show fabrication and installation details and include calculations for the following; include Product Data for components:
  1. Trapeze pipe hangers.
  2. Equipment supports.
- C. **Delegated-Design Submittal:** For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data.
- D. **Welding certificates.**

## SECTION – 15061 – HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

## 1.4 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

## PART 2 - PRODUCTS

## 2.1 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
  - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
  - 2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
  - 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
  - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
  - 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of **carbon steel**.
- B. Copper Pipe Hangers:
  - 1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
  - 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of **copper-coated steel**.

## 2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

## 2.3 THERMAL-HANGER SHIELD INSERTS

- A. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.
- B. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig or ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig] minimum compressive strength.
- C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

## SECTION – 15061 – HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

- E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

## 2.4 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

## 2.5 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

## 2.6 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

## 2.7 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-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: Nonstaining, noncorrosive, and nongaseous.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.

## PART 3 - EXECUTION

## 3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

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1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
  2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- D. 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.
- E. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. See Division 15 plumbing fixture Sections for requirements for pipe positioning systems for plumbing fixtures.
- F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- K. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- M. Insulated Piping:
1. Attach clamps and spacers to piping.
    - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.

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- c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
  - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 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.
5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### 3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

### 3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
  1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  2. Obtain fusion without undercut or overlap.
  3. Remove welding flux immediately.

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4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

### 3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to **1-1/2**.

### 3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 9 **painting Sections**.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

### 3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are 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 carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.
- F. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.
- G. Use padded hangers for piping that is subject to scratching.
- H. Use thermal-hanger shield inserts for insulated piping and tubing.
- I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

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1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
  2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
  3. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  4. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS .
  5. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
  6. 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 or carbon-steel plate, and with U-bolt to retain pipe.
  7. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
  8. 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.
- J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- K. 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.
- L. 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-joint 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. 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.

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8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- M. 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.
- N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
  2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
  3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
- O. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- P. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.
- Q. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 15061

**SECTION 15075**  
**MECHANICAL IDENTIFICATION**

**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.
- B. Division 15, "Mechanical Provisions".

**1.2 SUMMARY**

- A. This Section includes mechanical identification materials and devices for:
  - 1. Valve Tags
  - 2. Pipe Bands
  - 3. Equipment Labels

**1.3 SUBMITTALS**

- A. Product Data: For identification materials and devices.
- B. Samples: Of color, lettering style, and graphic representation required for each identification material and device.
- C. Valve Schedules: For each piping system. Reproduce on standard-size bond paper. Tabulate valve number, piping system, system abbreviation as shown on tag, room or space location of valve, and variations for identification. Mark valves intended for emergency shutoff and similar special uses. Furnish copies for maintenance manuals specified in Division 1.

**1.4 QUALITY ASSURANCE**

- A. Comply with ASME A13.1, "Scheme for the Identification of Piping Systems" for lettering size, length of color field, colors, and viewing angles of identification devices.

**1.5 SEQUENCING AND SCHEDULING**

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 IDENTIFYING DEVICES AND LABELS

- A. General: Pipe identification shall comply with ASME A13.1
- B. Equipment Nameplates: Metal permanently fastened to equipment with data engraved or stamped.
  - 1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and essential data.
  - 2. Location: Accessible and visible.

- C. Snap-On Plastic Pipe Markers: Manufacturer's standard preprinted, semirigid, snap-on type. Include color-coding according to ASME A13.1, unless otherwise indicated. Pipe identification bands shall be with directional flow arrows and legends. Identification bands on pipe or coverings 5-1/2" or less in diameter shall be sized to fit around pipe and overlap self. Identification bands on pipe or covering 6" or more in diameter shall have stainless steel spring fasteners. Pipe identification bands shall be:

Seton/Setmark	SNA Series
Setmark	STR Series
Brady	Snap-on Series

- D. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch sequenced numbers. Include 5/32-inch hole for fastener. Valve tags shall be:

Emedco	CB/W Series
Seton	Valve Tags
Brady	Valve Tags

- E. Valve Tag Fasteners: Brass, wire-link chain; beaded chain; or S-hooks.
- F. Plastic Equipment Markers: Manufacturer's standard laminated plastic, in the following color codes:
  - 1. Green: Cooling equipment and components.
  - 2. Yellow: Heating equipment and components.
  - 3. Brown: Energy reclamation equipment and components.
  - 4. Blue: Equipment and components that do not meet criteria above.
  - 5. Hazardous Equipment: Use colors and designs recommended by ASME A13.1.
  - 6. Terminology: Match schedules as closely as possible. Include the following:
    - a. Name and plan number.
    - b. Equipment service.
    - c. Design capacity.
    - d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.

7. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 for equipment.
- G. Lettering and Graphics: Coordinate names, abbreviations, and other designations used in mechanical identification with corresponding designations indicated. Use numbers, letters, and terms indicated for proper identification, operation, and maintenance of mechanical systems and equipment.
  1. Multiple Systems: Identify individual system number and service if multiple systems of same name are indicated.

### PART 3 - EXECUTION

#### 3.1 LABELING AND IDENTIFYING PIPING SYSTEMS

- A. Install pipe markers on each system. Include arrows showing normal direction of flow.
- B. Marker Type: Stenciled markers complying with ASME A13.1.
- C. Marker Type: Plastic markers, with application systems. Install on pipe insulation segment where required for hot, noninsulated pipes.
- D. Fasten markers on pipes and insulated pipes smaller than 6 inches OD by one of following methods:
  1. Snap-on application of pretensioned, semirigid plastic pipe marker.
- E. Fasten markers on pipes and insulated pipes 6 inches in diameter and larger by one of following methods:
  1. Taped to pipe or insulation with color-coded plastic adhesive tape, not less than 1-1/2 inches wide, lapped a minimum of 3 inches at both ends of pipe marker, and covering full circumference of pipe.
- F. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed locations according to the following:
  1. Near each valve and control device.
  2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Mark each pipe at branch, where flow pattern is not obvious.
  3. Near penetrations through walls, floors, ceilings, or nonaccessible 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 a maximum of 50-foot intervals along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
  7. On piping above removable acoustical ceilings, except omit intermediately spaced markers.

SYSTEM	LEGEND WORDING	BACKGROUND COLOR	LETTER COLOR
Chill Water Supply	CWS	BLUE	WHITE
Chill Water Return	CWR	BLUE	WHITE
Condenser Water Supply	CS	GREEN	WHITE
Condenser Water Return	CR	GREEN	WHITE
Heating Hot Water Supply	HS	YELLOW	BLACK
Heating Hot Water Return	HR	YELLOW	BLACK
Domestic Cold Water	CW	GREEN	WHITE
Hot Water	HW	GREEN	WHITE
Fire Protection	FP	RED	WHITE
Gas	GAS	YELLOW	BLACK

8. Band and Height of letters shall be:

Pipe Diameter*	Letter Height	Width of Band
½" - 1-1/4"	1/2"	8
1-1/2" to 2"	3/4"	8
2-1/2" to 6"	1-1/4"	12
8 " to 10"	2-1/2"	24
Over 10"	3-1/2"	32

\*Outside insulation on insulated piping.

### 3.2 VALVE TAGS

- A. Install on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, plumbing fixture supply stops, shutoff valves, faucets, convenience and lawn-watering hose connections, and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in valve schedule.

- B. Valve Tag Application Schedule: Tag valves according to size, shape, color scheme, and with captions similar to those indicated in the following:
- C. Tag Material: .032 inch thick, polish brass.

SYSTEM	TAG SIZE	TAG SHAPE	LETTER IDENTIFICATION
Domestic Cold Water	2"	Hexagonal	CW-1,2,3, ...
Domestic Hot Water 120 degree F	2"	Hexagonal	HW-1,2,3, ...
Domestic Hot Water 140 degree F	2"	Hexagonal	HWH-1,2,3, ...
Domestic Hot Water Circulation	2"	Hexagonal	HWC-1,2,3, ...
Heating Hot Water Supply	2"	Square	HHW-1,2,3, ...
Heating Hot Water Return	2"	Square	HHW-1,2,3, ...
Chill Water Supply	2"	Square	CWS-1,2,3, ...
Chill Water Return	2"	Square	CWR-1,2,3, ...
Fire Protection	2"	Square	FP-1,2,3, ...
Condenser Water Supply	2"	Square	CS-1, 2, 3, ...
Condenser Water Return	2"	Square	CR-1, 2, 3, ...
Gas	2"	Hexagonal	GAS-1, 2, 3, ...

- D. Install mounted valve schedule in equipment room.

### 3.3 EQUIPMENT SIGNS AND MARKERS

- A. Install engraved plastic-laminate signs or equipment markers on or near each major item of mechanical equipment. Include signs for the following general categories of equipment:
  1. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
  2. Fuel-burning units, boilers and water heaters.
  3. Pumps, chillers, condensers, and similar motor-driven units.
  4. AHUs, VAVs, Fan Coil Units, Unit Heaters, Exhaust Fans and similar motor-driven units

5. Expansion Tanks and pressure vessels.
  6. Air Separators, Shot feeders, Water-treatment systems, and similar equipment.
- B. Optional Sign Types: Stenciled signs may be provided instead of engraved plastic, at Installer's option, where lettering larger than 1-inch high is needed for proper identification because of distance from normal location of required identification.
1. Lettering Size: Minimum 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.
  2. Terms on Signs: Distinguish between multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
- C. Plasticized Tags: Install within concealed space, to reduce amount of text in exposed sign outside concealment, if equipment to be identified is concealed above acoustical ceiling or similar concealment.
1. Identify operational valves and similar minor equipment items located in unoccupied spaces, including machine rooms, by installing plasticized tags.
- D. Plastic Equipment Markers: Color-coded, laminated plastic. Comply with the following color code:
1. Green: Cooling equipment and components.
  2. Yellow: Heating equipment and components.
  3. Yellow/Green: Combination cooling and heating equipment and components.
  4. Brown: Energy reclamation equipment and components.
  5. Blue: Equipment and components that do not meet any criteria above.
  6. For hazardous equipment, use colors and designs recommended by ASME A13.1.
  7. Nomenclature: Include the following, matching terminology on schedules as closely as possible:
    - a. Name and plan number.
    - b. Equipment service.
    - c. Design capacity.
    - d. Other design parameters such as pressure drop, entering and leaving conditions, and rpm.
  8. Size: Approximate 2-1/2 by 4 inches for control devices, dampers, and valves; and 4-1/2 by 6 inches for equipment.
- E. Coordinate names, abbreviations, and other designations used in mechanical identification, with corresponding designations indicated. Use numbers, lettering, and wording indicated for proper identification and operation/maintenance of mechanical systems and equipment.
1. Multiple Systems: If multiple systems of same generic name are indicated, provide identification that indicates individual system number and service such as "VVR-100, "AHU-1", or "HWP-1"

3.4 ADJUSTING AND CLEANING

- A. Relocate mechanical identification materials and devices that have become visually blocked by work of this or other Divisions.
- B. Clean faces of identification devices and glass frames of valve charts.

END OF SECTION

**SECTION 15085**  
**PIPE INSULATION**

**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.
- B. The publications listed below form a part of this specification to the extent referenced. At the discretion of the Owner, the manufacturer of any material supplied will be required to furnish test reports pertaining to any of the tests necessary to assure compliance with the standard or standards referenced in this specification.

- 1. ASTM C 1126 (2000) Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation.
- 2. ASTM C 534 (2001a) Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
- 3. ASTM C547 (2000) Mineral Fiber Pipe Insulation.
- 4. ASTM B 209 (2001) Aluminum and Aluminum-Alloy Sheet and Plate
- 5. ASTM E 84 (2001) Surface Burning Characteristics of Building Materials.
- 6. MICA Insulation Stds 1999) National Commercial & Industrial Insulation Standards

**1.2 SUMMARY**

- A. This Section includes preformed, rigid and flexible pipe insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.
- B. Related Sections include the following:
  - 1. Division 7 Section "Firestopping" for firestopping materials and requirements for penetrations through fire and smoke barriers.
  - 2. Division 15 Section "Duct Insulation" for insulation for ducts and plenums.
  - 3. Division 15 Section "Hangers and Supports" for pipe insulation shields and protection saddles.
  - 4. Division 15 Section "Mechanical General Provisions"

**1.3 SUBMITTALS**

- A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.

- B. Shop Drawings: Show fabrication and installation details for the following:
  - 1. Application of protective shields, saddles, and inserts at pipe hangers for each type of insulation and hanger.
  - 2. Attachment and covering of heat trace inside insulation.
  - 3. Insulation application at pipe expansion joints for each type of insulation.
  - 4. Insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
  - 5. Removable insulation at piping specialties and equipment connections.
  - 6. Application of field-applied jackets.
- 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.
- D. Installer Certificates: Signed by the Contractor certifying that installers comply with requirements.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the U.S. Department of Labor, Bureau of Apprenticeship and Training.
- B. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.
  - 1. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.
  - 2. Insulation Installed Outdoors: Flame-spread rating of 75 or less, and smoke-developed rating of 150 or less.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.

#### 1.6 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 15 Section "Hangers and Supports."
- B. Coordinate clearance requirements with piping Installer for insulation application.
- C. Coordinate installation and testing of electric heat tracing.

## 1.7 SCHEDULING

- A. Schedule insulation application after testing piping systems and, where required, after installing and testing heat-trace tape. Insulation application may begin on segments of piping that have satisfactory test results.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Mineral-Fiber Insulation:
    - a. CertainTeed Manson.
    - b. Knauf FiberGlass GmbH.
    - c. Owens-Corning Fiberglas Corp.
    - d. Schuller International, Inc.
  - 2. Cellular-Glass Insulation:
    - a. Pittsburgh-Corning Corp.
  - 3. Flexible Elastomeric Thermal Insulation:
    - a. Armstrong World Industries, Inc.
    - b. Rubatex Corp.
  - 4. Polyolefin Insulation:
    - a. Armstrong World Industries, Inc.
    - b. IMCOA.
  - 5. Closed-Cell Phenolic-Foam Insulation:
    - a. Kooltherm Insulation Products, Ltd.

### 2.2 INSULATION MATERIALS

- A. Mineral-Fiber Insulation: Glass fibers bonded with a thermosetting resin complying with the following:
  - 1. Preformed Pipe Insulation: Comply with ASTM C 547, Type 1, with factory-applied, all-purpose, vapor-retarder jacket.
  - 2. Blanket Insulation: Comply with ASTM C 553, Type II, without facing.
  - 3. Fire-Resistant Adhesive: Comply with MIL-A-3316C in the following classes and grades:

- a. Class 1, Grade A for bonding glass cloth and tape to unfaced glass-fiber insulation, for sealing edges of glass-fiber insulation, and for bonding lagging cloth to unfaced glass-fiber insulation.
  - b. Class 2, Grade A for bonding glass-fiber insulation to metal surfaces.
4. Vapor-Retarder Mastics: Fire- and water-resistant, vapor-retarder mastic for indoor applications. Comply with MIL-C-19565C, Type II.
  5. Mineral-Fiber Insulating Cements: Comply with ASTM C 195.
  6. Expanded or Exfoliated Vermiculite Insulating Cements: Comply with ASTM C 196.
  7. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
- B. Cellular-Glass Insulation: Inorganic, foamed or cellulated glass, annealed, rigid, hermetically sealed cells, incombustible.
1. Preformed Pipe Insulation, with Jacket: Comply with ASTM C 552, Type II, Class 2.
- C. Flexible Elastomeric Thermal Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
1. Adhesive: As recommended by insulation material manufacturer.
  2. Ultraviolet-Protective Coating: As recommended by insulation manufacturer.
- D. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

### 2.3 FIELD-APPLIED JACKETS

- A. General: ASTM C 921, Type 1, unless otherwise indicated.
- B. Foil and Paper Jacket: Laminated, glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil.
- C. Aluminum Jacket: Factory cut and rolled to indicated sizes. Comply with ASTM B 209 (ASTM B 209M), 3003 alloy, H-14 temper or
- D. Aluminum Jacket: Aluminum roll stock, ready for shop or field cutting and forming to indicated sizes. Comply with ASTM B 209, 3003 alloy, H-14 temper.
1. Finish and Thickness: Smooth finish, 0.010 inch thick.
  2. Moisture Barrier: 1-mil-thick, heat-bonded polyethylene and kraft paper.
  3. Elbows: Preformed, 45- and 90-degree, short- and long-radius elbows; same material, finish, and thickness as jacket.

### 2.4 ACCESSORIES AND ATTACHMENTS

- A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, presized a minimum of 8 oz./sq. yd.
1. Tape Width: 4 inches.

- B. Bands: 3/4 inch wide, in one of the following materials compatible with jacket:
  - 1. Stainless Steel: ASTM A 666, Type 304; 0.020 inch thick for mechanical rooms and outdoors.
  - 2. Galvanized Steel: 0.005 inch thick for above drop ceiling.
- C. Wire: 0.080-inch, nickel-copper alloy; 0.062-inch, soft-annealed, stainless steel; or 0.062-inch, soft-annealed, galvanized steel.

## 2.5 VAPOR RETARDERS

- A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

## 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.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Preparation: Clean and dry pipe and fitting surfaces. Remove materials that will adversely affect insulation application.

### 3.3 GENERAL APPLICATION REQUIREMENTS

- A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each piping system.
- C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Apply insulation with longitudinal seams at top and bottom of horizontal pipe runs.
- E. Apply 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. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- H. Keep insulation materials dry during application and finishing.
- I. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- J. Apply insulation with the least number of joints practical.
- K. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to special instructions for applying insulation over fittings, valves, and specialties.
- L. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.
  - 1. Apply insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor retarders are indicated, extend insulation on anchor legs at least 12 inches (300 mm) from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
  - 3. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.
- M. Insulation Terminations: For insulation application where vapor retarders are indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
- N. Apply adhesives and mastics at the manufacturer's recommended coverage rate.
- O. Apply insulation with integral jackets as follows:
  - 1. Pull jacket tight and smooth.
  - 2. Circumferential Joints: Cover with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip and spaced 4 inches (100 mm) o.c.
  - 3. Longitudinal Seams: Overlap jacket seams at least 1-1/2 inches (40 mm). Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches (100 mm) o.c.
    - a. Exception: Do not staple longitudinal laps on insulation having a vapor retarder.
  - 4. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings.

5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor-retarder mastic.
- P. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.
1. Seal penetrations with vapor-retarder mastic.
  2. Apply insulation for exterior applications tightly joined to interior insulation ends.
  3. Extend metal jacket of exterior insulation outside roof flashing at least 2 inches below top of roof flashing.
  4. Seal metal jacket to roof flashing with vapor-retarder mastic.
- Q. Exterior Wall Penetrations: For penetrations of below-grade exterior walls, terminate insulation flush with mechanical sleeve seal. Seal terminations with vapor-retarder mastic.
- R. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and floors.
- S. Fire-Rated Wall and Partition Penetrations: Apply insulation continuously through penetrations of fire-rated walls and partitions.
1. Firestopping and fire-resistive joint sealers are specified in Division 7 Section "Firestopping."
- T. Floor Penetrations: Apply insulation continuously through floor assembly.
1. For insulation with vapor retarders, seal insulation with vapor-retarder mastic where floor supports penetrate vapor retarder.
- 3.4 MINERAL-FIBER INSULATION APPLICATION
- A. Apply insulation to straight pipes and tubes as follows:
1. Secure each layer of preformed pipe insulation to pipe with wire, tape, or bands without deforming insulation materials.
  2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic. Apply vapor retarder to ends of insulation at intervals of 15 to 20 feet to form a vapor retarder between pipe insulation segments.
  3. For insulation with factory-applied jackets, secure laps with outward clinched staples at 6 inches o.c.
  4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.
- B. Apply insulation to flanges as follows:
1. Apply preformed pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the 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. Apply canvas jacket material with manufacturer's recommended adhesive, overlapping seams at least 1 inch , and seal joints with vapor-retarder mastic.
- C. Apply insulation to fittings and elbows as follows:
1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
  2. When premolded insulation elbows and fittings are not available, apply mitered sections of pipe insulation, or glass-fiber blanket insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire, tape, or bands.
  3. Cover fittings with standard Aluminum fitting covers.
- D. Apply insulation to valves and specialties as follows:
1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
  2. When premolded insulation sections are not available, apply glass-fiber blanket insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to stainer basket without disturbing insulation.
  3. Apply insulation to flanges as specified for flange insulation application.
  4. Use preformed standard Aluminum fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
  5. For larger sizes seal insulation with canvas jacket and sealing compound recommended by the insulation material manufacturer.

### 3.5 CELLULAR-GLASS INSULATION APPLICATION

- A. Apply insulation to straight pipes and tubes as follows:
1. Secure each layer of insulation to pipe with wire, tape, or bands without deforming insulation materials.
  2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic.
  3. For insulation with factory-applied jackets, secure laps with outward clinched staples at 6 inches o.c.
  4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.
- B. Apply insulation to flanges as follows:
1. Apply preformed pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the 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 the same thickness as pipe insulation.
  4. Apply canvas jacket material with manufacturer's recommended adhesive, overlapping seams at least 1 inch (25 mm), and seal joints with vapor-retarder mastic.
- C. Apply insulation to fittings and elbows as follows:
1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
  2. When premolded sections of insulation are not available, apply mitered sections of cellular-glass insulation. Secure insulation materials with wire, tape, or bands.
  3. Cover fittings with standard PVC fitting covers.
  4. Cover fittings with heavy PVC fitting covers. Overlap PVC covers on pipe insulation jackets at least 1 inch (25 mm) at each end. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
- D. Apply insulation to valves and specialties as follows:
1. Apply premolded segments of cellular-glass insulation or glass-fiber blanket insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to stainer basket without disturbing insulation.
  2. Apply insulation to flanges as specified for flange insulation application.
  3. Use preformed standard Aluminum fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
  4. For larger sizes seal insulation with canvas jacket and sealing compound recommended by the insulation material manufacturer.
- ### 3.6 FLEXIBLE ELASTOMERIC THERMAL INSULATION APPLICATION
- A. Apply insulation to straight pipes and tubes as follows:
1. Follow manufacturer's written instructions for applying insulation.
  2. Seal longitudinal seams and end joints with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.
- B. Apply insulation to fittings and elbows as follows:
1. Apply mitered sections of pipe insulation.
  2. Secure insulation materials and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.
- C. Apply insulation to valves and specialties as follows:
1. Apply preformed valve covers manufactured of the same material as pipe insulation and attached according to the manufacturer's written instructions.
  2. Apply cut segments of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For

check valves, fabricate removable sections of insulation arranged to allow access to stainer basket.

3. Apply insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

### 3.7 FIELD-APPLIED JACKET APPLICATION

- A. Apply glass-cloth jacket, where indicated, directly over bare insulation or insulation with factory-applied jackets.
  1. Apply 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 jacket manufacturer's recommended adhesive.
  3. Completely encapsulate insulation with jacket, leaving no exposed raw insulation.
- B. Foil and Paper Jackets: Apply foil and paper jackets where indicated.
  1. Draw jacket material smooth and tight.
  2. Apply lap or joint strips with the same material as jacket.
  3. Secure jacket to insulation with manufacturer's recommended adhesive.
  4. Apply jackets 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-retarder mastic.
- C. Apply metal jacket where indicated, with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

### 3.8 FINISHES

- A. Glass-Cloth Jacketed Insulation: Paint insulation finished with glass-cloth jacket as specified in Division 9 Section "Painting."
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of the insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

### 3.9 PIPING SYSTEM APPLICATIONS

- A. Insulation materials and thicknesses are specified in schedules at the end of this Section.
- B. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:

1. Flexible connectors.
2. Vibration-control devices.
3. Fire-suppression piping.
4. Drainage piping located in crawl spaces, unless otherwise indicated.
5. Below-grade piping, unless otherwise indicated.
6. Chrome-plated pipes and fittings, unless potential for personnel injury.
7. Air chambers, unions, strainers, check valves, plug valves, and flow regulators.
8. Condenser water piping loop.

### 3.10 FIELD QUALITY CONTROL

- A. Inspection: The Architect will perform the following field quality-control inspections, after installing insulation materials, jackets, and finishes, to determine compliance with requirements:
- B. Inspection: Perform the following field quality-control inspections, after installing insulation materials, jackets, and finishes, to determine compliance with requirements:
  1. Inspect fittings and valves randomly selected by Architect.
  2. Remove fitting covers from 20 elbows or 1 percent of elbows, whichever is less, for various pipe sizes.
  3. Remove fitting covers from 20 valves or 1 percent of valves, whichever is less, for various pipe sizes.
- C. Insulation applications will be considered defective if sample inspection reveals noncompliance with requirements by the Architect. Remove defective Work and replace with new materials according to these Specifications.
- D. Reinstall insulation and covers on fittings and valves uncovered for inspection according to these Specifications.

### 3.11 INSULATION APPLICATION SCHEDULE, GENERAL

- A. Refer to insulation application schedules for required insulation materials, vapor retarders, and field-applied jackets.
- B. Application schedules identify piping system and indicate pipe size ranges and material, thickness, and jacket requirements.

### 3.12 INTERIOR INSULATION APPLICATION SCHEDULE

- A. Service: Domestic hot and recirculated hot water.
  1. Operating Temperature: 105 to 140 deg F.
  2. Insulation Material: Mineral fiber
  3. Insulation Thickness: Apply the following insulation thicknesses:
    - a. Copper Pipe, less than 1 Dia, 1/2" thickness
    - b. Copper Pipe, above 1" – 2" Dia., 1" thickness.
    - c. Copper Pipe, above 2" – 6" Dia., 1 1/2" thickness.

4. Jacket: Foil and paper.
  5. Vapor Retarder Required: No.
  6. Finish: None.
- B. Service: Domestic cold water.
1. Operating Temperature: 35 to 60 deg F.
  2. Insulation Material: Mineral fiber
  3. Insulation Thickness: Apply the following insulation thicknesses:
    - a. Copper Pipe, less than 1 Dia, 1/2" thickness
    - b. Copper Pipe, above 1" – 2" Dia., 1" thickness.
    - c. Copper Pipe, above 2 1/2" – 6" Dia., 1 1/2" thickness.
  4. Jacket: Foil and paper.
  5. Vapor Retarder Required: Yes.
  6. Finish: None.
- C. Service: Rainwater conductors.
1. Operating Temperature: 32 to 100 deg F (0 to 38 deg C).
  2. Insulation Material: Mineral fiber
  3. Insulation Thickness: Apply the following insulation thicknesses:
    - a. Cast Iron Pipe, 1" to 2" Dia., 1" Thickness.
    - b. Cast Iron Pipe, 2" to 6" Dia., 1 1/2" Thickness.
  4. Jacket: Foil and paper.
  5. Vapor Retarder Required: Yes.
  6. Finish: None.
- D. Service: Roof drain bodies.
1. Operating Temperature: 32 to 100 deg F.
  2. Insulation Material: Phenolic Foam
  3. Insulation Thickness: 1 1/2" Thickness.
  4. Field-Applied Jacket: None.
  5. Vapor Retarder Required: No.
  6. Finish: None.
- E. Service: Condensate drain piping.
1. Operating Temperature: 35 to 60 deg F.
  2. Insulation Material: Faced Phenolic Foam.
  3. Insulation Thickness: 1" Thickness.
  4. Field-Applied Jacket: None.
  5. Vapor Retarder Required: Yes.
  6. Finish: None.
- F. Service: Exposed sanitary drains and domestic water supplies and stops for ADA fixtures.

1. Operating Temperature: 35 to 120 deg F (2 to 49 deg C).
2. Insulation Material: Flexible Elastomeric Cellular
3. Insulation Thickness: ½” Thickness
4. Field-Applied Jacket: PVC P-trap and supply covers.
5. Vapor Retarder Required: No.
6. Finish: None.

G. Service: Chilled-water supply and return.

1. Operating Temperature: 40 to 60 deg F.
2. Insulation Material: Cellular glass, with jacket
3. Insulation Thickness: Apply the following insulation thicknesses:
  - a. Steel Pipe, less 2” Dia., 1” Thickness.
  - b. Steel Pipe 2” Dia. - and larger, 1 1/2” Thickness.
4. Jacket: Foil and paper
5. Vapor Retarder Required: Yes.
6. Finish: None.

H. Service: Heating Hot-water supply and return.

1. Operating Temperature: 140 to 200 deg F.
2. Insulation Material: Mineral fiber
3. Insulation Thickness: Apply the following insulation thicknesses:
  - a. Copper Pipe, less 1 ½” Dia, 1 1/2” thickness
  - b. Copper Pipe, above 1 ½” – 4” Dia., 2” thickness.
  - c. Steel Pipe, 4” Dia. and larger, 2” Thickness.
4. Jacket: Foil and paper.
5. Vapor Retarder Required: No.
6. Finish: None.

I. Service: Refrigerant suction and hot-gas piping.

1. Operating Temperature: 35 to 50 deg F.
2. Insulation Material: Flexible Elastomeric Cellular
3. Insulation Thickness: Apply the following insulation thicknesses:
  - a. Copper Pipe, less 1” Dia., 3/4” Thickness
  - b. Copper Pipe, 1” to 2” Dia., 1” Thickness
4. Field-Applied Jacket: None.
5. Vapor Retarder Required: Yes.
6. Finish: None.

3.13 EXTERIOR & EXPOSED INSULATION APPLICATION SCHEDULE

- A. This application schedule is for aboveground insulation outside the building.

B. Service: Domestic water.

1. Operating Temperature: 60 to 140 deg F (15 to 60 deg C).
2. Insulation Material: Mineral fiber.
3. Insulation Thickness: Apply the following insulation thicknesses:
  - a. Copper Pipe, less than 2 Dia, 1" thickness
  - b. Copper Pipe, above 2" – 6" Dia., 1 1/2" thickness.
4. Field-Applied Jacket: Aluminum.
5. Vapor Retarder Required: Yes.
6. Finish: None.
7. Misc.: Heat Traced

C. Service: Refrigerant suction.

1. Operating Temperature: 35 to 50 deg F (2 to 10 deg C).
2. Insulation Material: Flexible elastomeric.
3. Insulation Thickness: Apply the following insulation thicknesses:
  - a. Copper Pipe, less than 1" Dia., 3/4" Thickness
  - b. Copper Pipe, 1" to , 1 1/2" Dia., 1" Thickness
4. Field-Applied Jacket: None.
5. Vapor Retarder Required: No.
6. Finish: None.

D. Service: Chilled-water supply and return.

1. Operating Temperature: 40 to 60 deg F.
2. Insulation Material: Cellular glass, with jacket.
3. Insulation Thickness: Apply the following insulation thicknesses:
  - a. Steel less 1 1/2" Dia., 1" Thickness.
  - b. Steel 1 1/2" and Above, 1.5" Thickness.
4. Field-Applied Jacket: Aluminum.
5. Vapor Retarder Required: Yes.
6. Finish: None.
7. Misc.: Heat Traced

E. Service: Heating Hot-water supply and return.

1. Operating Temperature: 140 to 200 deg F.
2. Insulation Material: Mineral fiber
3. Insulation Thickness: Apply the following insulation thicknesses:
  - a. Copper Pipe, up to 1 1/2" Dia, 1.5" thickness
  - b. Copper Pipe, above 1 1/2" – 4" Dia., 2" thickness.
  - c. Steel Pipe, 4" Dia. and larger, 2" Thickness.

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4. Field-Applied Jacket: Aluminum
5. Vapor Retarder Required: No.
6. Finish: None.
7. Misc.: Heat Traced

END OF SECTION

**SECTION 15086**  
**DUCT INSULATION**

**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 semirigid and flexible duct, plenum, and breeching insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.
- B. Related Sections include the following:
  - 1. Division 7 Section "Firestopping" for firestopping materials and requirements for penetrations through fire and smoke barriers.
  - 2. Division 15 Related sections for insulation materials and application for pumps, tanks, hydronic specialties, and other equipment.
  - 3. Division 15 Section "Pipe Insulation" for insulation of piping systems.
  - 4. Division 15 Section "Metal Ducts".

**1.3 SUBMITTALS**

- A. Product Data: Identify thermal conductivity, thickness, and jackets both factory and field applied, for each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details for the following:
  - 1. Removable insulation sections at access panels.
  - 2. Application of field-applied jackets.
  - 3. Applications at linkages for control devices.
  - 4. Field fabricated Attenuators.
  - 5. Transfer return ducts "L" shape and "U" shape.
- C. Installer Certificates: Signed by the Contractor certifying that installers complies with requirements.

**1.4 QUALITY ASSURANCE**

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the U.S. Department of Labor, Bureau of Apprenticeship and Training.

- B. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.
  - 1. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.
  - 2. Insulation Installed Outdoors: Flame-spread rating of 75 or less, and smoke-developed rating of 150 or less.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.

#### 1.6 COORDINATION

- A. Coordinate clearance requirements with duct Installer for insulation application.

#### 1.7 SCHEDULING

- A. Schedule insulation application after testing duct systems. Insulation application may begin on segments of ducts that have satisfactory test results.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Mineral-Fiber Insulation:
    - a. CertainTeed Manson.
    - b. Knauf FiberGlass GmbH.
    - c. Owens-Corning Fiberglas Corp.
    - d. Schuller International, Inc.
  - 2. Flexible Elastomeric Thermal Insulation:
    - a. Armstrong World Industries, Inc.
    - b. Rubatex Corp.
  - 3. Closed-Cell Phenolic-Foam Insulation:
    - a. Kooltherm Insulation Products, Ltd.

4. Calcium Silicate Insulation:
  - a. Owens-Corning Fiberglas Corp.
  - b. Pabco.
  - c. Schuller International, Inc.

## 2.2 INSULATION MATERIALS

- A. Mineral-Fiber Board Thermal Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IB, without facing and with all-service jacket manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film.
- B. Mineral-Fiber Blanket Thermal Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II, without facing and with all-service jacket manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film.
- C. Flexible Elastomeric Thermal Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type II for sheet materials.
  1. Adhesive: As recommended by insulation material manufacturer.
  2. Ultraviolet-Protective Coating: As recommended by insulation manufacturer.
- D. Closed-Cell Phenolic-Foam Insulation: Block insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type II, Grade 1.
- E. Calcium Silicate Insulation: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a nonasbestos fibrous reinforcement. Comply with ASTM C 533, Type I.

## 2.3 FIELD-APPLIED JACKETS

- A. General: ASTM C 921, Type 1, unless otherwise indicated.
- B. Foil and Paper Jacket: Laminated, glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil.
- C. Stainless-Steel Jacket: Deep corrugated sheets of stainless steel complying with ASTM A 666, Type 304 or 316; 0.10 inch thick; and roll stock ready for shop or field cutting and forming to indicated sizes.
  1. Moisture Barrier: 3-mil- thick, heat-bonded polyethylene and kraft paper.
  2. Jacket Bands: Stainless steel, Type 304, 3/4 inch wide.

## 2.4 ACCESSORIES AND ATTACHMENTS

- A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, presized a minimum of 8 oz./sq. yd..
  1. Tape Width: 4 inches.

- B. Bands: 3/4 inch wide, in one of the following materials compatible with jacket:
  - 1. Stainless Steel: ASTM A 666, Type 304; 0.020 inch thick.
  - 2. Galvanized Steel: 0.005 inch thick.
  - 3. Aluminum: 0.007 inch thick.
  - 4. Brass: 0.010 inch thick.
  - 5. Nickel-Copper Alloy: 0.005 inch thick.
- C. Wire: 0.080-inch, nickel-copper alloy; 0.062-inch, soft-annealed, stainless steel; or 0.062-inch, soft-annealed, galvanized steel.
- D. Self-Adhesive Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct and plenum with adhesive. Pin length sufficient for insulation thickness indicated.

## 2.5 VAPOR RETARDERS

- A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

## 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.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

### 3.3 GENERAL APPLICATION REQUIREMENTS

- A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; and free of voids throughout the length of ducts and fittings.
- B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each duct system.
- C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

- D. Apply multiple layers of insulation with longitudinal and end seams staggered.
- E. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- F. Keep insulation materials dry during application and finishing.
- G. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- H. Apply insulation with the least number of joints practical.
- I. Apply insulation over fittings and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
- J. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic. Apply insulation continuously through hangers and around anchor attachments.
- K. Insulation Terminations: For insulation application where vapor retarders are indicated, seal ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
- L. Apply insulation with integral jackets as follows:
  - 1. Pull jacket tight and smooth.
  - 2. Joints and Seams: Cover with tape and vapor retarder as recommended by insulation material manufacturer to maintain vapor seal.
  - 3. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- M. Cut insulation according to manufacturer's written instructions to prevent compressing insulation to less than 75 percent of its nominal thickness.
- N. Install vapor-retarder mastic on ducts and plenums scheduled to receive vapor retarders.
  - 1. Ducts with Vapor Retarders: Overlap insulation facing at seams and seal with vapor-retarder mastic and pressure-sensitive tape having same facing as insulation. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-retarder seal.
  - 2. Ducts without Vapor Retarders: Overlap insulation facing at seams and secure with outward clinching staples and pressure-sensitive tape having same facing as insulation.
- O. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.
  - 1. Seal penetrations with vapor-retarder mastic.
  - 2. Apply insulation for exterior applications tightly joined to interior insulation ends.
  - 3. Seal insulation to roof flashing with vapor-retarder mastic.
- P. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and partitions, except fire-rated walls and partitions.

- Q. Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire/smoke damper sleeves for fire-rated wall and partition penetrations.
- R. Floor Penetrations: Terminate insulation at underside of floor assembly and at floor support at top of floor.
  - 1. For insulation indicated to have vapor retarders, taper termination and seal insulation ends with vapor-retarder mastic.

### 3.4 MINERAL-FIBER INSULATION APPLICATION

- A. Blanket Applications for Ducts and Plenums: Secure blanket insulation with adhesive and anchor pins and speed washers.
  - 1. Apply adhesives according to manufacturer's recommended coverage rates per square foot, for 100 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 anchor pins and speed washers on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    - a. On duct sides with dimensions 18 inches and smaller, 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 16 inches o.c. each way, and 3 inches maximum from insulation joints. Apply additional pins and clips to hold insulation tightly against surface at cross bracing.
    - c. Anchor pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    - d. Do not over compress insulation during installation.
  - 4. Impale insulation over anchors and attach speed washers.
  - 5. 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.
  - 6. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation segment with 1/2-inch staples, 1 inch o.c., and cover with pressure-sensitive tape having same facing as insulation.
  - 7. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. Secure with steel band at end joints and spaced a maximum of 18 inches o.c.
  - 8. Apply insulation on rectangular duct elbows and transitions with a full insulation segment for each surface. Apply insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
  - 9. Insulate duct stiffeners, hangers, and flanges that protrude beyond the insulation surface with 6-inch- wide strips of the same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 inches on centers.
  - 10. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.
- B. Board Applications for Ducts and Plenums: Secure board insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per square foot, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Space anchor pins as follows:
  - a. On duct sides with dimensions 18 inches and smaller, 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 16 inches o.c. each way, and 3 inches maximum from insulation joints. Apply additional pins and clips to hold insulation tightly against surface at cross bracing.
  - c. Anchor pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
  - d. Do not over compress insulation during installation.
4. 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. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation segment with 1/2-inch staples, 1 inch o.c., and cover with pressure-sensitive tape having same facing as insulation.
6. Apply insulation on rectangular duct elbows and transitions with a full insulation segment for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Apply 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 the insulation surface with 6-inch- wide strips of the same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 inches o.c.
8. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.

### 3.5 FLEXIBLE ELASTOMERIC THERMAL INSULATION APPLICATION

- A. Apply insulation to ducts and plenums as follows:
  1. Follow the manufacturer's written instructions for applying insulation.
  2. Seal longitudinal seams and end joints with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the duct and plenum surface.

### 3.6 CLOSED-CELL PHENOLIC-FOAM INSULATION APPLICATION

- A. Apply insulation as follows:
  1. Secure each layer of insulation to duct with stainless-steel bands at 12-inch (300-mm) intervals and tighten without deforming the insulation materials.
  2. Apply two-layer insulation with joints tightly butted and staggered at least 3 inches (75 mm). Secure inner layer with 0.062-inch (1.6-mm), soft-annealed, stainless-steel wire

spaced at 12-inch (300-mm) intervals. Secure outer layer with stainless-steel bands at 12-inch (300-mm) intervals.

3. On exposed applications, finish insulation with a skim coat of mineral-fiber, hydraulic-setting cement to surface of installed insulation. When dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch (25 mm). Apply finish coat of lagging adhesive over glass cloth or tape. Thin the finish coat to achieve smooth finish.

### 3.7 FIELD-APPLIED JACKET APPLICATION

- A. Apply glass-cloth jacket, where indicated, directly over bare insulation or insulation with factory-applied jackets.
  1. Apply 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 jacket manufacturer's recommended adhesive.
  3. Completely encapsulate insulation with jacket, leaving no exposed raw insulation.

### 3.8 FINISHES

- A. Glass-Cloth Jacketed Insulation: Paint insulation finished with glass-cloth jacket as specified in Division 9 Section "Painting."
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

### 3.9 DUCT SYSTEM APPLICATIONS

- A. Insulation materials and thicknesses are specified in schedules at the end of this Section.
- B. Materials and thicknesses for systems listed below are specified in schedules at the end of this Section.
- C. Insulate the following plenums and duct systems:
  1. Indoor concealed supply-, return-, and outside-air ductwork.
  2. Indoor exposed supply-, return-, and outside-air ductwork.
  3. Outdoor exposed supply and return ductwork.
  4. Indoor concealed exhaust ductwork.
- D. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:
  1. Metal ducts with duct liner.
  2. Factory-insulated flexible ducts.
  3. Factory-insulated double wall ducts.

4. Factory-insulated plenums, casings, terminal boxes, and filter boxes and sections.
5. Flexible connectors.
6. Vibration-control devices.
7. Testing agency labels and stamps.
8. Nameplates and data plates.
9. Access panels and doors in air-distribution systems.

3.10 INDOOR DUCT AND PLENUM APPLICATION SCHEDULE

A. Service: Round, supply-air ducts, concealed.

1. Material: Mineral-fiber blanket.
2. Thickness: 2 inches.
3. Number of Layers: One.
4. Field-Applied Jacket: Foil and paper.
5. Vapor Retarder Required: Yes.

B. Service: Round, outside-air ducts, concealed.

1. Material: Mineral-fiber blanket
2. Thickness: 1-1/2 inches.
3. Number of Layers: One.
4. Field-Applied Jacket: Foil and paper.
5. Vapor Retarder Required: Yes

C. Service: Rectangular, supply-air ducts, concealed.

1. Material: Mineral-fiber blanket.
2. Thickness: 2 inches.
3. Number of Layers: One
4. Field-Applied Jacket: Foil and paper
5. Vapor Retarder Required: Yes.

D. Service: Rectangular, return/exhaust-air ducts, concealed.

1. Material: Mineral-fiber blanket.
2. Thickness: 1-1/2 inches.
3. Number of Layers: One.
4. Field-Applied Jacket: Foil and paper.
5. Vapor Retarder Required: Yes

E. Service: Rectangular, outside-air ducts, concealed.

1. Material: Mineral-fiber blanket.
2. Thickness: 1 1/2 inches.
3. Number of Layers: One.
4. Field-Applied Jacket: Foil and paper.
5. Vapor Retarder Required: Yes.

F. Service: Round, return-air ducts, exposed.

1. Material: Mineral-fiber blanket
2. Thickness: 1-1/2 inches
3. Number of Layers: One
4. Field-Applied Jacket: Foil and paper
5. Vapor Retarder Required: Yes

G. Service: Round, double-wall supply-air ducts, exposed.

1. Material: Mineral-fiber blanket
2. Thickness: 2 inches.
3. Number of Layers: One
4. Field-Applied Jacket: NA
5. Vapor Retarder Required: Yes

H. Service: Round, outside-air ducts, exposed.

1. Material: Mineral-fiber blanket.
2. Thickness: 1-1/2 inches.
3. Number of Layers: One
4. Field-Applied Jacket: Foil and paper.
5. Vapor Retarder Required: Yes

I. Service: Rectangular, supply-air ducts, exposed.

1. Material: Mineral-fiber board
2. Thickness: 2 inches.
3. Number of Layers: One.
4. Field-Applied Jacket: Foil and paper.
5. Vapor Retarder Required: Yes.

J. Service: Rectangular, return-air ducts, exposed.

1. Material: Mineral-fiber board.
2. Thickness: 1-1/2 inches.
3. Number of Layers: One
4. Field-Applied Jacket: Foil and paper
5. Vapor Retarder Required: Yes.

K. Service: Rectangular, outside-air (ventilation) ducts, exposed.

1. Material: Mineral-fiber blanket.
2. Thickness: 1-1/2 inches.
3. Number of Layers: One
4. Field-Applied Jacket: Foil and paper
5. Vapor Retarder Required: Yes.

### 3.11 OUTDOOR DUCT AND PLENUM APPLICATION SCHEDULE

A. Service: Round, supply and return air ducts.

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1. Material: Mineral-fiber board.
  2. Thickness: 2 inches.
  3. Number of Layers: One.
  4. Field-Applied Jacket: Glass cloth.
  5. Field-Applied Jacket: Stainless steel.
    - a. Corrugation Dimension: 1-1/4 by 1/4 inch.
  6. Vapor Retarder Required: Yes.
- B. Service: Rectangular, supply and return air ducts.
1. Material: Mineral-fiber board.
  2. Thickness: 2 inches.
  3. Number of Layers: One.
  4. Field-Applied Jacket: Glass cloth.
  5. Field-Applied Jacket: Stainless steel.
    - a. Corrugation Dimension: 1-1/4 by 1/4 inch.
  6. Vapor Retarder Required: Yes.

END OF SECTION

**SECTION 15110**

**VALVES**

**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 general-duty valves:

1. Bronze angle valves.
2. Copper-alloy ball valves.
3. Ferrous-alloy butterfly valves.
4. Check valves.
5. Bronze gate valves.
6. Cast-iron gate valves.
7. Bronze globe valves.
8. Cast-iron globe valves.
9. Plug Valves

- B. Related Sections include the following:

1. Division 15 Section "Mechanical General Requirements"
2. Division 15 Section "Mechanical Identification" for valve tags and charts.
3. Division 15 Section "Mechanical Identification"
4. Division 15 Section "Pipe Insulation"
5. Division 15 Section "Building Management System" for control valves and actuators.
6. Division 15 piping Sections for specialty valves applicable to those Sections only.

**1.3 DEFINITIONS**

- A. The following are standard abbreviations for valves:

1. CWP: Cold working pressure.
2. EPDM: Ethylene-propylene-diene terpolymer rubber.
3. NBR: Acrylonitrile-butadiene rubber.
4. PTFE: Polytetrafluoroethylene plastic.
5. TFE: Tetrafluoroethylene plastic.

**1.4 SUBMITTALS**

- A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

#### 1.5 QUALITY ASSURANCE

- A. ASME Compliance: ASME B31.1 for power piping valves and ASME B31.9 for building services piping valves.
  - 1. Exceptions: Sanitary waste, and storm drainage piping valves unless referenced.
- B. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.
- C. NSF Compliance: NSF 61 for valve materials for potable-water service.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
  - 1. Protect internal parts against rust and corrosion.
  - 2. Protect threads, flange faces, grooves, and weld ends.
  - 3. Set 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 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 VALVES, GENERAL

- A. Refer to Part 3 "Valve Applications" Article for applications of valves.
- B. Bronze Valves: NPS 2 and smaller with threaded ends, unless otherwise indicated.
- C. Ferrous Valves: NPS 2-1/2 and larger with flanged ends, unless otherwise indicated.
- D. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- E. Valve Sizes: Same as upstream pipe, unless otherwise indicated.
- F. Valve Actuators:
  - 1. Gear Drive: For quarter-turn valves NPS 8 and larger.
  - 2. Handwheel: For valves other than quarter-turn types.
  - 3. Lever Handle: For quarter-turn valves NPS 6 and smaller, except plug valves.
  - 4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug head.
- G. Extended Valve Stems: On insulated valves.
- H. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.
- I. Valve Grooved Ends: AWWA C606.
- J. Solder Joint: (smaller sizes of plumbing piping only) With sockets according to ASME B16.18.
  - a. Caution: Use solder with melting point below 840 deg F for angle, check, gate, and globe valves; below 421 deg F for ball valves.
- K. Threaded: With threads according to ASME B1.20.1.
- L. Valve Bypass and Drain Connections: MSS SP-45.

2.3 BRONZE ANGLE VALVES

- A. Manufacturers:
  - 1. Type 1, Bronze Angle Valves with Metal Disc:
    - a. Cincinnati Valve Co.
    - b. Crane Co.; Crane Valve Group; Stockham Div.
    - c. Milwaukee Valve Company.
    - d. NIBCO INC.
- B. Type 1, Class 150, Bronze Angle Valves: Bronze body with bronze disc and union-ring bonnet.

2.4 CAST-IRON ANGLE VALVES

A. Manufacturers:

1. Type II, Cast-Iron Angle Valves with Metal Seats:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Crane Co.; Crane Valve Group; Stockham Div.
- d. NIBCO INC.

B. Cast-Iron Angle Valves, General: MSS SP-85, Type II.

C. Class 125, Cast-Iron Angle Valves: Bronze mounted with gray-iron body and bronze seats.

2.5 COPPER-ALLOY BALL VALVES

A. Manufacturers:

1. Two-Piece, Copper-Alloy Ball Valves:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Grinnell Corporation.
- c. NIBCO INC.
- d. Watts Industries, Inc.; Water Products Div.

B. Two-Piece, Copper-Alloy Ball Valves: Brass or bronze body with full-port, chrome-plated bronze ball; PTFE or TFE seats; and 600-psig minimum CWP rating and blowout-proof stem.

2.6 FERROUS-ALLOY BALL VALVES

A. Manufacturers:

1. American Valve, Inc.
2. Crane Co.; Crane Valve Group; Stockham Div.
3. Milwaukee Valve Company.
4. NIBCO INC.

B. Ferrous-Alloy Ball Valves: Class 150, full port.

2.7 FERROUS-ALLOY BUTTERFLY VALVES

A. Manufacturers:

1. Flangeless, Ferrous-Alloy Butterfly Valves:

- a. Crane Co.; Crane Valve Group; Stockham Div.
- b. Grinnell Corporation.

- c. NIBCO INC.
    - d. Watts Industries, Inc.; Water Products Div.
  - 2. Flanged, Ferrous-Alloy Butterfly Valves:
    - a. Cooper Cameron Corp.; Cooper Cameron Valves Div.
    - b. Grinnell Corporation.
    - c. Mueller Steam Specialty.
    - d. Tyco International, Ltd.; Tyco Valves & Controls.
  - 3. Grooved-End, Ductile-Iron Butterfly Valves:
    - a. Grinnell Corporation.
    - b. Milwaukee Valve Company.
    - c. NIBCO INC.
    - d. Victaulic Co. of America.
  - B. Ferrous-Alloy Butterfly Valves, General: MSS SP-67, Type I, for tight shutoff, with disc and lining suitable for potable water, unless otherwise indicated.
  - C. Flangeless, 175-psig CWP Rating, Ferrous-Alloy Butterfly Valves: Wafer type with one- or two-piece stem.
  - D. Flanged, 175-psig CWP Rating, Ferrous-Alloy Butterfly Valves: Flanged-end type with one- or two-piece stem.
  - E. Grooved-End, 175-psig CWP Rating, Ferrous-Alloy Butterfly Valves: Ductile-iron or steel body with grooved or shouldered ends.
- 2.8 BRONZE CHECK VALVES
- A. Manufacturers:
    - 1. Type 3, Bronze, Swing Check Valves with bronze disc.
      - a. Crane Co.; Crane Valve Group; Crane Valves.
      - b. Grinnell Corporation.
      - c. NIBCO INC.
      - d. Watts Industries, Inc.; Water Products Div.
    - B. Type 3, Class 150, Bronze, Swing Check Valves: Bronze body with bronze disc and seat.
- 2.9 FERROUS-ALLOY WAFER CHECK VALVES
- A. Manufacturers:
    - 1. Single-Plate, Ferrous-Alloy, Wafer Check Valves:
      - a. McWane, Inc.; Kennedy Valve Div.
      - b. Mueller Co.

- c. Tyco International, Ltd.; Tyco Valves & Controls.
    - d. Wheatley Gaso, Inc.
  - B. Single-Plate, Class 150, Ferrous-Alloy, Wafer Check Valves: Flangeless body.
  - C. Single-Plate, Class 150, Ferrous-Alloy, Double-Flanged Check Valves: Flanged-end body.
- 2.10 SPRING-LOADED, LIFT-DISC CHECK VALVES (for Pumps)
  - A. Manufacturers:
    - 1. Type I, Wafer Lift-Disc Check Valves:
      - a. Grinnell Corporation.
      - b. Milwaukee Valve Company.
      - c. Mueller Steam Specialty.
      - d. NIBCO INC.
    - 2. Type IV, Threaded Lift-Disc Check Valves:
      - a. Grinnell Corporation.
      - b. Mueller Steam Specialty.
      - c. NIBCO INC.
      - d. Watts Industries, Inc.; Water Products Div.
  - B. Lift-Disc Check Valves, General: FCI 74-1, with spring-loaded bronze or alloy disc and bronze or alloy seat.
  - C. Type I, Class 150, Wafer Lift-Disc Check Valves: Wafer style with cast-iron shell with diameter matching companion flanges.
  - D. Type IV, Class 150, Threaded Lift-Disc Check Valves: Threaded style with bronze shell and threaded ends.
- 2.11 BRONZE GATE VALVES
  - A. Manufacturers:
    - 1. Type 2, Bronze, Rising-Stem, Solid-Wedge Gate Valves:
      - a. Crane Co.; Crane Valve Group; Crane Valves.
      - b. Crane Co.; Crane Valve Group; Jenkins Valves.
      - c. Grinnell Corporation.
      - d. NIBCO INC.
    - B. Bronze Gate Valves, General: MSS SP-80, with ferrous-alloy handwheel.
    - C. Type 2, Class 150, Bronze Gate Valves: Bronze body with rising stem and bronze solid wedge and union-ring bonnet.

2.12 CAST-IRON GATE VALVES

A. Manufacturers:

1. Type I, Cast-Iron, Non-Rising or Rising -Stem Gate Valves:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Grinnell Corporation.
- c. NIBCO INC.
- d. Watts Industries, Inc.; Water Products Div.

B. Cast-Iron Gate Valves, General: MSS SP-70, Type I.

C. Class 125 NRS, Bronze-Mounted, Cast-Iron Gate Valves: Cast-iron body with bronze trim, non-rising stem, and solid-wedge disc.

D. Class 250, OS&Y, All-Iron, Cast-Iron Gate Valves: Cast-iron body with cast-iron trim, rising stem, and solid-wedge disc.

2.13 BRONZE GLOBE VALVES

A. Manufacturers:

1. Type 1, Bronze Globe Valves with Metal Disc:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Grinnell Corporation.
- c. Milwaukee Valve Company.
- d. NIBCO INC.

2. Type 3, Bronze Globe Valves with Renewable Seat and Metal Disc:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Grinnell Corporation.
- c. Milwaukee Valve Company.
- d. NIBCO INC.

B. Bronze Globe Valves, General: MSS SP-80, with ferrous-alloy handwheel.

C. Type 1, Class 150, Bronze Globe Valves: Bronze body with bronze disc and union-ring bonnet.

D. Type 3, Class 150, Bronze Globe Valves: Bronze body with bronze disc and renewable seat. Include union-ring bonnet.

2.14 CAST-IRON GLOBE VALVES

A. Manufacturers:

1. Type I, Cast-Iron Globe Valves with Metal Seats:

- a. Crane Co.; Crane Valve Group; Crane Valves.
  - b. Grinnell Corporation.
  - c. Milwaukee Valve Company.
  - d. NIBCO INC.
- B. Cast-Iron Globe Valves, General: MSS SP-85.
- C. Type I, Class 150, Cast-Iron Globe Valves: Gray-iron body with bronze seats.
- 2.15 FERROUS ALLOY ROTARY SEGMENTED PLUG VALVES
- A. Available Manufacturers:
- B. Manufacturers:
- 1. Nonlubricated-Type, Rotary Segmented Plug Valves:
    - a. Grinnell Corporation.
    - b. Mueller Flow Technologies.
    - c. Tyco International, Ltd.; Tyco Valves & Controls.
    - d. Wheatley Gaso, Inc.
    - e. Flowserve Corporation
    - f. Emerson
- C. Flanged or Flangeless, max. 175-psig CWP Rating, Ferrous-Alloy Rotary Segmented Plug Valves: one- or two-piece body, self centering seat ring. Range 300:1.
- D. ASME Class 150, Stainless steel trim, Graphite seat and Teflon Gasket.
- 2.16 CAST-IRON PLUG VALVES
- A. Available Manufacturers:
- B. Manufacturers:
- 1. Nonlubricated-Type, Cast-Iron Plug Valves:
    - a. Grinnell Corporation.
    - b. Mueller Flow Technologies.
    - c. Tyco International, Ltd.; Tyco Valves & Controls.
    - d. Wheatley Gaso, Inc.
    - e. Flowserve Corporation
- C. Cast-Iron Plug Valves, General: MSS SP-78.
- D. Class 150, nonlubricated-type, cast-iron plug valves.

2.17 RESILIENT-SEATED, CAST-IRON, ECCENTRIC PLUG VALVES

- A. Available Manufacturers:
- B. Manufacturers:
  - 1. General Signal; DeZurik Unit.
  - 2. Milliken Valve Company.
  - 3. Olson Technologies; Homestead Div.
  - 4. Pratt, Henry Company.
  - 5. Val-Matic Valve & Mfg. Corp.
  - 6. Flowserve Corporation
- C. Resilient-Seated, Cast-Iron, Eccentric Plug Valves, NPS 2-1/2 and Smaller: Design similar to MSS SP-108, and rated for 175-psig minimum CWP.
  - 1. Resilient Seating Material: Suitable for potable-water service, unless otherwise indicated.
- D. Resilient-Seated, Cast-Iron, Eccentric Plug Valves, NPS 3 and Larger: MSS SP-108, and rated for 175-psig minimum CWP.
  - 1. Resilient Seating Material: Suitable for potable-water service, unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.
  - 1. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- D. Examine threads on valve and mating pipe for form and cleanliness.
- E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- F. Do not attempt to repair defective valves; replace with new valves.

### 3.2 VALVE APPLICATIONS

- A. Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:
1. Shutoff Service: Ball, butterfly or gate valves.
  2. Throttling Service: Ball, butterfly or rotary segmented plug valves (for AHUs).
  3. Pump Discharge: Spring-loaded, lift-disc check valves.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.
- C. Chill and Hot Water Piping: Use the following types of valves:
1. Angle Valves, NPS 2 and Smaller: Type 2, Class 150, bronze.
  2. Angle Valves, NPS 2-1/2 and Larger: Type II, Class 150, cast iron.
  3. Ball Valves, NPS 2 and Smaller: Two-piece, 400-psig CWP rating, copper alloy.
  4. Ball Valves, NPS 2-1/2 and Larger: Class 150, ferrous alloy.
  5. Butterfly Valves, NPS 2-1/2 and Larger: Flanged, 150-psig CWP rating, ferrous alloy, with EPDM liner.
  6. Grooved-End, Ductile-Iron Butterfly Valves, NPS 2-1/2 and Larger: 175-psig CWP rating.
  7. Spring-Loaded, Lift-Disc Check Valves, NPS 2 and Smaller: Type IV, Class 150.
  8. Spring-Loaded, Lift-Disc Check Valves, NPS 2-1/2 and Larger: Type I or II, Class 250, cast iron.
  9. Gate Valves, NPS 2 and Smaller: Type 3, Class 150, bronze.
  10. Gate Valves, NPS 2-1/2 and Larger: Type I, Class 150 NRS, bronze-mounted cast iron.
  11. Globe Valves, NPS 2 and Smaller: Type 2, Class 150, bronze.
  12. Globe Valves, NPS 2-1/2 and Larger: Type I, Class 150, bronze-mounted cast iron.
  13. Rotary Segmented Plug Valves, NPS 1 and larger, 200-psig CWP rating, ferrous alloy, with stainless steel trim, graphite seat and Teflon Gasket.
  14. Plug Valves, NPS 2 and Larger: Class 150 nonlubricated-type, cast iron.
  15. Resilient-Seated, Eccentric Plug Valves, NPS 3 and Larger: 175-psig (1207-kPa) CWP rating, cast iron.
- D. Heating Water Piping: Use the following types of valves:
1. Angle Valves, NPS 2 and Smaller: Type 2, Class 150, bronze.
  2. Angle Valves, NPS 2-1/2 and Larger: Type II, Class 250, cast iron.
  3. Ball Valves, NPS 2 and Smaller: Two-piece, 400-psig CWP rating, copper alloy.
  4. Ball Valves, NPS 2-1/2 and Larger: Class 150, ferrous alloy.
  5. Butterfly Valves, NPS 2-1/2 and Larger: Flanged, 175-psig CWP rating, ferrous alloy, with EPDM liner.
  6. Grooved-End, Ductile-Iron Butterfly Valves, NPS 2-1/2 and Larger: 175-psig CWP rating.
  7. Lift Check Valves, NPS 2 and Smaller: Type 2, Class 150, bronze.
  8. Swing Check Valves, NPS 2 and Smaller: Type 4, 150, bronze.
  9. Swing Check Valves, NPS 2-1/2 and Larger: Type II, Class 250, gray iron.
  10. Grooved-End, Ductile-Iron, Swing Check Valves, NPS 2-1/2 and Larger: 175-psig CWP rating.
  11. Spring-Loaded, Lift-Disc Check Valves, NPS 2 and Smaller: Type IV, Class 150.

12. Spring-Loaded, Lift-Disc Check Valves, NPS 2-1/2 and Larger: Type I or II, Class 250, cast iron.
13. Gate Valves, NPS 2 and Smaller: Type 2, Class 150, bronze.
14. Gate Valves, NPS 2-1/2 and Larger: Type I, Class 250, NRS, bronze-mounted cast iron.
15. Globe Valves, NPS 2 and Smaller: Type 2, Class 150, bronze.
16. Globe Valves, NPS 2-1/2 and Larger: Type I, Class 250, bronze-mounted cast iron.
17. Rotary Segmented Plug Valves, NPS 1 ½ and larger, 200-psig CWP rating, ferrous alloy, with stainless steel trim, graphite seat and Teflon Gasket.
18. Plug Valves, NPS 2 (DN 50) and Larger: Class 150, lubricated -type, cast iron.
19. Resilient-Seated, Eccentric Plug Valves, NPS 3 and Larger: 175-psig CWP rating, cast iron.

E. Domestic Water Piping: Use the following types of valves:

1. Angle Valves, NPS 2 and Smaller: Type 2, Class 125, bronze.
2. Angle Valves, NPS 2-1/2 and Larger: Type II, Class 125, cast iron.
3. Ball Valves, NPS 2 and Smaller: Two-piece, 400-psig CWP rating, copper alloy.
4. Ball Valves, NPS 2-1/2 and Larger: Class 150, ferrous alloy.
5. Butterfly Valves, NPS 2-1/2 and Larger: Flanged, 150-psig CWP rating, ferrous alloy, with EPDM liner.
6. Grooved-End, Ductile-Iron Butterfly Valves, NPS 2-1/2 and Larger: 175-psig CWP rating.
7. Lift Check Valves, NPS 2 and Smaller: Type 2, Class 125 horizontal, bronze.
8. Swing Check Valves, NPS 2 and Smaller: Type 4, Class 125, bronze.
9. Swing Check Valves, NPS 2-1/2 and Larger: Type II, Class 125, gray iron.
10. Gate Valves, NPS 2 and Smaller: Type 1, Class 125, bronze.
11. Gate Valves, NPS 2-1/2 and Larger: Type I, Class 125 OS&Y, bronze-mounted cast iron.
12. Globe Valves, NPS 2 and Smaller: Type 2, Class 125, bronze.
13. Globe Valves, NPS 2-1/2 and Larger: Type I, Class 125, bronze-mounted cast iron.
14. Plug Valves, NPS 2 and Larger: Class 125, non-lubricated-type, cast iron.

G. Select valves, except wafer and flangeless types, with the following end connections:

15. For Copper Tubing, NPS 2 and Smaller: Solder-joint or threaded ends, except provide valves with threaded ends for chill water, condenser water and heating hot water services.
16. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged or threaded ends.
17. For Copper Tubing, NPS 5 and Larger: Flanged ends.
18. For Steel Piping, NPS 2 and Smaller: Threaded ends.
19. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged or threaded ends.
20. For Steel Piping, NPS 5 and Larger: Flanged ends.
21. For Grooved-End, Copper Tubing and Steel Piping: Valve ends may be grooved.

### 3.3 VALVE INSTALLATION

- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

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- B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- C. Locate valves for easy access and provide separate support where necessary.
- D. Install valves in horizontal piping with stem at or above center of pipe.
- E. Install valves in position to allow full stem movement.
- F. Coordinate actuator requirements with controls contractor.
- G. Install check valves for proper direction of flow and as follows:
  - 1. Swing Check Valves: In horizontal position with hinge pin level.
  - 2. Lift Check Valves: With stem upright and plumb.

## 3.4 JOINT CONSTRUCTION

- A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.
- B. Grooved Joints: Assemble joints with keyed coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.
- C. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

## 3.5 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.

END OF SECTION

**SECTION 15121**

**PIPE EXPANSION FITTINGS AND LOOPS**

**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 pipe expansion fittings and loops for mechanical piping systems, and the following:
  - 1. Expansion compensators
  - 2. Flexible-hose expansion Joints.
  - 3. Pipe bends and loops.
  - 4. Guides and anchors.

**1.3 PERFORMANCE REQUIREMENTS**

- A. Compatibility: Products suitable for piping system fluids, materials, working pressures, and temperatures.
- B. Capability: Absorb 200 percent of maximum piping expansion between anchors.

**1.4 SUBMITTALS**

- A. Product Data: For each type of expansion fitting indicated.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer.
  - 1. Design Calculations: For thermal expansion of piping systems and selection and design of expansion fittings and loops.
  - 2. Anchor Details: Detail fabrication of each indicated. Show dimensions and methods of assembly.
  - 3. Alignment Guide Details: Detail field assembly and anchorage.
- C. Welding Certificates: Copies of certificates for welding procedures and personnel.
- D. Schedule: Indicate manufacturer's number, size, location, and features for each expansion fitting and loop.

1.5 QUALITY ASSURANCE

- A. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Expansion Compensators:

- a. Adscos Manufacturing Corp.
- b. Flexicraft Industries.
- c. Flex-Weld, Inc.
- d. Hyspan Precision Products, Inc.
- e. Metraflex Co.
- f. Senior Flexonics, Inc.; Expansion Joint Div.

2. Flexible-Hose Expansion Joints:

- a. Flexicraft Industries.
- b. Metraflex Co.

3. Guides:

- a. Adscos Manufacturing Corp.
- b. Advanced Thermal Systems, Inc.
- c. B-Line Systems, Inc.
- d. Flex-Weld, Inc.
- e. Grinnell Corp.
- f. Hyspan Precision Products, Inc.
- g. Metraflex Co.

- B. Expansion Compensators: 175-psig minimum pressure rating, with internal guides, antitorque device, and removable end clip for positioning.

1. End Connections for NPS 2 and Smaller: Threaded.
2. End Connections for NPS 2-1/2 and Larger: Flanged.
3. Joints for Copper Piping: Two-ply, phosphor-bronze bellows and brass shroud.
4. Joints for Steel Piping: Two-ply, stainless-steel bellows and carbon-steel shroud.

- C. Flexible-Hose Expansion Joints: Manufactured assembly with two flexible-metal-hose legs joined by long-radius 180-degree return bend with inlet and outlet elbow fittings, corrugated-metal inner hoses, and braided outer sheaths. The prefabricated assembly shall be suitable for an operating pressure and temperature of the system. May have thread ends, flanged ends, or

sweat ends from 0.5 to 3". To be suitable for 1.5" or 4.0" of movement in compression or extension, as needed by system. Supply suitable drain/air release plug, and center support nut located at the bottom of the return elbow. Elbow materials and end fittings to be consistent with the pipe material. Approved Models, ML Expansion Loops by Flexicraft Industries.

1. Joints for Copper Piping: Copper fittings with solder-joint end connections.
  - a. NPS 2 and Smaller: Bronze hoses and double-braid bronze sheaths with 700 psig at 70 deg F and 500 psig at 450 deg F minimum pressure ratings.
  - b. NPS 2-1/2 to NPS 4: Stainless-steel hoses and double-braid, stainless-steel sheaths with 420 psig at 70 deg F and 315 psig at 450 deg F minimum pressure ratings.
2. Joints for Steel Piping: Carbon-steel fittings.
  - a. Joints for NPS 2 and Smaller: Stainless-steel hoses and double-braid, stainless-steel sheaths with 700 psig at 70 deg F and 515 psig at 600 deg F minimum pressure ratings.
  - b. Joints for NPS 2-1/2 to NPS 6: Stainless-steel hoses and double-braid, stainless-steel sheaths with 275 psig at 70 deg F and 200 psig at 600 deg F minimum pressure ratings.

## 2.2 GUIDES

- A. Steel, factory fabricated, with bolted two-section outer cylinder and base for alignment of piping and two-section guiding spider for bolting to pipe.

## 2.3 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M.
- B. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex head.
- C. Washers: ASTM F 844, steel, plain, flat washers.
- D. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, and tension and shear capacities appropriate for application.
  1. Stud: Threaded, zinc-coated carbon steel.
  2. Expansion Plug: Zinc-coated steel.
  3. Washer and Nut: Zinc-coated steel.
- E. Chemical Fasteners: Insert-type-stud bonding system anchor for use with hardened portland cement concrete, and tension and shear capacities appropriate for application.
  1. Bonding Material: ASTM C 881, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
  2. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud, unless otherwise indicated.
  3. Washer and Nut: Zinc-coated steel.

- F. Concrete: Portland cement mix, 3000 psi minimum. Refer to Division 3 Section "Cast-in-Place Concrete" for formwork, reinforcement, and concrete.
- G. Grout: ASTM C 1107, Grade B, factory-mixed and -packaged nonshrink and nonmetallic grout; suitable for interior and exterior applications.
  - 1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout.
  - 2. Properties: Nonstaining, noncorrosive, and nongaseous.
  - 3. Design Mix: 5000-psi, 28-day compressive strength.

### PART 3 - EXECUTION

#### 3.1 PIPE BEND AND LOOP INSTALLATION

- A. Install pipe bends and loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.
- B. Attach pipe bends and loops to anchors.
  - 1. Steel Anchors: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
  - 2. Concrete Anchors: Attach by fasteners. Follow fastener manufacturer's written instructions.

#### 3.2 SWING CONNECTIONS

- A. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.
- B. Connect risers and branch connections to terminal units with at least four pipe fittings, including tee in riser.
- C. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.

#### 3.3 GUIDE INSTALLATION

- A. Install guides on piping adjoining expansion fittings and loops.
- B. Attach guides to pipe and secure to building structure.

#### 3.4 ANCHOR INSTALLATION

- A. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

- B. Fabricate and install steel anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and AWS D1.1.
- C. Construct concrete anchors of poured-in-place concrete of dimensions indicated and include embedded fasteners.
- D. Install pipe anchors according to expansion fitting manufacturer's written instructions if expansion fittings are indicated.
- E. Use grout to form flat bearing surfaces for expansion fittings, guides, and anchors installed on or in concrete.

### 3.5 PAINTING

- A. Touching 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 a minimum dry film thickness of 2.0 mils.
- B. Touching Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 9 Section "Painting."
- 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 15122

### GAGES

#### 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 meters and gages for mechanical systems and water meters installed outside the building.
- B. Related Sections include the following:
  - 1. Division 15 Section "Plumbing Specialties".
  - 2. Division 15 Section "Hydronic Piping".
  - 3. Division 15 Section "Building Management System"
  - 4. Division 15 Mechanical equipment Sections that specify meters and gages as part of factory-fabricated equipment.

##### 1.3 SUBMITTALS

- A. Product Data: Include scale range, ratings, and calibrated performance curves for each meter, gage, fitting, specialty, and accessory specified.
- B. Shop Drawings: Include schedule indicating manufacturer's number, scale range, fittings, and location for each meter and gage.
- C. Product Certificates: Signed by manufacturers of meters and gages certifying accuracies under specified operating conditions and compliance with specified requirements.

#### PART 2 - PRODUCTS

##### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Liquid-in-Glass Thermometers:

- a. Terrice: H. O. Terrice Co.
- b. Weiss Instruments, Inc.
- c. WIKA Instruments Corp.
- d. Winter's Thermogauges, Inc.

2. Pressure Gages:

- a. Terrice: H. O. Terrice Co.
- b. Weiss Instruments, Inc.
- c. WIKA Instruments Corp
- d. AMETEK, Inc.; U.S. Gauge Div.

3. Test Plugs:

- a. Flow Design, Inc.
- b. Sisco Manufacturing Co.
- c. Terrice: H. O. Terrice Co.
- d. Watts Industries, Inc.; Water Products Div.

4. Venturi-Type Flow Elements:

- a. Armstrong Pumps, Inc.
- b. Bailey-Fischer & Porter Co.
- c. Flow Design, Inc.
- d. Victaulic Co. of America

2.2 THERMOMETERS, GENERAL

A. Scale Range: Temperature ranges for services listed are as follows:

1. Domestic Hot Water: 30 to 240 deg F, with 2-degree scale divisions
2. Domestic Cold Water: 0 to 100 deg F, with 2-degree scale divisions
3. Chill Water: 0 to 100 deg F, with 2-degree scale divisions
4. Heating Hot Water: 30 to 300 deg F, with 2-degree scale divisions

B. Accuracy: Plus or minus 1 percent of range span or plus or minus one scale division to maximum of 1.5 percent of range span.

2.3 LIQUID-IN-GLASS THERMOMETERS

A. Description: ASTM E 1.

B. Case: Die cast and aluminum finished in baked-epoxy enamel, glass front, spring secured, 9 inches long.

C. Adjustable Joint: Finish to match case, 180-degree adjustment in vertical plane, 360-degree adjustment in horizontal plane, with locking device.

D. Tube: Red or blue reading, organic-liquid filled with magnifying lens.

- E. Scale: Satin-faced non-reflective aluminum with permanently etched markings.
- F. Stem: Copper-plated steel, aluminum, or brass for separable socket; of length to suit installation.

#### 2.4 INSERTION DIAL THERMOMETERS

- A. Description: ASME B40.3, bimetal type.
- B. Dial: 1-inch diameter.
- C. Case: Stainless steel.
- D. Stem: Dustproof and leak proof 1/8-inch- diameter, tapered-end stem with nominal length of 5 inches

#### 2.5 SEPARABLE SOCKETS

- A. Description: Fitting with protective socket for installation in threaded pipe fitting to hold fixed thermometer stem.
  - 1. Material: Brass, for use in copper piping.
  - 2. Material: Stainless steel, for use in steel piping.
  - 3. Extension-Neck Length: Nominal thickness of 2 inches, but not less than thickness of insulation. Omit extension neck for sockets for piping not insulated.
  - 4. Insertion Length: To extend to center of pipe.

#### 2.6 THERMOMETER WELLS

- A. Description: Fitting with protective well for installation in threaded pipe fitting to hold test thermometer.
  - 1. Material: Brass, for use in copper piping.
  - 2. Material: Stainless steel, for use in steel piping.
  - 3. Extension-Neck Length: Nominal thickness of 2 inches, but not less than thickness of insulation. Omit extension neck for wells for piping not insulated.
  - 4. Insertion Length: To extend to center of pipe.
  - 5. Cap: Threaded, with chain permanently fastened to socket.
  - 6. Heat-Transfer Fluid: Oil or graphite.

#### 2.7 PRESSURE GAGES

- A. Description: ASME B40.1, phosphor-bronze bourdon-tube type with bottom connection; liquid-filled-case type.
- B. Case: Drawn steel, brass, or aluminum with 4-1/2-inch- diameter, glass lens.
- C. Connector: Brass, NPS 1/4.

- D. Scale: White-coated aluminum with permanently etched markings.
- E. Accuracy: Grade B, plus or minus 2 percent of middle 50 percent of scale.
- F. Range: Comply with the following:
  - 1. Vacuum: 30 inches Hg of vacuum to 15 psig of pressure .
  - 2. Fluids under Pressure: Two times the operating pressure.

2.8 PRESSURE-GAGE FITTINGS

- A. Valves: NPS 1/4 brass or stainless-steel needle type.
- B. Syphons: NPS 1/4 coil of brass tubing with threaded ends.
- C. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant porous-metal disc of material suitable for system fluid and working pressure.

2.9 TEST PLUGS

- A. Description: Nickel-plated, brass-body test plug in NPS 1/2 fitting.
- B. Body: Length as required to extend beyond insulation.
- C. Pressure Rating: 500 psig minimum.
- D. Core Inserts: Two self-sealing valves, suitable for inserting 1/8-inch OD probe from dial-type thermometer or pressure gage.
- E. Core Material for Air and Water: Minus 30 to plus 275 deg F, ethylene-propylene-diene terpolymer rubber.
- F. Test-Plug Cap: Gasketed and threaded cap, with retention chain or strap.
- G. Test Kit: Pressure gage and adapter with probe, two bimetal dial thermometers, and carrying case.
  - 1. Pressure Gage and Thermometer Range: Approximately two times the system's operating conditions.

2.10 Venturi Flow Elements: Differential-pressure-design, flow-element fitting made for installation in piping.

- 1. Construction: Bronze, brass, or factory-primed steel; with brass fittings and attached tag with flow conversion data. Include ends threaded for NPS 2 and smaller elements and flanged for NPS 2-1/2 and larger elements.
- 2. Pressure Rating: 250 psig.
- 3. Temperature Rating: 250 deg F.

PART 3 - EXECUTION

3.1 THERMOMETER INSTALLATION

- A. Install thermometers and adjust vertical and tilted positions.
- B. Install in the following locations:
  - 1. Inlet and outlet of each hydronic zone.
  - 2. Inlet and outlet of each hydronic boiler and chiller.
  - 3. Inlet and outlet of each hydronic coil in air-handling units.
- C. Install separable sockets in vertical position in piping tees where fixed thermometers are indicated.
  - 1. Install with socket extending to center of pipe.
  - 2. Fill sockets with oil or graphite and secure caps.
- D. Install thermometer wells in vertical position in piping tees where test thermometers are indicated.
  - 1. Install with stem extending to center of pipe.
  - 2. Fill wells with oil or graphite and secure caps.

3.2 PRESSURE-GAGE INSTALLATION

- A. Install pressure gages in piping tees with pressure-gage valve located on pipe at most readable position.
- B. Install dry-type pressure gages in the following locations:
  - 1. Discharge of each pressure-reducing valve.
  - 2. Building water-service entrance.
  - 3. Chilled-water and condenser-water inlets and outlets of chillers.
  - 4. Hot water inlet and outlet of each boiler
- C. Install liquid-filled-type pressure gages at suction and discharge of each pump.
- D. Install pressure-gage needle valve and snubber in piping to pressure gages.

3.3 FLOW-MEASURING SYSTEM INSTALLATION

- A. Install flow-measuring elements at discharge of each pump, at inlet of each hydronic coil, chillers, boilers, and elsewhere as indicated.
- B. Install differential-pressure-type flow elements with minimum straight lengths of pipe upstream and downstream from element as prescribed by manufacturer's written instructions.
- C. Install connection fittings for attachment to portable flow meters in accessible locations.

- D. Install connections, tubing, and accessories between flow elements and meters as prescribed by manufacturer's written instructions.

#### 3.4 CONNECTIONS

- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping and specialties. The following are specific connection requirements:
  1. Install gages adjacent to machines and equipment to allow service and maintenance.
  2. Install taps/wells for digital controls sensors where required by controls contractor.

#### 3.5 ADJUSTING AND CLEANING

- A. Calibrate according to manufacturer's written instructions, after installation.
- B. Adjust faces of gages to proper angle for best visibility.
- C. Clean windows of gages and clean factory-finished surfaces. Replace cracked and broken windows, and repair scratched and marred surfaces with manufacturer's touchup paint.

END OF SECTION

**SECTION 15131**  
**CHEMICAL TREATMENT**

**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 specifies cleaning and treatment of circulating HVAC water systems, including the following.

- 1. Cleaning compounds.
- 2. Chemical treatment for closed loop heat transfer systems.
- 3. Chemical treatment for open loop systems.

- B. Related Sections include the following:

- 1. Division 15 Section "Mechanical General Requirements"
- 2. Division 15 Section "Mechanical Identification" for valve tags and charts.
- 3. Division 15 Section "Mechanical Identification"
- 4. Division 15 Section "Hydronic Piping"

**1.3 QUALITY ASSURANCE**

- A. Technical Services: Provide the services of an experienced water treatment chemical engineer or technical representative to direct flushing, cleaning, pre-treatment, training, debugging, and acceptance testing operations; direct and perform chemical limit control during construction period and monitor systems for a period of 12 months after acceptance, including not less than 4 service calls and written status reports. During this period perform monthly tests of the cooling tower for Legionella pneumophila and submit reports stating Legionella bacteria count per millimeter. Minimum service during construction/start-up shall be 8 hours.
- B. Field Quality Control and Certified Laboratory Reports: During the one year guarantee period, the water treatment laboratory shall provide not less than 12 reports based on on-site periodic visits, as stated in paragraph 1.3.A, sample taking and testing, and review with personnel, of water treatment control for the previous period. In addition to field tests, the water treatment laboratory shall provide certified laboratory test reports. These monitoring reports shall assess chemical treatment

accuracy, scale formation, fouling and corrosion control, and shall contain instructions for the correction of any out-of-control condition.

- C. Log Forms: Provide one year supply of preprinted water treatment test log forms.

#### 1.4 SUBMITTALS

- A. Submit chemical water treatment company qualifications and resumes of chemical treatment technician(s) to be used on this project.
- B. Product Data: Submit manufacturer's water treatment equipment cut sheets, installation and start-up instructions.
- C. Shop drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loadings, required clearances, and methods of assembly of components.
- D. Maintenance Data: Submit maintenance data and part lists for water treatment equipment and accessory; including "trouble-shooting" maintenance guide. Include this data, provide product data and shop drawings as required. Instruct owner's personnel in the use and operation of the water treatment system.
- E. Manufacturer's Literature and Data:
1. Cleaning compounds and recommended procedures for their use.
  2. Chemical treatment for closed systems, including installation and operating instructions.
  3. Chemical treatment for open loop systems, including installation and operating instructions.
- F. Water analysis verification.
- G. Materials Safety Data Sheet for all proposed chemical compounds, based on U.S. Department of Labor Form No. L5B-005-4.

#### 1.5 APPLICABLE PUBLICATIONS

- A. The publication listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

National Fire Protection Association (NFPA):  
National Electric Code (NEC)

### PART 2 - PRODUCTS

#### 2.1 CLEANING COMPOUNDS

- A. Alkaline phosphate or non-phosphate detergent/surfactant/specific to remove organic soil, hydrocarbons, flux, pipe mill varnish, pipe compounds, iron oxide, and like deleterious substances, with or without inhibitor, suitable for system wetted metals without deleterious effects.

- B. Refer to Section 15181, HYDRONIC PIPING, PART 3, for flushing and cleaning procedures.

## 2.2 CHEMICAL TREATMENT FOR CLOSED LOOP SYSTEMS

- A. Inhibitor: Provide sodium nitrite/borate, molybdate-based inhibitor or other approved proprietary compound suitable for make-up quality and make-up rate and which will cause or enhance bacteria/corrosion problems or mechanical seal failure due to excessive total dissolved solids. Shot feed manually. Maintain inhibitor residual as determined by water treatment laboratory, taking into consideration residual and temperature effect on pump mechanical seals.
- B. pH Control: Inhibitor formulation shall include adequate buffer to maintain pH range of 8.0 to 10.5.
- C. Performance: Protect various wetted, coupled, materials of construction including ferrous, and red and yellow metals. Maintain system essentially free of scale, corrosion, and fouling. Corrosion rate of following metals shall not exceed specified mills per year penetration; ferrous, 0-2; brass, 0-1; copper, 0-1. Inhibitor shall be stable at equipment skin surface temperatures and bulk water temperatures of, respectively, not less than 250 degrees F and 125 degrees Fahrenheit.
- D. Pot Feeder: By-pass type, complete with necessary shut off valves, drain and air release valves, and system connections, for introducing chemicals into system, cast iron or steel tank with funnel or large opening on top for easy chemical addition. Feeders shall be five gallon minimum capacity at 150 psig minimum working pressure.

## 2.3 CHEMICAL TREATMENT FOR OPEN LOOP SYSTEM(S)

- A. General: Furnish a factory fabricated and tested packaged, self-contained, chemical feed/blowdown monitoring, controlling and alarming system, containing all except specified indicated remote components, and requiring only terminal sample stream and chemical piping/tubing connections, remote component electrical connection and power supply. System shall be suitable for a broad spectrum make-up water supply and chemical treatment program. Components, except those specified or indicated otherwise, shall be housed in one or more joined or divided steel enclosures. Furnish equipment to treat the cooling tower.
- B. System Functions:
1. Automatically maintain a predetermined, selectable, total dissolved solids concentration through a continuously monitoring conductivity controller, maintain a predetermined, selectable, scale/corrosion inhibitor and dispersant residual, through a continuously make-up monitoring meter/counter/timer and inhibitor/dispersant ratio controller; achieve a predetermined, selectable, peak concentration of one or two microbiocides as needed on an alternating basis, through a programmable timer controller. De-energize controller or stagger feed chemicals which would degrade or which are incompatible if fed simultaneously.
  2. Automatically maintain a predetermined, selectable, pH level through a continuously monitoring pH controller. Provide acid feed limit timer and audible/visual alarm actuated on low pH or by limit timer for systems with make up water alkalinity of 125 PPM or higher or hardness of 300 PPM or higher.
- C. Electric/Electronic Controller(s):

1. pH Control: Industrial duty, 100 percent solid state circuitry, preamplifier type, with glass sensor, audible and visual low pH alarm. Reference electrode shall have a non-clogging reference junction, at least one year supply of KCl saturated crystals or equivalent maintenance free construction. Electrode flow cell assembly shall be rated, at minimum, for service at 125 psig at 125 degrees F. Sensor and reference electrode shall be removable without tools. Control accuracy shall be 0.02 pH and long term stability of plus or minus 0.1 pH per year without recalibration of components. Zero adjustment shall be 0 - 25 percent of span and deadband adjustment shall 0 - 5 percent of span. Control range shall be manufacturer's standard for the service.
2. Conductivity Control: Industrial duty; 100 percent solid state type with audible and visual high conductivity alarm. Probes shall be removable without tools, manufacturer's standard material, except that metal probes requiring periodic plating are not acceptable. Probe assembly shall be rated, at minimum, for service at 125 psig at 125 degrees F. Probes with non-shock impressed AC current to minimize long term drift are required. Circuits shall be automatically temperature compensated over system application range. Calibration adjustment shall be 0 - 25 percent of span and deadband adjustment shall be 0 - 5 percent of span. Control range shall be 0 - 5000 micro-ohms.
3. Biocide Control: Industrial duty, 100 percent solid state electro/mechanical type, programmable to automatically control the feed of microbiocides, on a selected day or days of the week, time of day and feed increment, complete with any required relays.
4. Inhibitor/Dispersant Control: Industrial duty, solid state or electromechanical, adjustable, impulse counter, timer, and inhibitor/dispersant ratio controller, to receive make-up volumetric flow related impulses transmitted by contact head water meter and upon reaching count set-point, energize timer and ratio controller.

D. Mechanical Components:

1. Sample and chemical feed piping valves and specialties: Mechanical component section shall be fitted to external terminal points with sample stream/chemical injection manifold, chemical feed pump suction/discharge piping and tubing, including but not limited to isolation valves, strainer, flow cell assembly, flow switch, chemical injectors for each chemical fed and relief valves, drain valves, back pressure valves, sample back-flow check valves, air lock vent valves, and anti-syphon valves, as necessary for a properly functioning system. Provide flexible, transparent, integrally reinforced, PVC chemical feed pump suction tubing fitted with combination rigid PVC or CPVC foot-valve/strainer and assemble with all stainless steel component worm drive tubing clamps or PVC compression fittings. Rigid chemical injection piping shall be Schedule 80 CPVC.
2. System enclosures: System components shall be mounted in one or more joined or divided NEMA Class 1 enclosures with hinged, gasketed, lockable doors. Electric/electronic section shall be fitted with gasketed window door. Provide two sets of keys.
3. Chemical feed storage: Utilize shipping containers or those permanent containers provided by the water treatment contractor.
4. Chemical feed pumps: Simplex, self-priming, diaphragm positive displacement type, rated for chemical exposure encountered and with 25 percent safety factor pressure/temperature encountered. Minimum pressure/temperature rating shall be 80 psig 100 degrees F. Pumps shall be sized to operate in excess of 15 percent of minimum published liquid capacity and not in excess of 85 percent of maximum published strokes per minute. Microbiocide feed pump shall be sized to introduce required liquid volume within one-half hour. Within above

limitations, where two or more pumps are required, these shall be identical in size and materials, for the more severe chemical duty required. Pumps shall operate on 120 volt, 60 Hz, single phase power and shall be fitted with flexible power cord and three-prong plug.

- a. Reagent head: Reagent head to be isolated from power and constructed of rigid thermoplastic material, with double ceramic ball checks, reinforced polymer or elastomer diaphragm and polymer or elastomer seats and seals.
- b. Mounting shelves: Fabricate from carbon steel sheet metal or plastic to provide flat top and angled side panels complete with punched holes for pump wall mounting fasteners. Flange and hem sheet metal to provide load carrying capacity. Exposed metal surface shall be painted (3 mils).

E. Piping Specialties:

1. Blowdown valve: Include in a bleedoff piping assembly complete with inlet valve, strainer with flush valve, and blowdown valve with throttling provision.
  - a. Solenoid type: UL listed, packless type with brass, bronze, or stainless steel wetted parts, NEMA Class A. Continuous duty, watertight, encapsulated coil, NEMA Class 1 enclosures, rated for pressure and temperature encountered and 120 VAC power supply.
  - b. Solenoid pilot operated diaphragm type: UL listed, packless type with brass, bronze, or stainless steel wetted parts, NEMA Class A continuous duty, watertight, encapsulated coil, NEMA Class 1 enclosure, rated for 120 VAC power supply. Main valve shall be packless diaphragm type with cast iron body, bronze or stainless steel wetted metal trim and fasteners, nylon reinforced Buna N elastomer diaphragm, Buna N seats and seals, external throttling adjustment and non-slam closure.
2. In lieu of the field installed individual valves and injection system, the Contractor may provide chemical injection corporation stop and nozzle assembly suitable for installation into large diameter steel piping or plastic piping through a coupling or saddle, and shall include bronze or stainless steel corporation stop with one inch or less NPT threads, packing assembly, injection nozzle assembly complete with integral or external check valve, brass chain attached to corporation stop with length to limit nozzle assembly withdrawal until corporation stop is closed and nozzle discharge location adjustable to centerline of receiving pipe.
3. Make-up water meter: Rotating disc, in sizes 1-1/2 inch and smaller and turbine type in sizes 2 inches and over with bronze or cast iron body rated for 125 psig, magnetic drive or mechanical impulse contactor matched to signal receiver, and six or more digit totalizer. Contactor shall be rated at 120 VAC, minimum one ampere resistive.
4. Chemical feed pump ancillaries: Manufacturer's standard devices, constructed of PVC, CPVC polypropylene, or AISI Type 316 stainless steel, to suit installation conditions; relief valves where not integral to chemical feed pump, anti-syphon valve, back-pressure valve(s), airlock vent valve, foot valve/strainer combination for suction piping.
5. Strainer: Rigid PVC or CPVC conforming to ASTM D1784 with cleanable AISI Type 304 or 316 stainless steel strainer element.
6. Valves for plastic piping: Ball type, with rigid PVC or CPVC body conforming to ASTM D1784, integral union ends and polytetrafluoroethylene seats and seals.
7. Testing materials and equipment: The water treatment laboratory shall provide chemical reagents, glassware, hardware, instruments, and expendables, to perform all necessary chemical test functions.

- F. Chemicals: provide sufficient chemicals for start-up and testing and twelve months operation from date of project acceptance.
1. Scale/corrosion inhibitor: Provide a concentrated liquid organic corrosion/scale/ fouling inhibiting formation without phosphates, chromates, zinc and other materials in excess of allowable, local, effluent limits. Feed automatically. Maintain residual as determined by water treatment laboratory.
  2. Dispersant: Provide a concentrated liquid organic/polyelectrolyte formulation. Feed automatically. Maintain residual as determined by water treatment laboratory.
  3. pH Control: Depending upon local water conditions, provide 60 or 66 degree Baume technical grade, concentrated sulfuric acid for acidic treatment or sodium hydroxide (NaOH) for basic treatment to maintain pH in the range of 7.0 to 8.0 automatically. Provide one initial 12.5 gallon carboy of acid or base and one spare carboy of acid or base, if required.
  4. Microbiocides: Provide two different, one oxidizing and one non-oxidizing, concentrated algaecide-biocide formulations containing no heavy metals and which are effective at maximum encountered pH. Alternate solutions as needed to effectuate selective kill without build-up of immunity. Period treatment with a chlorine releasing agent is permissible within allowable, local, effluent limits. Feed automatically. Develop peak concentration and maintain for minimum period as determined by water treatment laboratory.
- G. Water Analysis: Confirm raw water analysis or provide analysis if none is furnished:

Description Year (Avg.)

Silica (SiO<sub>2</sub>) \_\_\_\_\_

Iron & Aluminum \_\_\_\_\_

Calcium (Ca) \_\_\_\_\_

Magnesium (Mg) \_\_\_\_\_

Sodium (Na) & Potassium (K) \_\_\_\_\_

Carbonate (CO<sub>3</sub>) \_\_\_\_\_

Bicarbonate (HCO<sub>3</sub>) \_\_\_\_\_

Sulfate (SO<sub>4</sub>) \_\_\_\_\_

Chloride (Cl) \_\_\_\_\_

Nitrate (NO<sub>3</sub>) \_\_\_\_\_

Turbidity \_\_\_\_\_

pH \_\_\_\_\_

Residual Chlorine \_\_\_\_\_

Total Alkalinity \_\_\_\_\_

Non Carbonate Hardness \_\_\_\_\_

Total Hardness \_\_\_\_\_

Dissolved Solids \_\_\_\_\_

H. Conduct performance test to prove capacity and performance of treatment system.

Raw water total hardness, PPM \_\_\_\_\_

Concentration cycles \_\_\_\_\_

Raw water, pH \_\_\_\_\_

System water, pH \_\_\_\_\_

Chemical solution used \_\_\_\_\_

Acid solution used \_\_\_\_\_

Quantity of chemical solution injected into system per cycle \_\_\_\_\_

Quantity of acid injected into system per cycle \_\_\_\_\_

Make up water required \_\_\_\_\_

Waste to drain requirement \_\_\_\_\_

PART 3 - EXECUTION

3.1 PRE –OPERATIONAL SYSTEM CLEAN-OUT

Correct pre-treatment cleaning and protection of all hydronic systems are necessary for proper future operations. All dirt, pipe dope, grease and oil are to be removed from all piping.

Immediately following hydrostatic testing, the pre-treatment cleaning chemical BC 89L should be dosed. The cleaner chemical used should not require heating to be effective. The pH should not be higher than 9.0 units and the total alkalinity limited to 2000 ppm. This is to be circulated for 24-48 hours and then flushed from the system with a running flush until the total alkalinity of the system water is the same as that of the make up water. All cleaner chemical is to be removed from the system before dosing the corrosion inhibitor. This fact is to be confirmed by the water treatment vendor. Where required, all cleaner chemicals to be removed from the jobsite by the water treatment vendor.

Immediately following pre-treatment cleaning, the corrosion and scale control chemical B939L should be dosed. The water treatment vendor must confirm the correct level of inhibition chemical.

The water treatment vendor is to submit a written report to the engineer that the systems were flushed and cleaned, the cleaner totally removed and the inhibition chemicals dosed to the required levels.

3.2 SERVICE REQUIREMENTS AND FREQUENCY

A. The water treatment vendor shall provide all consulting services for a period of one year from start up of the cooling/chilled/heating systems and will include:

1. Installation and system start-up procedure recommendations.

2. Pre-operation system cleanout procedure supervision.
3. Initial water analysis and recommendations.
4. Training of operating personnel on proper feeding and control techniques.
5. Monthly field service, although additional visits may be required during startup and during seasonal operational changes.
6. Submission of reports/log sheets to engineer.
7. Laboratory and technical assistance.

### 3.3 INSPECTION

- A. Examine areas and conditions under which the water treatment equipment is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to the Contracting Officer.
- B. Delivery and Storage: Deliver all chemicals in manufacturer's sealed shipping containers. Store in designated space and protect from deleterious exposure and hazardous spills.

### 3.4 INSTALLATION OF WATER TREATMENT SYSTEM

- A. Install water treatment equipment in accordance with manufacturer's published installation instructions, complying with recognized industrial practices to ensure that the installed system comply with requirements and serve intended purposes.
- B. Access: Provide access space around industrial water treatment system for maintenance and for service as indicated, but in no case less than that recommended by the manufacturer.
- C. Piping connections: Provide piping valves, accessories, gages, supports, etc., as required.
- D. Support: Install chemical feed tanks, supported from platform, stands, piping, or foundation.
- E. Charge systems according to the manufacturer's instructions and as directed by the Technical Representative.
- F. Before adding cleaning chemical to the closed system, all air handling coils, PIUs and VAV coil units should be isolated by closing the inlet and outlet valves and opening the bypass valves. This is done to prevent dirt and solids from lodging the coils.
- G. After chemical cleaning is satisfactorily completed, open the inlet and outlet valves to each coil and close the by-pass valves. Also, clean all strainers.
- H. Perform tests and report results.

### 3.5 O&M MANUALS

- A. Include manufacturer's technical product data, including MSDS sheets and installation instructions for water conditioning materials and products. Include data on conductivity and dosing controllers, chemical feed pumps, by-pass filter/ feeders, corrosion coupon racks, solids separators, filters and any other equipment specified or offered.
- B. Msds sheets for all chemicals used to be left on site in respective mechanical rooms attached to the relevant chemical tanks.

- C. Instruct personnel in system maintenance and operation.

END OF SECTION

**SECTION 15140**  
**DOMESTIC WATER PIPING**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes domestic water piping from locations indicated to fixtures and equipment inside the building.
- B. Related Sections include the following:
  - 1. Division 15 Section "Gages" for thermometers, pressure gages, and fittings.
  - 2. Division 15 Section "Plumbing Specialties" for water distribution piping specialties.
  - 3. Division 15 Section "Valves".
  - 4. Division 15 Section "Pipe Insulation"

1.3 DEFINITIONS

- A. PE: Polyethylene plastic.
- B. PVC: Polyvinyl chloride plastic.

1.4 PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing domestic water piping systems with the following minimum working-pressure ratings, unless otherwise indicated:
  - 1. Domestic Water Service Piping: 160 psig.
  - 2. Domestic Water Distribution Piping: 125 psig.

1.5 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Water Samples: Specified in "Cleaning" Article in Part 3.
- C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.6 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 61, "Drinking Water System Components-Health Effects; Sections 1 through 9," for potable domestic water piping and components.
- C. CODES AND STANDARDS
  - 1. Install work to conform to:
    - a. State Plumbing Code, latest edition with local amendments.
    - b. State Gas Code, latest edition with local amendments.
    - c. NFPA 54.
    - d. Comply with NSF 61, "Drinking Water System Components-Health Effects; Sections 1 through 9," for potable domestic water piping and components.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. THIS PROJECT USES A RETURN PLENUM, NO PVC PIPING ALLOWED IN RETURN AIR PLENUM!
- B. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.
- C. Transition Couplings for Aboveground Pressure Piping: Coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
- D. Transition Couplings for Underground Pressure Piping: AWWA C219, metal, sleeve-type coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

2.2 STEEL PIPING

- A. Steel Pipe: ASTM A 53, Schedule 40, galvanized. Include ends matching joining method.
  - 1. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53 or ASTM A 106, Schedule 40, galvanized, seamless steel pipe. Include ends matching joining method.
  - 2. Malleable-Iron Unions: ASME B16.39, Class 150, hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface, and female threaded ends.
  - 3. Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, galvanized, standard pattern.
  - 4. Cast-Iron Flanges: ASME B16.1, Class 125.
  - 5. Cast-Iron, Flanged Fittings: ASME B16.1, Class 125, galvanized.
  - 6. Steel-Piping, Grooved-End Fittings: ASTM A 47 galvanized, malleable-iron casting; ASTM A 106, galvanized, steel pipe; or ASTM A 536, galvanized, ductile-iron casting; with dimensions matching steel pipe.

- a. Steel-Piping, Keyed Couplings: AWWA C606, for steel-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.
7. Steel-Piping, Expansion Joints: Compound, galvanized, steel fitting with telescoping body and slip-pipe section. Include packing rings, packing, limit rods, chrome-plated finish on slip-pipe sections, and flanged ends.

## 2.3 COPPER TUBING

- A. Copper Tube: ASTM B 88, Types K and L, water tube, annealed temper.
  1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
  2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
  3. 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.
- B. Hard Copper Tube: ASTM B 88, Types L and M (ASTM B 88M, Types B and C), water tube, drawn temper.
  1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
  2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
  3. 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.
  4. Copper, Grooved-End Fittings: ASTM B 75 (ASTM B 75M) copper tube or ASTM B 584 bronze castings.
    - a. Copper-Tubing, Keyed Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, gasket suitable for hot water, and bolts and nuts.

## 2.4 PE ENCASUREMENT

- A. PE Encasement for Underground Metal Piping: ASTM A 674 or AWWA C105 PE film, 0.008-inch minimum thickness, tube or sheet.

## 2.5 VALVES

- A. Refer to Division 15 Section "Valves" for bronze and cast-iron, general-duty valves.
- B. Refer to Division 15 Section "Plumbing Specialties" for balancing and drain valves.

## PART 3 - EXECUTION

3.1 EXCAVATION

- A. Refer to Division 2 Section "Earthwork" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.
- B. Flanges may be used on aboveground piping, unless otherwise indicated.
- C. Grooved joints may be used on aboveground grooved-end piping.
- D. Underground Domestic Water Service Piping: Use the following piping materials for each size range:
1. NPS 2 and Smaller: Soft copper tube, Type K; copper pressure fittings; and soldered joints.
  2. NPS 2-1/2 to NPS 3-1/2: Use NPS 3 or NPS 4 ductile-iron pipe; mechanical joint, ductile-iron fittings; and restrained, gasketed joints.
  3. NPS 4 to NPS 8: Mechanical-joint, ductile-iron pipe; mechanical joint, ductile-iron fittings; and restrained, gasketed joints.
- E. Aboveground Domestic Water Piping: Use the following piping materials for each size range:
1. NPS 1-1/2 and Smaller: Hard copper tube, Type L; copper pressure fittings; and soldered joints.
  2. NPS 2: Hard copper tube, Type L; copper pressure fittings; and soldered joints.
  3. NPS 2-1/2 to NPS 3-1/2: Hard copper tube, Type L; copper pressure fittings; and soldered joints.
  4. NPS 4 and larger: Steel pipe; gray-iron, threaded fittings; and threaded joints or steel pipe with grooved ends; steel-piping, grooved-end fittings; steel-piping, keyed couplings; and grooved joints.
- F. Underground Domestic Water Piping NPS 4 and Smaller: Hard copper tube, Type L; copper pressure fittings; and soldered joints.
- G. Nonpotable-Water Piping: Use the following piping materials for each size range:
1. NPS 3-1/2 and Smaller: Steel pipe; gray-iron, threaded fittings; and threaded joints.

2. NPS 4 to NPS 8: Steel pipe; gray-iron, threaded fittings; and threaded joints or steel pipe with grooved ends; steel-piping, grooved-end fittings; steel-piping, keyed couplings; and grooved joints.

### 3.3 VALVE APPLICATIONS

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
  1. Shutoff Duty: Use bronze ball or gate valves for piping NPS 2 and smaller. Use cast-iron butterfly or gate valves with flanged ends for piping NPS 2-1/2 and larger.
  2. Throttling Duty: Use bronze ball or globe valves for piping NPS 2 and smaller. Use cast-iron butterfly valves with flanged ends for piping NPS 2-1/2 and larger.
  3. Hot-Water-Piping, Balancing Duty: Memory-stop balancing valves.
  4. Drain Duty: Hose-end drain valves.
- B. Cast-iron, grooved-end valves may be used with grooved-end piping.

### 3.4 PIPING INSTALLATION

- A. Refer to Division 2 Section "Water Distribution" for site water distribution and service piping.
- B. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping installation.
- C. Extend domestic water service piping to exterior water distribution piping in sizes and locations indicated.
- D. Install underground ductile-iron piping according to AWWA C600. Install buried piping inside building between wall and floor penetrations and connection to water service piping outside building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.
  1. Encase piping with polyethylene film according to ASTM A 674 or AWWA C105.
- E. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for sleeves and mechanical sleeve seals.
- F. Install aboveground domestic water piping level with 0.25 percent slope downward toward drain and plumb.
- G. Fill water piping. Check components to determine that they are not air bound and that piping is full of water.
- H. Perform the following steps before operation:
  1. Close drain valves, hydrants, and hose bibbs.
  2. Open shutoff valves to fully open position.

3. Open throttling valves to proper setting.
  4. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
  5. Remove and clean strainer screens. Close drain valves and replace drain plugs.
  6. Remove filter cartridges from housings, and verify that cartridges are as specified for application where used and that cartridges are clean and ready for use.
- 
- I. Check plumbing equipment and verify proper settings, adjustments, and operation. Do not operate water heaters before filling with water.
  - J. Check plumbing specialties and verify proper settings, adjustments, and operation.
    1. Water-Pressure Regulators: Set outlet pressure at 60 psig maximum, unless otherwise indicated.
  - M. All indoor domestic water piping shall be insulated throughout.
- 
- ### 3.5 INSTALLATION - FLOOR DRAINS
- A. Locate floor drains accurately as required to receive equipment drains and to coordinate with equipment location.
  - B. Coordinate with placement of concrete to locate drainage products in low points of areas to be drained, with body set at proper height to allow top to be flush with finished floor and at low point in finished work.
  - C. Coordinate with placement of mop basin receptor to make watertight joint to drainage product.
  - D. Adjust strainers to finished floor elevation at completion of work.
  - E. Provide trap primer piping, with copper tubing and soldered fittings. Extend piping from trap primer device to primer tap connection in drain body.
  - F. Floor drain types generally are (refer to Drawings):  
FD-1 - General purpose in finished areas, with trap primer connections.  
FD-2 - Mechanical equipment rooms, with trap primer connections.
- 
- ### 3.6 INSTALLATION – UNIONS
- A. Provide unions at connections to valves and equipment to allow dismantling of pipe connections without cutting pipe.
  - B. Flanged connections are considered as unions.
- 
- ### 3.7 JOINT CONSTRUCTION
- A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

- B. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.
- C. Grooved Joints: Assemble joints with keyed-coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

### 3.8 VALVE INSTALLATION

- A. Install sectional valve close to water main on each branch and riser serving plumbing fixtures or equipment. Use ball or gate valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.
- B. Install shutoff valve on each water supply to equipment and on each water supply to plumbing fixtures without supply stops. Use ball or gate valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.
- C. Install drain valves for equipment, at base of each water riser, at low points in horizontal piping, and where required to drain water piping.
  - 1. Install hose-end drain valves at low points in water mains, risers, and branches.
  - 2. Install stop-and-waste drain valves where indicated.
- D. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Use ball valves for piping NPS 2 and smaller and butterfly valves for piping NPS 2-1/2 and larger. Refer to Division 15 Section "Plumbing Specialties" for balancing valves.

### 3.9 HANGER AND SUPPORT INSTALLATION

- A. Refer to Division 15 Section "Hangers and Supports" for pipe hanger and support devices. Install the following:
  - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
  - 2. Individual, Straight, Horizontal Piping Runs: According to the following:
    - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
  - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Install supports according to Division 15 Section "Hangers and Supports."
- C. "Plumber Strap" IS NOT ALLOWED
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced 1 size for double-rod hangers, to a minimum of 3/8 inch.

- F. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.
  - 2. NPS 1-1/2: 108 inches with 3/8-inch rod.
  - 3. NPS 2: 10 feet with 3/8-inch rod.
  - 4. NPS 2-1/2: 11 feet with 1/2-inch rod.
  - 5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.
  - 6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
  - 7. NPS 6: 12 feet with 3/4-inch rod.
- G. Install supports for vertical steel piping every 15 feet.
- H. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
  - 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
  - 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
  - 4. NPS 2-1/2: 108 inches with 1/2-inch rod.
  - 5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
  - 6. NPS 6: 10 feet with 5/8-inch rod.
- I. Install supports for vertical copper tubing every 10 feet.

### 3.10 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Existing galvanized pipe above 1 1/2" to remain shall be inspected, if rusted the pipe shall be demolished and replace with new copper pipe.
- C. Install piping adjacent to equipment and machines to allow service and maintenance.
- D. Connect domestic water piping to exterior water service piping. Use transition fitting and dielectric unions to join dissimilar piping materials.
- E. Connect domestic water piping to service piping with shutoff valve, and extend and connect to the following:
  - 1. Water Heaters: Cold-water supply and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
  - 2. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 15 Section "Plumbing Fixtures."
  - 3. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

### 3.11 FIELD QUALITY CONTROL

- A. Inspect domestic water piping as follows:
1. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
  2. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
    - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
    - b. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
  3. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
  4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- B. Test domestic water piping as follows:
1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  2. Leave uncovered and unconcealed new, altered, extended, or replaced domestic water piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
  3. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
  4. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
  5. Prepare reports for tests and required corrective action.

### 3.12 ADJUSTING

- A. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
1. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
  2. Adjust calibrated balancing valves to flows indicated.

### 3.13 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
1. Purge new piping and parts of existing domestic water piping that have been altered, extended, or repaired before using.

2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction or, if methods are not prescribed, procedures described in either AWWA C651 or AWWA C652 or as described below:
  - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
  - b. Fill and isolate system according to either of the following:
    - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
    - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
  - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
  - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- B. Prepare and submit reports of purging and disinfecting activities.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

END OF SECTION

**SECTION 15150**  
**SANITARY WASTE, VENT & STORM PIPING**

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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 soil and waste, sanitary drainage and vent piping inside the building and to locations indicated.
- B. Related Sections include the following:
1. Division 15 Section "Plumbing Specialties" for soil, waste, and vent piping systems specialties.
- C. Note that the intent of the design is to reuse the existing soil and waste sanitary drainage and vent piping system; field verify and modify as required. Sanitary inverts are not indicated on the drawings and they must be field verified by the contractor at point of tie-in to existing sanitary piping for reference.

1.3 DEFINITIONS

- A. The following are industry abbreviations for plastic piping materials:
1. ABS: Acrylonitrile-butadiene-styrene plastic.
  2. EPDM: Ethylene-propylene-diene terpolymer.
  3. PE: Polyethylene plastic.
  4. PVC: Polyvinyl chloride plastic.
  5. PP: Polypropylene
  6. CPVC: Chlorinate Polyvinyl chloride plastic.

1.4 PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing piping systems with the following minimum working-pressure ratings, unless otherwise indicated:
1. Soil, Waste, and Vent Piping: 10-foot head of water.

1.5 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.6 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.
- B. Flexible Transition Couplings for Underground Nonpressure Piping: ASTM C 1173 with elastomeric sleeve. Include ends of same sizes as piping to be joined and include corrosion-resistant metal band on each end.
- C. All sewer/vent piping inside building shall be cast iron and sewer piping outside building shall be ductile iron.

2.2 CAST- IRON SOIL PIPING

- A. Hub-and-Spigot Pipe and Fittings: ASTM A 74, Service class.
  - 1. Gaskets: ASTM C 564, rubber.
- B. Hubless Pipe and Fittings: ASTM A 888 or CISPI 301.
  - 1. Couplings: ASTM C 1277 assembly of metal housing, corrosion-resistant fasteners, and ASTM C 564 rubber sleeve with integral, center pipe stop.
    - a. Heavy-Duty, Type 304, Stainless-Steel Couplings: ASTM A 666, Type 304, stainless-steel shield; stainless-steel bands; and sleeve.
      - 1) NPS 1-1/2 to NPS 4: 3-inch- wide shield with 4 bands.
      - 2) NPS 5 to NPS 10: 4-inch- wide shield with 6 bands.

2.3 COPPER TUBING (for Condensate only)

- A. Hard Copper Tube: ASTM B 88, Types M, water tube, drawn temper.

1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end.
3. 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.

#### 2.4 PE ENCASEMENT

- A. PE Encasement for Underground Metal Piping: ASTM A 674 or AWWA C105, PE film, 0.008-inch minimum thickness, tube or sheet.

### PART 3 - EXECUTION

#### 3.1 EXCAVATION

- A. Refer to Division 2 Section "Earthwork" for excavating, trenching, and backfilling.

#### 3.2 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.
- B. Flanges may be used on aboveground pressure piping, unless otherwise indicated.
- C. Aboveground, Soil, Waste, Storm and Vent Piping: Use the following piping materials for each size range:
  1. NPS 1-1/2: Hubless, cast-iron soil piping and one of the following:
    - a. Couplings: Heavy Duty, stainless steel.
  2. NPS 2 to NPS 4: Hubless, cast-iron soil piping and one of the following:
    - a. Couplings: Heavy Duty, stainless steel.
  3. NPS 5 and NPS 6: Hubless, cast-iron soil piping and one of the following:
    - a. Couplings: Heavy Duty, stainless steel.
- D. Aboveground Storm Piping: Use the following piping materials for each size range:
  1. Hubless, cast-iron soil piping:
  2. Couplings: ASTM C 1277 assembly of metal housing, corrosion-resistant fasteners, and ASTM C 564 rubber sleeve with integral center pipe stop.
    - a. Heavy-Duty, Type 304, Stainless-Steel Couplings: ASTM A 666, Type 304, stainless-steel shield; stainless-steel bands; and sleeve.

- 1) NPS 1-1/2 to NPS 4: 3-inch- wide shield with 4 bands.
- 2) NPS 5 to NPS 10: 4-inch- wide shield with 6 bands.

### 3.3 PIPING INSTALLATION

- A. Refer to Division 2 Section "Sanitary Sewerage" for Project-site sanitary sewer piping.
- B. Refer to Division 15 Section "Mechanical General Requirements" for basic piping installation.
- C. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- D. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for wall penetration systems.
- E. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
  1. Encase underground piping with PE film according to ASTM A 674 or AWWA C105.
- F. Make changes in direction for soil and waste drainage, vent and storm piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- G. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- H. Install soil and waste drainage, vent piping and storm piping at the following minimum slopes, unless otherwise indicated:
  1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and Larger.
  2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
  3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- I. Install engineered soil and waste drainage and vent piping systems in locations indicated and as follows:
  1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.

- J. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- K. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction and engineer of record.

#### 3.4 JOINT CONSTRUCTION

- A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.
- B. Cast-Iron, Soil-Piping Joints: Make joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
  - 1. Gasketed Joints: Make with rubber gasket matching class of pipe and fittings.
  - 2. Hubless Joints: Make with rubber gasket and sleeve or clamp.

#### 3.5 HANGER AND SUPPORT INSTALLATION

- A. Refer to Division 15 Section "Hangers and Supports" for pipe hanger and support devices. Install the following:
  - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
  - 2. Individual, Straight, Horizontal Piping Runs: According to the following:
    - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer than 100 Feet: MSS Type 43, adjustable roller hangers.
  - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Install supports according to Division 15 Section "Hangers and Supports."
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
- E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
  - 2. NPS 3: 60 inches with 1/2-inch rod.
  - 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
  - 4. NPS 6: 60 inches with 3/4-inch rod.
  - 5. NPS 8 to NPS 12: 60 inches with 7/8-inch rod.
  - 6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

- F. Install supports for vertical cast-iron soil piping every 15 feet.
- G. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1-1/4: 72 inches with 3/8-inch rod.
  - 2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
  - 3. NPS 2-1/2: 108 inches with 1/2-inch rod.
  - 4. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
- H. Install supports for vertical copper tubing every 10 feet.
- I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

### 3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping or manhole. Use transition fitting to join dissimilar piping materials.
- C. Connect drainage and vent piping to the following:
  - 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 15 Section "Plumbing Fixtures."
  - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
  - 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 15 Section "Plumbing Specialties."
  - 4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

### 3.7 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
  - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
  - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

- D. Test sanitary drainage, storm and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
  3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
  4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
  5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
  6. Prepare reports for tests and required corrective action.

### 3.8 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

### 3.9 INSULATION

- A. Insulate or reinsulated all non-insulated or torn insulation on existing interior storm drain piping.

END OF SECTION

**SECTION 15175**  
**EXPANSION TANKS**

**PART 1 - GENERAL**

**1.1 WORK INCLUDES**

- A. Floor mounted Expansion tank:.
- B. Accessories and connection to hydronic piping system.
- C. Structural supports.

**1.2 REFERENCE STANDARDS**

- A. Construct pressure tanks to ASME Section VII. Division 1 for unfired pressure vessels.

**1.3 SUBMITTALS**

Submit shop drawings and product data in accordance with Section 01300.

**1.4 CERTIFICATION**

Tank must be provided with an ASME approved pressure vessel label.  
Bladder Expansion Tanks – Series “ L “

**PART 2 - PRODUCTS**

**2.1 EXPANSION TANKS**

- A. Tanks: Closed type, welded steel design and constructed per ASME Section VII. Div. Rated for working pressure of minimum 125 psi and 240 deg F operating temperature.
- B. Tanks to be furnished with a ring base, lifting rings, air charging connections, 1” NPT drains, and NPT system connection.
- C. Heavy duty butyl rubber bladder removable for inspection and field replaceable. Air charged through valve connection (standard tire valve) to facilitate adjusting pressure to meet actual system conditions.
- D. Factory primed and painted.
- E. Provide pressure relief valve, and automatic cold water fill assembly complete with pressure reducing valve, reduced pressure double check back pressure valve (RPZ), test cocks, strainer, vacuum breaker, drain assembly and by-pass valve assembly.

- F. Tank shall be as manufactured by:
  - a. Armstrong Pumps, Inc. "L Series"
  - b. Taco, Inc.
  - c. ITT Bell & Gossett; ITT Fluid Technology Corp.
  - d. Armtrol, Inc.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Inspect the Expansion Tank for damage which may have occurred during shipping. DO NOT INSTALL THE UNIT.
- B. Support tanks inside building on concrete house keeping pads and anchor tanks in accordance with manufacturer's recommendations.
- C. Allow at least 18" clearance above the tank for the system connection. Refer to manufacturers installation instructions.
- D. Install a gate valve, with lockshield to isolate the tank from the system should be installed to facilitate:
  - a. Hydrostatic testing of the system.
  - b. Service of the tank.
- E. Install a drain valve between the gate valve and the tank system connection to facilitate service.
- F. Check the tank system connection to be sure nothing is obstructing the inlet passage way. System air must be purged and not allowed to enter the tank.
- G. Before installing the tank, check the charge with an automotive tire gauge. If the tank charge is not at the desired psi, bleed off or fill to the psi required. Any alteration in the factory pre-charge should be completed JUST PRIOR to filling the system with water.
- H. Tank connection piping and air separators with air vents should be arranged so that the air will not be trapped in the tank. Connect the piping with the pitch down to the tank.
- I. Connect the tank on the suction side of the pump.

#### 3.2 PERFORMANCE

- A. Set expansion tank pressure relief valve at 10 percent above system working pressure.
- B. Set makeup water pressure reducing valve at 30 psi.

END OF SECTION

**SECTION 15181**  
**HYDRONIC PIPING**

**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 piping, special-duty valves, and hydronic specialties for chilled-water cooling systems; makeup water for these systems; blowdown drain lines; and condensate drain piping.
- B. Related Sections include the following:
  - 1. Division 7 Section "Joint Sealants" for materials and methods for sealing pipe penetrations through exterior walls.
  - 2. Division 15 Section "Mechanical General Requirements" for general piping materials and installation requirements.
  - 3. Division 15 Section "Hangers and Supports" for pipe supports, product descriptions, and installation requirements. Hanger and support spacing is specified in this Section.
  - 4. Division 15 Section "Valves" for general-duty gate, globe, ball, butterfly, and check valves.
  - 5. Division 15 Section "Gages" for thermometers and pressure gages.
  - 6. Division 15 Section "Mechanical Identification" for labeling and identifying hydronic piping.
  - 7. Division 15 Section "Pumps" for pumps, motors, and accessories for hydronic piping.
  - 8. Division 15 Section "Pipe Insulation".

**1.3 SUBMITTALS**

- A. Product Data: For each type of special-duty valve indicated. Include flow and pressure drop curves based on manufacturer's testing for diverting fittings, calibrated balancing valves, and automatic flow-control valves.
- B. Shop Drawings: Detail fabrication of pipe anchors, hangers, special pipe support assemblies, alignment guides, expansion joints and loops, and their attachment to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.
- C. Field Test Reports: Written reports of tests specified in Part 3 of this Section. Include the following:
  - 1. Test procedures used.

2. Test results that comply with requirements.
  3. Failed test results and corrective action taken to achieve requirements.
- D. Maintenance Data: For hydronic specialties and special-duty valves to include in maintenance manuals specified in Division 1.
- 1.4 QUALITY ASSURANCE
- A. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Air separators and expansion tanks to comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.
- 1.5 COORDINATION
- A. Coordinate layout and installation of hydronic piping and suspension system components with other construction, including light fixtures, HVAC equipment, fire-protection-system components, building structure, partition assemblies and existing piping to remain.
- B. Coordinate piping installation with roof curbs, equipment supports, and roof penetrations. Roof specialties are specified in Division 7 Sections.
- C. Coordinate pipe fitting pressure classes with products specified in related Sections.
- D. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 3 Sections.
- E. Coordinate installation of pipe sleeves for penetrations through exterior walls and floor assemblies. Coordinate with requirements for firestopping specified in Division 7 Section "Through-Penetration Firestop Systems" for fire and smoke wall and floor assemblies.
- 1.6 EXTRA MATERIALS
- A. Water Treatment Chemicals: Furnish sufficient chemicals for initial system startup and for preventive maintenance for one year from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Grooved Mechanical-Joint Fittings and Couplings:
    - a. Central Sprinkler Company; Central Grooved Piping Products.
    - b. Grinnell Corporation.

- c. Victaulic Company of America.
- 2. Calibrated Balancing Valves:
  - a. Armstrong Pumps, Inc.
  - b. Flow Design, Inc.
  - c. Griswold Controls.
  - d. ITT Bell & Gossett; ITT Fluid Technology Corp.
  - e. Taco, Inc.
- 3. Pressure-Reducing Valves:
  - a. Amtrol, Inc.
  - b. Armstrong Pumps, Inc.
  - c. ITT Bell & Gossett; ITT Fluid Technology Corp.
  - d. Spence Engineering Company, Inc.
  - e. Watts Industries, Inc.; Watts Regulators.
- 4. Safety Valves:
  - a. Amtrol, Inc.
  - b. Armstrong Pumps, Inc.
  - c. Conbraco Industries, Inc.
  - d. ITT McDonnell & Miller Div.; ITT Fluid Technology Corp.
  - e. Spence Engineering Company, Inc.
- 5. Automatic Flow-Control Valves:
  - a. Flow Design, Inc.
  - b. Griswold Controls.
  - c. Belima
- 6. Expansion Tanks:
  - a. Amtrol, Inc.
  - b. Armstrong Pumps, Inc.
  - c. ITT Bell & Gossett; ITT Fluid Technology Corp.
  - d. Taco, Inc.
- 7. Air Separators and Air Purgers:
  - a. Amtrol, Inc.
  - b. Armstrong Pumps, Inc.
  - c. ITT Bell & Gossett; ITT Fluid Technology Corp.
  - d. Taco, Inc.

## 2.2 PIPING MATERIALS

- A. General: Refer to Part 3 "Piping Applications" Article for applications of pipe and fitting materials.

2.3 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: Type L.
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Solder Filler Metals: ASTM B 32, 95-5 tin antimony.
- E. Brazing Filler Metals: AWS A5.8, Classification BAg-1 (silver).

2.4 STEEL PIPE AND FITTINGS

- A. Steel Pipe, NPS 2 and Smaller: ASTM A 53, Type S (seamless) or Type F (furnace-butt welded), Grade A, Schedule 40, black steel, plain ends.
- B. Steel Pipe, NPS 2-1/2 through NPS 12: ASTM A 53, Type E (electric-resistance welded), Grade A, Schedule 40, black steel, plain ends.
  - 1. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53, Schedule 40, black steel; seamless for NPS 2 and smaller and electric-resistance welded for NPS 2-1/2 and larger.
- C. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250.
- D. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300.
- E. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300.
- F. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced.
- G. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
- H. Wrought 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.
- I. Grooved Mechanical-Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47 (ASTM A 47M), Grade 32510 malleable iron; ASTM A 53, Type F, E, or S, Grade B fabricated steel; or ASTM A 106, Grade B steel fittings with grooves or shoulders designed to accept grooved end couplings.
- J. Grooved Mechanical-Joint Couplings: Ductile- or malleable-iron housing and synthetic rubber gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

- K. Spherical, Rubber, Flexible Connectors: Fiber-reinforced rubber body with steel flanges drilled to align with Classes 150 and 300 steel flanges; operating temperatures up to 250 deg F and pressures up to 150 psig .
- L. Gasket Material: Thickness, material, and type suitable for fluid to be handled; and design temperatures and pressures.

## 2.5 VALVES

- A. Gate, globe, check, ball, and butterfly valves are specified in Division 15 Section "Valves."
- B. Refer to Part 3 "Valve Applications" Article for applications of each valve.
- C. Calibrated Balancing Valves, NPS 2 and Smaller: Bronze body, ball type, 125-psig working pressure, 250 deg F maximum operating temperature, and having threaded ends. Valves shall have calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, and be equipped with a memory stop to retain set position.
- D. Calibrated Balancing Valves, NPS 2-1/2 and Larger: Cast-iron or steel body, ball type, 125-psig working pressure, 250 deg F maximum operating temperature, and having flanged or grooved connections. Valves shall have calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, and be equipped with a memory stop to retain set position.
- E. Pressure-Reducing Valves: Diaphragm-operated, bronze or brass body with low inlet pressure check valve, inlet strainer removable without system shutdown, and noncorrosive valve seat and stem. Select valve size, capacity, and operating pressure to suit system. Valve shall be factory set at operating pressure and have capability for field adjustment.
- F. Safety Valves: Diaphragm-operated, bronze or brass body with brass and rubber, wetted, internal working parts; shall suit system pressure and heat capacity and shall comply with the ASME Boiler and Pressure Vessel Code, Section IV.

## 2.6 HYDRONIC SPECIALTIES

- A. Manual Air Vent: Bronze body and nonferrous internal parts; 150-psig working pressure; 225 deg F operating temperature; manually operated with screwdriver or thumbscrew; with NPS 1/8 discharge connection and NPS 1/2 inlet connection.
- B. Expansion Tanks: Welded carbon steel, rated for 150-psig working pressure and 240 deg F maximum operating temperature. Separate air charge from system water to maintain design expansion capacity by a flexible diaphragm securely sealed into tank. Include drain fitting and taps for pressure gage and air-charging fitting. Support vertical tanks with steel legs or base; support horizontal tanks with steel saddles. Factory fabricate and test tank with taps and supports installed and labeled according to the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.
- C. Tangential-Type Air Separators: Welded black steel; ASME constructed and labeled for 150-psig working pressure and 375 deg F maximum operating temperature; perforated stainless-steel

air collector tube designed to direct released air into expansion tank; tangential inlet and outlet connections; threaded connections for NPS 2 and smaller; flanged connections for NPS 2-1/2 and larger; threaded blowdown connection. Provide units in sizes for full-system flow capacity.

- D. Bypass Chemical Feeder: Welded steel construction; 125-psig working pressure; 5-gal. capacity; with fill funnel and inlet, outlet, and drain valves.
  - 1. Chemicals: Specially formulated, based on analysis of makeup water, to prevent accumulation of scale and corrosion in piping and connected equipment.
- E. Y-Pattern Strainers: 150-psig working pressure; cast-iron body (ASTM A 126, Class B), flanged ends for NPS 2-1/2 and larger, threaded connections for NPS 2 and smaller, bolted cover, perforated stainless-steel basket, and bottom drain connection.
- F. Spherical, Rubber, Flexible Connectors: Fiber-reinforced rubber body with steel flanges drilled to align with Classes 150 and 300 steel flanges; operating temperatures up to 250 deg F and pressures up to 150 psig.

### PART 3 - EXECUTION

#### 3.1 PIPING APPLICATIONS

- A. Hot and Chilled Water, NPS 2 and Smaller: Aboveground, use Schedule 40 steel pipe with threaded joints. Below ground or within slabs, use Type K annealed-temper copper tubing with soldered joints. Use the fewest possible joints belowground and within floor slabs.
- B. Hot and Chilled Water, NPS 2-1/2 and Larger: Schedule 40 steel pipe with grooved mechanical-joint couplings.
- C. Condensate Drain Lines: Type L drawn-temper copper tubing with soldered joints or Schedule 40, PVC pipe with solvent-welded joints.

#### 3.2 VALVE APPLICATIONS

- A. General-Duty Valve Applications: Unless otherwise indicated, use the following valve types:
  - 1. Shutoff Duty: Gate, ball, and butterfly valves.
  - 2. Throttling Duty: Globe, ball, and butterfly valves.
- B. Install shutoff duty valves at each branch connection to supply mains, at supply connection to each piece of equipment, unless only one piece of equipment is connected in the branch line. Install throttling duty valves at each branch connection to return mains, at return connections to each piece of equipment, and elsewhere as indicated.
- C. Install calibrated balancing valves in the return water line of each heating or cooling element and elsewhere as required to facilitate system balancing.
- D. Install check valves at each pump discharge and elsewhere as required to control flow direction.

- E. Install safety valves on hot-water generators and elsewhere as required by the ASME Boiler and Pressure Vessel Code. Install safety-valve discharge piping, without valves, to floor. Comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, for installation requirements.
- F. Install pressure-relief valves on hot-water generators and elsewhere as required to safe guard against system over pressure.

### 3.3 PIPING INSTALLATIONS

- A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping installation requirements.
- B. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- C. 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.
- D. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- E. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- F. Unless otherwise indicated, install branch connections to mains using tee fittings in main pipe, with the takeoff coming out the bottom of the main pipe. For up-feed risers, install the takeoff coming out the top of the main pipe.
- G. Install strainers on supply side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.
- H. Anchor piping for proper direction of expansion and contraction.

### 3.4 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor devices are specified in Division 15 Section "Hangers and Supports." Comply with requirements below for maximum spacing of supports.
- B. Install the following pipe attachments:
  - 1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
  - 2. Adjustable roller hangers and spring hangers for individual horizontal piping 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.
- C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 1 and less: Maximum span, 7 feet; minimum rod size, 1/4 inch.
  2. NPS 1-1/2: Maximum span, 9 feet ; minimum rod size, 3/8 inch.
  3. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
  4. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.
  5. NPS 3: Maximum span, 12 feet; minimum rod size, 3/8 inch.
  6. NPS 4: Maximum span, 14 feet; minimum rod size, 1/2 inch.
  7. NPS 6: Maximum span, 17 feet; minimum rod size, 1/2 inch.
- D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
  2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
  3. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
  4. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
  5. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
  6. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.
- E. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.
- 3.5 HYDRONIC SPECIALTIES INSTALLATION
- A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.
  - B. Install in-line air separators in pump suction lines. Install piping to compression tank with a 2 percent upward slope toward tank. Install drain valve on units NPS 2 and larger.
  - C. Install bypass chemical feeders in each hydronic system where indicated, in upright position with top of funnel not more than 48 inches above floor. Install feeder in bypass line, off main, using globe valves on each side of feeder and in the main between bypass connections. Pipe drain, with ball valve, to nearest equipment drain.
  - D. Install expansion tank. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system design requirements.
- 3.6 TERMINAL EQUIPMENT CONNECTIONS
- A. Size for supply and return piping connections shall be same as for equipment connections.
  - B. Install control valves in accessible locations close to connected equipment.
  - C. Install bypass piping with globe valve around control valve.
  - D. Install ports for pressure and temperature gages at coil inlet connections.
- 3.7 PRE –OPERATIONAL SYSTEM CLEAN-OUT

- A. All dirt, pipe dope, grease and oil are to be removed from all piping. Immediately following hydrostatic testing, the pre-treatment cleaning chemical BC 89L should be dosed. The cleaner chemical used should not require heating to be effective. The pH should not be higher than 9.0 units and the total alkalinity limited to 2000 ppm. This is to be circulated for 24-48 hours and then flushed from the system with a running flush until the total alkalinity of the system water is the same as that of the make up water. All cleaner chemical is to be removed from the system before dosing the corrosion inhibitor. This fact is to be confirmed by the water treatment vendor. All cleaner chemicals are to be removed from the jobsite by the water treatment vendor.

### 3.8 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to 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. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
  - 4. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- 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 trapped air. Furnish and use drains installed at low points for complete draining of liquid.
  - 3. Check expansion tanks to determine that they are not air bound and that system is full of water.
  - 4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the design pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A of ASME B31.9, "Building Services Piping."
  - 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.

### 3.9 ADJUSTING

- A. Mark calibrated nameplates of pump discharge valves after hydronic system balancing has been completed, to permanently indicate final balanced position.
- B. Perform these adjustments before operating the system:
  - 1. Open valves to fully open position. Close coil bypass valves.

2. Check pump for proper direction of rotation.
3. Set automatic fill valves for required system pressure.
4. Check 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. Check operation of automatic bypass valves.
7. Check and set operating temperatures of boilers, chiller, and cooling tower to design requirements.
8. Lubricate motors and bearings.

### 3.10 LEAK TESTING

- A. Inspect all joints and connections for leaks and workmanship and make corrections as necessary, to the satisfaction of the Resident Engineer. Tests may be either of those below, or a combination, as approved by the Resident Engineer.
- B. An operating test at design pressure, and for hot systems, design maximum temperature.
- C. A hydrostatic test at 1.5 times design pressure. For water systems the design maximum pressure would usually be the static head, or expansion tank maximum pressure, plus pump head. Factory tested equipment (coils, exchangers, etc.) need not be field tested. Avoid excessive pressure on mechanical seals and safety devices.

### 3.11 FLUSHING AND CLEANING PIPING SYSTEMS

- A. Clean and flush existing cooling tower basin.
- B. Condensate and Vent Piping: No flushing or chemical cleaning required. Accomplish cleaning by pulling all strainer screens and cleaning all scale/dirt legs during start-up operation.
- C. Water Piping: Clean systems as recommended by the suppliers of chemicals specified in Section 15131, WATER TREATMENT (HVAC).
  1. Initial flushing: Remove loose dirt, mill scale, metal chips, weld beads, rust, and like deleterious substances without damage to any system component. Provide temporary piping or hose to bypass coils, control valves, exchangers and other factory cleaned equipment unless acceptable means of protection are provided and subsequent inspection of hide-out areas takes place. Isolate or protect clean system components, including pumps and pressure vessels, and remove any component which may be damaged. Open all valves, drains, vents and strainers at all system levels. Remove plugs, caps, spool pieces, and components to facilitate early debris discharge from system. Sectionalize system to obtain debris carrying velocity of 6 feet per second, if possible. Connect dead-end supply and return headers as necessary. Flush bottoms of risers. Install temporary strainers where necessary to protect down-stream equipment. Supply and remove flushing water and drainage by various type hose, temporary and permanent piping and Contractor's booster pumps. Flush until clean as approved by the Architect/Engineer.
  2. Cleaning: Using products supplied in Section 15131, WATER TREATMENT, (HVAC), circulate systems at normal temperature to remove adherent organic soil, hydrocarbons, flux,

pipe mill varnish, pipe joint compounds, iron oxide, and like deleterious substances not removed by flushing, without chemical or mechanical damage to any system component. Removal of tightly adherent mill scale is not required. Keep isolated equipment which is "clean" and where dead-end debris accumulation cannot occur. Sectionalize system if possible, to circulate at velocities not less than 6 feet per second. Circulate each section for not less than four hours. Blow-down all strainers, or remove and clean as frequently as necessary. Drain and prepare for final flushing.

3. Final Flushing: Return systems to conditions required by initial flushing after all cleaning solution has been displaced by clean make-up. Flush all dead ends and isolated clean equipment. Gently operate all valves to dislodge any debris in valve body by throttling velocity. Flush for not less than one hour.

END OF SECTION

## SECTION 15185

### PUMPS

#### PART 2 - GENERAL

##### 2.1 RELATED DOCUMENTS

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

##### 2.2 SUMMARY

- a. This section includes the furnishing and installation of materials, as hereinafter specified or shown on the contract drawings, necessary for complete pumping equipment. All pumps except where integral with a manufactured piece of equipment.
- b. This Section includes the following categories of hydronic pumps for hydronic systems:
  1. In-line circulators.
  2. Vertical in-line pumps.
  3. Automatic condensate pump units.
- c. Related Sections include the following:
  1. Division 15 Section "Motors" for general motor requirements.
  2. Division 15 Section " Mechanical General Requirements".
  3. Division 15 Section "Mechanical Identification"
  4. Division 15 Section " Valves" and "Gages"
  5. Division 15 Section " Hydronic Piping"
  6. Division 15 Section "Building Management System"
  7. Division 15 Section "Testing, Adjusting, and Balancing"

##### 2.3 SUBMITTALS

- a. Product Data: Include certified performance curves and rated capacities; shipping, installed, and operating weights; 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: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.
- c. Maintenance Data: For pumps to include in maintenance manuals specified in Division 1.

#### 2.4 QUALITY ASSURANCE

- a. UL Compliance: Fabricate and label pumps to comply with UL 778, "Motor-Operated Water Pumps," for construction requirements.
- b. Product Options: Drawings indicate size, profiles, connections, and dimensional requirements of pumps and are based on the specific types and models indicated. Other manufacturers' pumps with equal performance characteristics may be considered. Refer to Division 1 Section "Substitutions."
- 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.

#### 2.5 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.

#### 2.6 COORDINATION

- a. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete."

#### 2.7 EXTRA MATERIALS

- a. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Mechanical Seals: One mechanical seal for each pump.

### PART 3 - PRODUCTS

#### 3.1 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. In-Line Circulators:
    - a. Armstrong Pumps, Inc
    - b. Taco; Fabricated Products Div.
    - c. Bell & Gossett ITT; Div. of ITT Fluid Technology Corp.
    - d. Grundfos Pumps Corp.
  - 2. Vertical In-Line Pumps:
    - a. Armstrong Pumps, Inc.
    - b. Bell & Gossett ITT; Div. of ITT Fluid Technology Corp.
    - c. Taco; Fabricated Products Div
    - d. Patterson Pump Co.
  - 3. Automatic Condensate Pump Units:
    - a. Little Giant Pump Co.
    - b. Beckett Corp.
    - c. Hartell Div.; Milton Roy Co.
    - d. Marsh Manufacturing, Inc.
  - 4. Variable Frequency Drives (supplied by pump manufacturer)
    - a. ABB Power Distribution, Inc.; ABB Control, Inc. Subsidiary.
    - b. Eaton Corp.; Cutler-Hammer Products.
    - c. General Electrical Distribution & Control.
    - d. MagneTek Drives and Systems.
    - e. Siemens Energy and Automation; Industrial Products Division.

### 3.2 GENERAL PUMP REQUIREMENTS

- a. Pump Units: Factory assembled and tested.
- b. Motors: Include built-in, thermal-overload protection and grease-lubricated ball bearings. Select each motor to be nonoverloading over full range of pump performance curve.
- c. Motors Indicated to Be Energy Efficient: Minimum efficiency as indicated according to IEEE 112, Test Method B. Include motors with higher efficiency than "average standard industry motors" according to IEEE 112, Test Method B, if efficiency is not indicated.
- d. Refer to pump schedule for pump flows, heads, motor speed, enclosure, efficiency and power requirements.
- e. Secondary vertical inline pumps for chill and hot water shall be equipped with variable frequency drive.

### 3.3 IN-LINE CIRCULATORS

- a. Description: Horizontal, in-line, centrifugal, single-stage, bronze-fitted, radially split case design; rated for 125-psig minimum working pressure and a continuous water temperature of 225 deg F.
  1. Casing: Cast iron, with threaded companion flanges for piping connections, and threaded gage tapings at inlet and outlet connections.
  2. Impeller: ASTM B 584, cast bronze, statically and dynamically balanced, closed, overhung, single suction, and keyed to shaft.
  3. Shaft and Sleeve: Stainless-steel shaft with oil-lubricated copper sleeve.
  4. Seals: Mechanical type. Include carbon-steel rotating ring, stainless-steel spring, ceramic seat, and flexible bellows and gasket.
  5. Pump Bearings: Oil-lubricated, bronze journal and thrust type.
  6. Motor Bearings: Oil-lubricated, sleeve type.
  7. Coupling: Flexible, capable of absorbing torsional vibration and shaft misalignment.
  8. Motor: Resiliently mounted to pump casing.
- B. Accessories; pumps shall be provided with aqua stats and circuit setters.

### 3.4 COMPACT IN-LINE CIRCULATORS

- a. Description: Water cooled, horizontal, in-line, compact design, seal-less, centrifugal, and single stage. Include pump and motor assembled on a common shaft in hermetically sealed unit, without stuffing boxes or mechanical seals. Include lubrication of sleeve bearing and cooling of motor by circulating pumped liquid through motor section, and isolation of motor section from motor-stator windings by corrosion-resistant, nonmagnetic, alloy liner. Include design rated for 125-psig minimum working pressure and a continuous water temperature of 225 deg F.
- b. Casing: Cast bronze with stainless-steel liner, static O-ring seal to separate motor section from motor stator, and flanged piping connections.
- c. Impeller: Overhung, single suction, closed or open, nonmetallic.
- d. Shaft and Sleeve: Stainless-steel shaft with carbon-steel sleeve.
- e. Motor: Single speed.

### 3.5 SPLIT COUPLED VERTICAL IN-LINE PUMPS

- A. Description: Split Coupled Vertical, in-line, centrifugal, flexible-coupled, single-stage, radially split case design with pump characteristics which provide rising heads to shut off. Include vertical-mounting, bronze-fitted design and mechanical seals rated for 150-psig minimum working pressure and a continuous water temperature of 225 deg F. Refer to pump schedule for pump flows, heads, motor speed, enclosure, efficiency and power requirements.
- b. Pumps basis of design Armstrong Series 4300 split coupled type, with rigid spacer type coupling.
- c. Pump Construction:

1. Pump Casing - Cast Iron for working pressure below 175 psig at 220 deg F (250 psig ANSI flange rating) and Suction and discharge connections shall be flanged and the same size and shall be drilled and tapped for seal flush and gauge connections.
  2. Impeller - Bronze, fully enclosed type. ASTM B 584, cast bronze, statically and dynamically balanced, closed, overhung, single suction, and keyed to shaft.
  3. Shaft - Provide Stainless Steel pump shaft.
  4. Coupling - Rigid spacer type of high tensile aluminum alloy couplings shall be split to allow removal from pump and motor shafts, leaving space between the shafts sufficient to replace all mechanical seal components without disturbing the pump or motor.
  5. Mechanical Seals - Shall be Stainless Steel outside multi-spring balanced type with Viton secondary seal. Provide bronze gland plate with Stainless Steel hardware. Provide factory installed flush line with manual vent.
  6. All split coupled pumps shall be provided with a lower seal chamber throttle bushing.
  7. Motor Horsepower - Shown on the schedule are minimum and have been sized for continuous operation without exceeding full load nameplate rating over the entire pump curve, exclusive of service factor.
  8. Provide in the flush line to the mechanical seal a 50 micron cartridge filter and sight flow indicator, to suit the working pressure encountered.
  9. Filters shall be changed, by the installing contractor, after system is flushed and on a regular basis until turned over to the owner.
- d. Suction Diffuser: Angle or straight 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.
- e. 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.
- f. Combination Variable-Frequency Drive and Disconnects: Combination variable-frequency drives (VFDs) and disconnects shall be provided for each secondary loop pump motor. Each VFD–disconnect shall be properly sized, mounted, wired to the pump motor, and commissioned by the pump manufacturer to facilitate temporary heating, cooling and/or timely completion of the project.
- g. Combination Variable-Frequency Drive and Disconnects
1. Combination variable-frequency drives (VFDs) and disconnects shall be provided for each secondary pump motor. Each VFD–disconnect shall be properly sized, mounted, wired to the fan motor, and commissioned by the air handler manufacturer to facilitate temporary heating, cooling, ventilation, and/or timely completion of the project.
  2. The combination VFD–disconnect shall include the VFD, a circuit-breaker disconnect, a drive-off switch, and manual speed-control dial. Units with factory-mounted controls shall include a control transformer with sufficient volt amps to support both the VFD and controls requirements, binary output on/off wiring, analog output-speed-signal wiring, and all interfacing wiring between the VFD and the direct digital controller.
  3. Description: NEMA ICS 2, IGBT, PWM, VFC; listed and labeled as a complete unit and arranged to provide variable speed of a NEMA MG 1, Design B, 3-phase, premium-efficiency induction motor by adjusting output voltage and frequency.

4. Design and Rating: Match load type such as pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.
5. The VFD shall include the following minimal protective features:
  - a. Current-limited stall prevention
  - b. Auto restart after momentary power loss
  - c. Speed search for starting into rotating motor
  - d. Anti-windmill with DC injection before start
  - e. Phase-to-phase short-circuit protection
  - f. Ground-fault protection
  - g. The VFD–disconnect shall be supplied with an instantaneous, short-circuit-trip circuit breaker. A through-the-door interlocking handle shall be spring loaded and designed to rest only in the full “On” or “Off” state. A concealed defeater mechanism shall allow entry into the enclosure when the handle is in the “On” position. A heavy-duty, snap-action, flange-operated, fusible disconnect switch is also acceptable. The blades shall be visible in the Off position. A terminal guard shall be supplied on the line-side terminals. NEMA Class R fuse clips and fuses shall be provided.
  - h. The VFD–disconnect shall have a NEMA Type 1 enclosure.
  - i. Optional bypass circuitry with a drive-bypass switch shall be provided.
  - j. The VFD shall be UL508C-listed and CSA-certified and shall conform to applicable NEMA, ICS,
  - k. NFPA, IEC, and ISO 9001 standards.

### 3.6 CLOSED COUPLED VERTICAL IN-LINE PUMPS

- A. Description: Closed Coupled Vertical, in-line, centrifugal, flexible-coupled, single-stage, radially split case design with pump characteristics which provide rising heads to shut off. Include vertical-mounting, bronze-fitted design and mechanical seals rated for 150-psig minimum working pressure and a continuous water temperature of 225 deg F. Refer to pump schedule for pump flows, heads, motor speed, enclosure, efficiency and power requirements.
- b. Pumps basis of design Armstrong Series 4380 motor mounted Vertical In-Line. Refer to the schedule for pump flows and heads and motor speed, efficiency, enclosure and power requirements.
- c. Pump Construction:
  1. Pump casing shall be cast iron, suitable for 175 psi working pressure at 140°F. Ductile iron pump casings are suitable for pressures to 250 psi. The casing shall be hydrostatically tested to 150% maximum working pressure.
  2. The casing shall be radially split to allow removal of the rotating element without disturbing the pipe connections.
  3. The casing suction and discharge connections shall be the same size and shall be provided with drilled and tapped seal vent and pressure gauge connections.
  4. Pump impeller shall be bronze, fully enclosed type. Impeller shall be dynamically balanced.
  5. A bronze shaft sleeve, extending the full length of the mechanical seal area, shall be provided.

6. Mechanical Seal shall be single spring inside type with carbon against Ceramic faces. EPDM elastomer with stainless steel spring and hardware shall be provided. Seal vent line shall be factory installed and shall be piped from the seal area to the pump suction connection.
7. Motor power requirements shown on the pump schedule are the minimum acceptable and have been sized for continuous operation without exceeding the full load nameplate rating over the entire pump curve, exclusive of service factor.

### 3.7 AUTOMATIC CONDENSATE PUMP UNITS

- a. Description: Packaged units with corrosion-resistant pump, plastic tank with cover, and automatic controls. Include factory- or field-installed check valve and a 72-inch- minimum, electrical power cord with plug.

## PART 4 - EXECUTION

### 4.1 EXAMINATION

- a. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation.
  1. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.
  2. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.
- b. Proceed with installation only after unsatisfactory conditions have been corrected.

### 4.2 PUMP INSTALLATION

- a. Install pumps according to manufacturer's written instructions.
  1. Install pumps according to HI 1.1-1.5, "Centrifugal Pumps for Nomenclature, Definitions, Application and Operation."
- b. Install pumps to provide access for periodic maintenance, including removing motors, impellers, couplings, and accessories.
- c. Support pumps and piping separately so piping is not supported by pumps.
- d. Suspend in-line pumps using continuous-thread hanger rod and vibration-isolation hangers. Install seismic bracing as required by authorities having jurisdiction.
- e. Automatic Condensate Pump Units: Install units for collecting condensate and extend to open drain.

### 4.3 CONNECTIONS

- a. Piping installation requirements are specified in other Division 15 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 the 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 valve on discharge side of in-line circulators.
- f. Install suction diffuser and shutoff valve on suction side of vertical in-line pumps.
- g. Install triple-duty valve on discharge side of vertical in-line pumps.
- h. Install pressure gages on pump suction and discharge. Install at integral pressure-gage tappings where provided.
- i. Install temperature and pressure-gage connector plugs in suction and discharge piping around each pump.
- j. Install check valve and gate or ball valve on each condensate pump unit discharge.
- k. Install electrical connections for power, controls, and devices.
- l. Electrical power and control wiring and connections are specified in Division 16 Sections.
- m. Furnish pump manufacturer HOA switches and disconnect switches and variable frequency drives for secondary chill and heating hot water main pumps.
- n. Ground equipment.
  1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

#### 4.4 COMMISSIONING

- a. Verify that pumps are installed and connected according to the Contract Documents.
- b. Verify that electrical wiring installation complies with manufacturer's written instructions and the Contract Documents.
- c. Perform the following preventive maintenance operations and checks before starting:
  1. Lubricate bearings.
  2. Remove grease-lubricated bearing covers, flush bearings with kerosene, and clean thoroughly. Fill with new lubricant according to manufacturer's written instructions.
  3. Disconnect coupling and check motor for proper rotation that matches direction marked on pump casing.

4. Verify that pumps are free to rotate by hand and that pumps for handling hot liquids are free to rotate with pumps hot and cold. Do not operate pumps if they are bound or drag, until cause of trouble is determined and corrected.
  5. Check suction piping connections for tightness to avoid drawing air into pumps.
  6. Clean strainers.
  7. Verify that pump controls are correct for required application.
- d. Starting procedure for pumps with shutoff power not exceeding safe motor power is as follows:
1. Prime pumps by opening suction valves and closing drains, and prepare pumps for operation.
  2. Open cooling water-supply valves in cooling water supply to bearings, where applicable.
  3. Open cooling water-supply valves if stuffing boxes are water cooled.
  4. Open sealing liquid-supply valves if pumps are so fitted.
  5. Open warm-up valves of pumps handling hot liquids if pumps are not normally kept at operating temperature.
  6. Open circulating line valves if pumps should not be operated against dead shutoff.
  7. Start motors.
  8. Open discharge valves slowly.
  9. Observe leakage from stuffing boxes and adjust sealing liquid valve for proper flow to ensure lubrication of packing. Let packing "run in" before reducing leakage through stuffing boxes; then tighten glands.
  10. Check general mechanical operation of pumps and motors.
  11. Close circulating line valves once there is sufficient flow through pumps to prevent overheating.
- e. When pumps are to be started against closed check valves with discharge shutoff valves open, steps are the same, except open discharge valves before starting motors.
- f. Refer to Division 15 Section "Testing, Adjusting, and Balancing" for detailed requirements for testing, adjusting, and balancing hydronic systems.

#### 4.5 DEMONSTRATION

- a. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps as specified below:
  1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining pumps.
  2. Review data in maintenance manuals. Refer to Division 1 Section "Contract Closeout."
  3. Schedule training with Owner, through Architect, with at least seven days' advance notice.

END OF SECTION

**SECTION 15410**  
**PLUMBING FIXTURES**

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 plumbing fixtures and related components. The intent is to furnish all new fixtures in all new Restrooms, Exam Rooms, Labs, and Break Rooms. Replace all existing fixtures (water closets and lavatories) shown on the drawings to remain with high efficiency fixtures. Existing fixtures to be replaced include associated fixture fittings, flush valves, p-traps, stop valves and faucets.
- B. Note that all new water closets to be replaced shall be floor mounted and shall be bottom discharge to minimize major sanitary connection upgrade.
- C. Related Sections include the following:
  - 1. Division 15 Section " Domestic Water Heaters"
  - 2. Division 15 Section "Plumbing Specialties" for backflow preventers and specialty fixtures not in this Section.
  - 3. Division 15 Section "Valves".
  - 4. Division 15 Section "Domestic Water Piping".

1.3 DEFINITIONS

- A. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- B. Fitting: Device that controls flow of water into or out of plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.
- C. Defective fixture: Fixtures that are broken/cracked, scratched, discolored and can not be cleaned or a unit that does not match the majority of the existing fixtures.

1.4 SUBMITTALS

- A. Product Data: Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports and indicate materials and finishes, dimensions, construction details, and flow-control rates for each type of fixture indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.
- C. Maintenance Data: For plumbing fixtures to include in maintenance manuals specified in Division 1.

## 1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
  - 1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- 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. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Americans with Disabilities Act"; about plumbing fixtures for people with disabilities.
- D. Regulatory Requirements: Comply with requirements in U.S. Architectural & Transportation Barriers Compliance Board's "Uniform Federal Accessibility Standards (UFAS), 1985-494-187" about plumbing fixtures for people with disabilities.
- E. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- F. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- G. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- H. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
  - 1. Stainless-Steel Fixtures Other Than Service Sinks: ASME A112.19.3M.
  - 2. Vitreous-China Fixtures: ASME A112.19.2M.
  - 3. Water-Closet, Flushometer Trim: ASSE 1037.
- I. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:

1. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
2. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
3. Faucet Hose: ASTM D 3901.
4. Faucets: ASME A112.18.1M.
5. Hose-Connection Vacuum Breakers: ASSE 1011.
6. Hose-Coupling Threads: ASME B1.20.7.
7. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
8. NSF Materials: NSF 61.
9. Pipe Threads: ASME B1.20.1.
10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
11. Supply and Drain Fittings: ASME A112.18.1M.

J. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:

1. Atmospheric Vacuum Breakers: ASSE 1001.
2. Brass and Copper Supplies: ASME A112.18.1M.
3. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
4. Tubular Brass Drainage Fittings and Piping: ASME A112.18.1M.

K. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Floor Drains: ASME A112.21.1M.
2. Grab Bars: ASTM F 446.
3. Hose-Coupling Threads: ASME B1.20.7.
4. Off-Floor Fixture Supports: ASME A112.6.1M.
5. Pipe Threads: ASME B1.20.1.
6. Plastic Toilet Seats: ANSI Z124.5.
7. Supply and Drain Protective Shielding Guards: ICC A117.1.

## 1.6 COORDINATION

- A. Coordinate roughing-in and final plumbing fixture locations, and verify that fixtures can be installed to comply with original design and referenced standards.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified in other Part 2 articles. Refer to Drawing P-1.0 for fixture schedule.

### 2.2 FIXTURES

A. Acceptable Manufacturers: (Basis of Design Refer to schedule on P-1.0)

1. China Fixtures:

AKohler Co; K-4330 / K-4330L

- b. Zurn; Z-5610 / Z-5611
- c. American Standard, Inc.
- d. Crane Plumbing/Fiat Products.
- e. Gerber Plumbing Fixtures Corp.

2. Stainless Steel Sinks

- a. Elkay
- b. Just
- c. Kohler

3. Lavatory & Sink Faucets:

- a. American Standard
- b. Chicago Faucets
- c. Delta
- d. Eljer
- e. Kohler
- f. Speakman Co.

4. FLUSHOMETER (Water Closet & Urinals)

- a. Sloan Valve Company
- b. Zurn
- c. Geberit
- d. TOTO

5. TOILET SEATS

- a. American Standards
- b. Bemis
- c. Centaco
- d. Church
- e. Eljer
- f. Kohler

6. ELECTRIC WATER COOLER

- a. Oasis Corp.
- b. Elkay Manufacturing Co.;
- c. Halsey Taylor;
- d. Haws Corporation;
- e. Sunroc Corp.

2.3 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Guard, for ADA lavatories and sinks: Manufactured plastic enclosure for covering for hot- and cold-water supplies and trap and drain piping and complying with ADA requirements.

1. Available Manufacturers:

- a. TRUEBRO
- b. McGuire

2.4 FIXTURE SUPPORTS

1. Available Manufacturers:

- a. American Standard
- b. Kohler
- c. Zurn

2.5 DISHWASHER & ICE MACHINE CONNECTION:

1. Available Manufacturers:

- a. Guy Gray
- b. Watertite

2.6 FITTINGS:

1. Available Manufacturers:

- a. American Standard
- b. Chicago
- c. Delta
- d. Eljer
- e. Kohler
- f. Zurn

2.7 GENERAL REQUIREMENTS:

- A. Fixture color - All white
- B. Trim finish - chrome-plated.
- C. Provide floor mounted concealed arm carriers for wall hung fixtures.
- D. Supplies, chrome plated components including chrome plated copper riser tubes, chrome plated valves, escutcheons (including under counters) and chrome handwheels. Plastic supply tubes are not allowed. Chrome Plated, compression or threaded chrome plated extension, with chrome plated escutcheon, angle stop with hand wheel, chrome plated supply tube. No braided stainless steel and no PEX or Plastic Pipe supply components allowed.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water soil and for waste piping systems and supports to verify actual locations and sizes of piping connections and that locations and types of supports match those indicated, before plumbing fixture installation. Verify that substrate conditions are complete and acceptable for the installation of all floor mounted fixtures including showers. Verify that plumbing and electrical work is acceptable for all fixture installation. Use manufacturer's roughing-in data if roughing-in data are not indicated.
- B. Examine walls, floors, and cabinets for suitable conditions where fixtures are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FIXTURE INSTALLATION

- A. Assemble fixtures, trim, fittings, and other components according to manufacturers' written instructions. Comply with manufacturer's written instructions for installation of all fixtures.
- B. For wall-hanging fixtures, install off-floor supports affixed to building substrate.
  - 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
  - 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
  - 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install back-outlet, wall-hanging fixtures onto waste fitting seals and attach to supports.
- D. Install wall-hanging fixtures with tubular waste piping attached to supports.
- E. Install counter-mounting fixtures in and attached to casework.
- F. Install fixtures level and plumb according to manufacturers' written instructions and roughing-in drawings.
- G. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
  - 1. Exception: Use ball, gate, or globe valve if stops are not specified with fixture. Refer to Division 15 Section "Valves" for general-duty valves.
- H. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- I. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- J. Install flushometer valves per manufacturer's installation instructions coordinate grab bar location with flush valve installation.

- K. Install toilet seats on water closets.
- L. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- M. Install water-supply, flow-control fittings with specified flow rates in fixture supplies at stop valves.
- N. Install faucet, flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- O. Comply with manufacturer's written instructions for installation of showers and accessories. Anchor support brackets and frames to construction using anchors suitable for supporting substrate. Column showers shall be supported from floor and ceiling structure. Provide plumbing connections necessary for a completed installation.
- P. Install traps on fixture outlets.
  - 1. Exception: Omit trap on fixtures with integral traps.
- Q. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for escutcheons.
- R. Seal joints between fixtures and walls, floors, and counters using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Refer to Division 7 Section "Joint Sealants" for sealant and installation requirements.
- S. Dental equipment shall be provided by dental equipment subcontractor. The plumbing contractor shall furnish all fixture trim and plumb all dental equipment and fixtures in accordance with these contract documents, standards and regulations and manufacturer's recommendations.
- T. NOTE: Chemical feed/blowdown equipment in chiller room shall be furnished with 3/4" hose bibb with vacuum breaker and hose connection. Hose bibb shall be plumbed next to the chemical feed equipment from existing domestic water piping in chiller room.

### 3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect water supplies from water distribution piping to fixtures.
- C. Connect drain piping from fixtures to drainage piping.
- D. Supply and Waste Connections to Plumbing Fixtures: Connect fixtures with water supplies, stops, risers, traps, and waste piping. Use size fittings required to match fixtures. Connect to plumbing piping.

- E. Supply and Waste Connections to Fixtures and Equipment. Furnish and connect fixtures and equipment with water supplies, stops, risers, traps, and waste piping specified. Use size fittings required to match fixtures and equipment. Connect to plumbing piping.
- F. Ground equipment.
  - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

### 3.4 FIELD QUALITY CONTROL

- A. Verify that installed fixtures are categories and types specified for locations where installed.
- B. Check that fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

### 3.5 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Operate and adjust controls. Replace damaged and malfunctioning units.
- C. Adjust water pressure at faucets, flush valves and bubblers to produce proper flow and stream.
- D. Replace washers and seals of leaking and dripping faucets and stops.

### 3.6 CLEANING

- A. Clean new and existing fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
  - 1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
  - 2. Remove sediment and debris from drains.
  - 3. Remove stains on existing fixtures to remain with manufacturer recommended cleaning products.
  - 4. Clean exposed surfaces using non-abrasive materials and methods recommended by manufacturer

### 3.7 PROTECTION

- A. Provide protective covering for new installed and existing to remain fixtures and fittings.
- B. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION

**SECTION 15430**  
**PLUMBING SPECIALTIES**

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 plumbing specialties:

1. Backflow preventers.
2. Dishwasher air-gap fittings.
3. Balancing valves.
4. Thermostatic water mixing valves.
5. Strainers.
6. Outlet boxes.
7. Washer-supply outlets.
8. Trap seal primer valves.
9. Drain valves.
10. Miscellaneous piping specialties.
11. Sleeve penetration systems.
12. Flashing materials.
13. Cleanouts.
14. Floor drains.

- B. Related Sections include the following:

1. Division 15 Section "Gages" for water meters, thermometers, and pressure gages.

1.3 DEFINITIONS

- A. The following are industry abbreviations for plastic piping materials:

1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. PE: Polyethylene plastic.
3. PUR: Polyurethane plastic.
4. PVC: Polyvinyl chloride plastic.
5. PP. Polypropylene

1.4 PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing piping systems with following minimum working-pressure ratings, unless otherwise indicated:
  - 1. Domestic Water Piping: 125 psig.
  - 2. Sanitary Waste and Vent Piping: 10-foot head of water.
  - 3. Storm Drainage Piping: 10-foot head of water.
  - 4. Force-Drainage Piping: 100 psig.

#### 1.5 SUBMITTALS

- A. Product Data: Include rated capacities and shipping, installed, and operating weights. Indicate materials, finishes, dimensions, required clearances, and methods of assembly of components; and piping and wiring connections for the following:
  - 1. Backflow preventers and water regulators.
  - 2. Balancing valves and strainers.
  - 3. Thermostatic water mixing valves and water tempering valves.
  - 4. Water hammer arresters, air vents, and trap seal primer valves and systems.
  - 5. Hose bibs and wall hydrants.
  - 6. Outlet boxes.
  - 7. Cleanouts
  - 8. Floor drains
  - 9. Air-admittance valves, vent caps, vent terminals, and roof flashing assemblies.
  - 10. Sleeve penetration systems.
- B. Field test reports.
- C. Maintenance Data: For plumbing specialties to include in maintenance manuals. Include the following:
  - 1. Backflow preventers and water regulators.
  - 2. Thermostatic water mixing valves and water tempering valves.
  - 3. Trap seal primer valves and systems.

#### 1.6 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of plumbing specialties and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
- B. Plumbing specialties shall bear label, stamp, or other markings of specified testing agency.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for piping materials and installation.

E. NSF Compliance:

1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components. Include marking "NSF-pw" on plastic potable-water piping and "NSF-dwv" on plastic drain, waste, and vent piping.
2. Comply with NSF 61, "Drinking Water System Components--Health Effects, Sections 1 through 9," for potable domestic water plumbing specialties.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified.
2. Products: Subject to compliance with requirements, provide one of the products specified.
3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
4. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 BACKFLOW PREVENTERS

A. Manufacturers:

1. Conbraco Industries, Inc.
2. FLOMATIC Corp.
3. Mueller Co.; Hersey Meters Div.
4. Watts Industries, Inc.; Water Products Div.
5. Zurn Industries, Inc.; Wilkins Div.

B. General: ASSE standard, backflow preventers.

1. NPS 2 and Smaller: Bronze body with threaded ends.
2. NPS 2-1/2 and Larger: Bronze, cast-iron, steel, or stainless-steel body with flanged ends.
  - a. Interior Lining: AWWA C550 or FDA-approved, epoxy coating for backflow preventers having cast-iron or steel body.
3. Interior Components: Corrosion-resistant materials.
4. Exterior Finish: Polished chrome plate if used in chrome-plated piping system.
5. Strainer: On inlet, if indicated.

- C. Pipe-Applied, Atmospheric-Type Vacuum Breakers: ASSE 1001, with floating disc and atmospheric vent.
- D. Hose-Connection Vacuum Breakers: ASSE 1011, nickel plated, with nonremovable and manual drain features, and ASME B1.20.7, garden-hose threads on outlet. Units attached to rough-bronze-finish hose connections may be rough bronze.
- E. Reduced-Pressure-Principle Backflow Preventers: ASSE 1013, suitable for continuous pressure application. Include outside screw and yoke gate valves on inlet and outlet, and strainer on inlet; test cocks; and pressure-differential relief valve with ASME A112.1.2 air-gap fitting located between two positive-seating check valves.
  - 1. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
- F. Laboratory Faucet Vacuum Breakers: ASSE 1035, suitable for continuous pressure application and chrome plated; consisting of primary and secondary checks; intermediate vacuum breaker; and threaded ends, NPS 1/4 or NPS 3/8 as required.
- G. Hose-Connection Backflow Preventers: ASSE 1052, suitable for at least 3-gpm (0.19-L/s) flow and applications with up to 10-foot head of water (30-kPa) back pressure. Include two check valves; intermediate atmospheric vent; and nonremovable, ASME B1.20.7, garden-hose threads on outlet.

### 2.3 WATER REGULATORS

- A. Manufacturers:
  - 1. Watts Industries, Inc.; Water Products Div.
  - 2. Zurn Industries, Inc.; Wilkins Div.
  - 3. Cla-Val Co.
  - 4. Conbraco Industries, Inc.
  - 5. FLOMATIC Corp.
- B. General: ASSE 1003, water regulators, rated for initial working pressure of 150 psig minimum. Include integral factory-installed or separate field-installed, Y-pattern strainer.
  - 1. NPS 2 and Smaller: Bronze body with threaded ends.
    - a. General-Duty Service: Single-seated, direct operated, unless otherwise indicated.
  - 2. NPS 2-1/2 and Larger: Bronze or cast-iron body with flanged ends. Include AWWA C550 or FDA-approved, interior epoxy coating for regulators with cast-iron body.
    - a. Type: Pilot-operated, single- or double-seated, cast-iron-body main valve, with bronze-body pilot valve.
  - 3. Interior Components: Corrosion-resistant materials.

2.4 BALANCING VALVES

A. Calibrated Balancing Valves: Adjustable, with two readout ports and memory setting indicator. Include manufacturer's standard hoses, fittings, valves, differential pressure meter, and carrying case.

1. Available Manufacturers:
2. Manufacturers:
  - a. Armstrong Pumps, Inc.
  - b. Flow Design, Inc.
  - c. ITT Industries; Bell & Gossett Div.
  - d. Taco, Inc.
  - e. Watts Industries, Inc.; Water Products Div.
3. NPS 2 and Smaller: Bronze, Y-pattern body with adjustment knob and threaded ends.
4. NPS 2-1/2 and Larger: Cast-iron, Y-pattern body with bronze disc and flanged or grooved ends.
5. Manufacturers:
  - a. Conbraco Industries, Inc.
  - b. Crane Co.; Crane Valve Group; Crane Valves.
  - c. Grinnell Corporation.
  - d. Milwaukee Valve Company.
  - e. NIBCO INC.
  - f. Red-White Valve Corp.

2.5 THERMOSTATIC WATER MIXING VALVES

A. Manufacturers:

1. Lawler Manufacturing Company, Inc.
2. Bradley Corporation
3. Leonard Valve Company.
4. Mark Controls Corp.; Powers Process Controls.
5. Symmons Industries, Inc.
6. T & S Brass and Bronze Works, Inc.

B. REFERENCES

1. ASSE 1016 - Individual Thermostatic, Pressure Balancing, and Combination Pressure Balancing and Thermostatic Control Valves for Individual Fixture Fittings; 1996.
2. ASSE 1017 - Temperature Actuated Mixing Valves for Hot Water Distribution; 2003.
3. ANSI Z358.1 - American National Standard for Emergency Eyewash and Shower Equipment; 2004.
4. CSA B125.3 - Plumbing Fittings.
5. CUPC - Certification and listed for compliance with both ASSE 1017 and Canadian Stan-

Standard B125.3-2005.

- C. General: ASSE 1017, manually adjustable, thermostatic water mixing valve with bronze body. Include check stop and union on hot- and cold-water-supply inlets, adjustable temperature setting, and thermometer.
  - 1. Type: Bimetal thermostat, operation and pressure rating 125 psig minimum.
- D. Thermostatic Water Mixing Valve: Unit, with the following:
  - 1. Piping, valves, and unions including thermometer.
  - 2. Piping Component Finish: Rough bronze.
  - 3. Cabinet: Surface-mounting stainless-steel box with stainless-steel hinged door and thermometer in front.
- E. Manifolded, Thermostatic Water Mixing-Valve Assemblies: Factory-fabricated unit consisting of parallel arrangement of thermostatic water mixing valves.
  - 1. Arrangement: One large-flow, thermostatic water mixing valve with flow-control valve, pressure regulator, inlet and outlet pressure gages, and one small-flow, thermostatic water mixing valve with flow-control valve. Include outlet thermometer, factory- or field-installed inlet and outlet valves, and other indicated options.
  - 2. Include piping, valves, and unions.
  - 3. Piping Component Finish: Rough bronze.
  - 4. Cabinet: Surface-mounting stainless-steel box with stainless-steel hinged door and thermometer in front.

## 2.6 STRAINERS

- A. Strainers: Y-pattern, unless otherwise indicated, and full size of connecting piping. Include ASTM A 666, Type 304, stainless-steel screens with 3/64-inch round perforations, unless otherwise indicated.
  - 1. Pressure Rating: 125-psig minimum steam working pressure, unless otherwise indicated.
  - 2. NPS 2 and Smaller: Bronze body, with female threaded ends.
  - 3. NPS 2-1/2 and Larger: Cast-iron body, with interior AWWA C550 or FDA-approved, epoxy coating and flanged ends.
  - 4. Y-Pattern Strainers: Screwed screen retainer with centered blowdown.
    - a. Drain: Factory- or field-installed, hose-end drain valve.
- B. Drainage Basket Strainers: Non-pressure-rated, cast-iron or coated-steel body; with bolted flange or clamp cover and drain with plug.
  - 1. Basket: Bronze or stainless steel with 1/8- or 3/16-inch- diameter holes and lift-out handle.
  - 2. Female threaded ends for NPS 2 and smaller, and flanged ends for NPS 2-1/2 and larger.

## 2.7 OUTLET BOXES

- A. Manufacturers:
1. Acorn Engineering Company.
  2. Gray, Guy Manufacturing Co., Inc.
  3. Oatey.
  4. Symmons Industries, Inc.
  5. WaterTite
  6. Zurn Industries, Inc.; Jonespec Div.
- B. General: Recessed-mounting outlet boxes with supply fittings complying with ASME A112.18.1M. Include box with faceplate, services indicated for equipment connections, and wood-blocking reinforcement.
- C. Dishwasher Outlet Boxes: With hot water hose connections and the following:
1. Box and Faceplate: Plastic.
  2. Shutoff Fittings: One hose bibbs.
  3. Supply Fittings: One NPS 1/2 gate valves and NPS 1/2 copper, water tubing.
  4. Inlet Hoses: One ASTM D 3571, 60-inch- long inlet hoses with female hose-thread couplings.
- D. Icemaker Outlet Boxes: With hose connection and the following:
1. Box and Faceplate: Stainless steel.
  2. Shutoff Fitting: Hose bibb.
  3. Supply Fitting: NPS 1/2 gate valve, filter and check valve and NPS 1/2 copper, water tubing.
- E. Reinforcement: 2-by-4-inch fire-retardant-treated-wood blocking between studs.

## 2.8 KEY-OPERATION HYDRANTS

- A. Manufacturers:
1. Josam Co.
  2. Simmons Manufacturing Co.
  3. Smith, Jay R. Mfg. Co.
  4. Watts Industries, Inc.; Drainage Products Div.
  5. Woodford Manufacturing Co.
  6. Zurn Industries, Inc.; Jonespec Div.
  7. Zurn Industries, Inc.; Specification Drainage Operation.
- B. General: ASME A112.21.3M, key-operation hydrant with pressure rating of 125 psig.
1. Inlet: NPS 3/4 threaded.
  2. Outlet: ASME B1.20.7, garden-hose threads.
  3. Operating Keys: Two with each key-operation hydrant.

- C. Nonfreeze Concealed-Outlet Wall Hydrants: ASSE 1019, self-drainable with flush-mounting box with cover, integral nonremovable hose-connection vacuum breaker, casing and operating rod to match wall thickness, concealed outlet, and wall clamp.
  - 1. Classification: Type A, for automatic draining with hose removed or Type B, for automatic draining with hose removed or with hose attached and nozzle closed.
  - 2. Box and Cover Finish: Rough bronze.
  
- D. Nonfreeze Concealed-Outlet Ground Hydrants: Draining type with flush-mounting box with cover, casing and operating rod of at least length required for burial of valve below frost line, drain hole, and garden-hose threads complying with ASME B1.20.7 on outlet.
  - 1. Box and Cover Finish: Rough bronze.

2.9 WHEEL-HANDLE WALL HYDRANTS

A. Manufacturers:

- 1. Woodford Manufacturing Co
- 2. Zurn Industries, Inc.; Jonespec Div
- 3. Smith, Jay R. Mfg. Co.
- 4. Watts Industries, Inc.; Drainage Products Div.
- 5. Watts Industries, Inc.; Water Products Div.
- 6. Zurn Industries, Inc.; Jonespec Div.

- B. Description: Frost-proof design similar to ASME A112.21.3M, for wall mounting with wheel-handle operation, NPS 1/2 threaded or solder-joint inlet, casing and operating rod to match wall thickness, and projecting outlet with ASME B1.20.7 garden-hose threads on outlet. Include wall clamp; integral vacuum breaker or nonremovable, drainable hose-connection vacuum breaker complying with ASSE 1011; and garden-hose threads complying with ASME B1.20.7 on outlet.

2.10 TRAP SEAL PRIMER VALVES

A. Supply-Type Trap Seal Primer Valves: ASSE 1018, water-supply-fed type, with the following characteristics:

- 1. Manufacturers:
  - a. Precision Plumbing Products Inc.
  - b. Josam Co.
  - c. MIFAB Manufacturing, Inc.
  - d. Precision Plumbing Products, Inc.
  - e. Smith, Jay R. Mfg. Co.
  - f. Tyler Pipe; Wade Div.
  - g. Watts Industries, Inc.; Water Products Div.
  - h. Zurn Industries, Inc.; Jonespec Div.
  
- 2. 125-psig minimum working pressure.
- 3. Bronze body with atmospheric-vented drain chamber.

4. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
5. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
6. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

B. Drainage-Type Trap Seal Primer Valves: ASSE 1044, fixture-trap, waste-drainage-fed type, with the following characteristics:

1. Available Manufacturers:
  - a. Smith, Jay R. Mfg. Co.
  - b. MIFAB Manufacturing, Inc.
2. Chrome-plated, cast-brass, NPS 1-1/4 minimum, lavatory P-trap with NPS 3/8 minimum, trap makeup connection.

## 2.11 MISCELLANEOUS PIPING SPECIALTIES

A. Water Hammer Arresters: ASSE 1010 or PDI-WH 201, metal-bellows type with pressurized metal cushioning chamber. Sizes indicated are based on ASSE 1010 or PDI-WH 201, Sizes A through F.

1. Manufacturers:
  - a. Precision Plumbing Products Inc
  - b. Josam Co.
  - c. Smith, Jay R. Mfg. Co.
  - d. Tyler Pipe; Wade Div.
  - e. Zurn Industries, Inc.; Specification Drainage Operation.

B. Water Hammer Arresters: ASSE 1010 or PDI-WH 201, piston type with pressurized metal-tube cushioning chamber. Sizes indicated are based on ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

1. Manufacturers:
  - a. Precision Plumbing Products, Inc.
  - b. Amtrol, Inc.
  - c. Josam Co.
  - d. Sioux Chief Manufacturing Co., Inc.
  - e. Watts Industries, Inc.; Drainage Products Div.
  - f. Watts Industries, Inc.; Water Products Div.
  - g. Zurn Industries, Inc.; Wilkins Div.

C. Hose Bibbs: Bronze body with replaceable seat disc complying with ASME A112.18.1M for compression-type faucets. Include NPS 1/2 threaded inlet, of design suitable for pressure of at least 125 psig; integral nonremovable, drainable hose-connection vacuum breaker; and garden-hose threads complying with ASME B1.20.7 on outlet.

1. Finish for Equipment Rooms: Rough bronzed.
2. Finish for Service Areas: Rough bronze.
3. Finish for Finished Rooms: Chrome plated.

4. Operation for Equipment Rooms: Wheel handle.
  5. Operation for Service Areas: Operating key.
  6. Operation for Finished Rooms: Operating key.
  7. Include operating key with each operating-key hose bibb.
  8. Include wall flange with each hose bibb.
- D. Air Vents: Float type for automatic air venting.
1. Bolted Construction: Bronze body with replaceable, corrosion-resistant metal float and stainless-steel mechanism and seat; threaded NPS 3/8 minimum inlet; 125-psig minimum pressure rating at 140 deg F; and threaded vent outlet.
- E. Air-Admittance Valves: Plastic housing or polypropylene for laboratory sinks with mechanical-operation sealing diaphragm, designed to admit air into drainage and vent piping and to prevent transmission of sewer gas into building.
1. Manufacturers:
    - a. Studor, Inc.; “Chem-Vent”
    - b. IPS Corporation.
    - c. J & B Products.
    - d. Magic Vent Co., Inc.
    - e. Oatey.
    - f. Sioux Chief Manufacturing Co., Inc.
  2. Fixture Vent Valve: ASSE 1051, designed for installation on waste piping, instead of vent connection, for single fixture, in NPS 1-1/2 to NPS 2.
- F. Roof Flashing Assemblies: Manufactured assembly made of 6-lb/sq. ft., 0.0938-inch- thick, lead flashing collar and skirt extending at least 8 inches from pipe with galvanized steel boot reinforcement and counter-flashing fitting.
1. Available Manufacturers:
    - a. Acorn Engineering Company
    - b. Elmdor/Stoneman Div.
    - c. Bradford White Venting
  2. Open-Top Vent Cap: Without cap.
  3. Low-Silhouette Vent Cap: With vandal-proof vent cap.
  4. Extended Vent Cap: With field-installed, vandal-proof vent cap.
- G. Open Drains: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting, joined with ASTM C 564, rubber gaskets.
- H. Deep-Seal Traps: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap seal primer valve connection.
1. NPS 2 minimum water seal.
  2. NPS 2-1/2 and Larger: minimum water seal.

- I. Floor-Drain Inlet Fittings: Cast iron, with threaded inlet and threaded or spigot outlet, and trap seal primer valve connection.
- J. Fixed Air-Gap Fittings: Manufactured cast-iron or bronze drainage fitting with semi-open top with threads or device to secure drainage inlet piping in top and bottom spigot or threaded outlet larger than top inlet. Include design complying with ASME A112.1.2 that will provide fixed air gap between installed inlet and outlet piping.
- K. Stack Flashing Fittings: Counter flashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
- L. Vent Caps: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and set-screws to secure to vent pipe.
- M. Vent Terminals: Commercially manufactured, shop- or field-fabricated, frost-proof assembly constructed of galvanized steel, copper, or lead-coated copper. Size to provide 1-inch enclosed air space between outside of pipe and inside of flashing collar extension, with counterflashing.

## 2.12 FLASHING MATERIALS

- A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
  - 1. General Use: 4-lb/sq. ft., 0.0625-inch thickness.
  - 2. Vent Pipe Flashing: 3-lb/sq. ft., 0.0469-inch thickness.
  - 3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.
- B. Copper Sheet: ASTM B 152, of the following minimum weights and thicknesses, unless otherwise indicated:
  - 1. General Applications: 12 oz./sq. ft..
  - 2. Vent Pipe Flashing: 8 oz./sq. ft..
- C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.
- D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.
- E. Fasteners: Metal compatible with material and substrate being fastened.
- F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- G. Solder: ASTM B 32, lead-free alloy.
- H. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

2.13 CLEANOUTS

A. Cleanouts, FCO & WCO: Comply with ASME A112.36.2M.

1. Application: Floor cleanout & Wall cleanouts.
2. Products:
  - a. Josam Co.
  - b. Smith, Jay R. Mfg. Co..
  - c. Tyler Pipe, Wade Div..
  - d. Watts Industries, Inc., Drainage Products Div.
  - e. Zurn Industries, Inc., Jonespec Div..
3. Body or Ferrule Material: Cast iron.
4. Clamping Device: Not required.
5. Outlet Connection: Spigot.
6. Closure: Brass plug with tapered threads
7. Adjustable Housing Material: Cast iron with set-screws or other device.
8. Frame and Cover Material and Finish: Polished bronze.
9. Frame and Cover Shape: Round.
10. Top Loading Classification: Medium Duty.

2.14 FLOOR DRAINS

A. Floor Drains, shall comply with ASME A112:21.1M.

1. Application: Floor drains, Funnel floor drain, Floor sinks, Roof drains and Hub Drains.
2. Manufacturers:
  - a. Zurn Industries, Inc.
  - b. Josam Co.
  - c. Smith, Jay R. Mfg. Co.
  - d. Tyler Pipe, Wade Div..
  - e. Watts Industries, Inc., Drainage Products Div.;
3. General Requirements:
  - a. Floor drain outlets shall be of size as noted on drawings.
  - b. Before setting any drains, the Contractor shall obtain information relative to the finish grade or floor for the exact top elevation of the drains.
  - c. Floor drains located in floors having waterproofing membranes shall be equipped with flashing flange and clamping collar.
  - d. Trap material shall be cast iron.
  - e. All interior sanitary floor drains shall have trap seal primer valve drain connection.
4. Products:
  - a. Watts FD-200-A-7

Floor Drains in Finished Spaces or floors shall be with 6" diameter type "BE" polished nickel bronze funnel with nickel bronze strainer, cast iron body, inside caulk, and bottom outlet.

- c. Watts FD-200-A-7  
Floor drains for equipment in unfinished spaces shall be with 8" diameter top with cast iron body, sediment bucket, flashing clamp, heavy duty slotted grate, inside caulk, and bottom outlet.
- d. J.R. Smith 3431 or Zurn Z-1901:  
Floor Sinks shall be 12"X12"X8" deep receptors with cast iron body, acid resisting porcelain enamel interior and top, slotted light duty grate with white ABS anti splash interior dome strainer, ½ grate, inside caulk, and bottom outlet.
- c. Zurn Z326  
Hub Drains shall be 6 ¾" diameter indirect waste funnel pipe size with Dura-Coated cast iron body.

## 2.15 ROOF DRAINS

- A. Roof Drains, Shall comply with ASME A112.21.2M. Roof Drains shall be Zurn "Z-100" for concrete deck, Dura-Coated cast iron body with combination membrane flashing clamp/gravel and low silhouette Cast iron dome.

- 1. Application: Roof drain
- 2. Manufacturers:
  - a. Zurn Industries, Inc; Z-100
  - b. Josam Co.
  - c. Smith, Jay R. Mfg. Co.
  - d. Watts Industries, Inc., Drainage Products Div.
- 3. General Requirements
  - a. Material: Cast iron.
  - b. Dimensions of Body: 15" diameter
  - c. Combination Flashing Ring and Gravel Stop: Required
  - d. Outlet: Bottom.
  - e. Dome Material: Cast iron.
  - f. Extension Collars: Required.
  - g. Underdeck Clamp: Required.
  - h. Sump Receiver: Required.

## 2.22 ACCESS PANELS:

- A. The contractor shall group together valves concealed in suspended ceilings, walls, and furred spaces to reduce the number of access panels, but with valves freely accessible for maintenance.

- B. Panels shall have flush doors with No. 14 USCG steel door and trim No. 16 USCG steel frame, metal wings for keying into construction, concealed hinges, and screwdriver operated stainless steel cam lock. Panels shall be shop coated with one coat of zinc chromate primer. Valves above removable ceilings shall have tiles marked with tile clips for identification.
- C. Manufacturer: Acudor Product Inc. or approved equal

### PART 3 - INSTALLATION

#### 3.1 INSTALLATION

- A. Refer to Division 15 Section "Mechanical General Requirements" for piping joining materials, joint construction, and basic installation requirements.
- B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
  - 1. Locate backflow preventers in same room as connected equipment or system.
  - 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
  - 3. Do not install bypass piping around backflow preventers.
- C. Install pressure regulators with inlet and outlet shutoff valves and balance valve bypass. Install pressure gages on inlet and outlet.
- D. Install strainers on supply side of each control valve, pressure regulator, and solenoid valve.
- E. Install trap seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- F. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
  - 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
  - 2. Locate at each change in direction of piping greater than 45 degrees.
  - 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
  - 4. Locate at base of each vertical soil and waste stack.
- G. Install cleanout deck plates with top flush with finished floor, for floor cleanouts for piping below floors.
- H. Install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall, for cleanouts located in concealed piping.

- I. Install flashing flange and clamping device with each stack and cleanout passing through floors with waterproof membrane.
  - J. Install vent flashing sleeves on stacks passing through roof. Secure over stack flashing according to manufacturer's written instructions.
  - K. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
    - 1. Position floor drains for easy access and maintenance.
    - 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
      - a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
      - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
      - c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
    - 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
    - 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
  - L. Fasten wall-hanging plumbing specialties securely to supports attached to building substrate if supports are specified and to building wall construction if no support is indicated.
  - M. Fasten recessed-type plumbing specialties to reinforcement built into walls.
  - N. Install wood-blocking reinforcement for wall-mounting and recessed-type plumbing specialties.
  - O. Install individual shutoff valve in each water supply to plumbing specialties. Use ball, gate, or globe valve if specific valve is not indicated. Install shutoff valves in accessible locations. Refer to Division 15 Section "Valves" for general-duty ball, butterfly, check, gate, and globe valves.
  - P. Install air vents at piping high points. Include ball, gate, or globe valve in inlet and drain piping from outlet to floor drain.
  - Q. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
  - R. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.
- 3.2 CONNECTIONS
- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Connect plumbing specialties to piping specified in other Division 15 Sections.
- D. Ground equipment.
- E. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- F. Connect plumbing specialties and devices that require power according to Division 16 Sections.

### 3.3 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
  - 1. Lead Sheets: Burn joints of lead sheets 6-lb/sq. ft., 0.0938-inch (thickness or thicker. Solder joints of lead sheets 4-lb/sq. ft., 0.0625-inch thickness or thinner.
  - 2. Copper Sheets: Solder joints of copper sheets.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
  - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches and skirt or flange extending at least 8 inches around pipe.
  - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
  - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 7 Section "Sheet Metal Flashing and Trim."
- F. Fabricate and install flashing and pans, sumps, and other drainage shapes.

### 3.4 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each backflow preventer and thermostatic water mixing valve.
  - 1. Text: Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.
  - 2. Refer to Division 15 Section "Mechanical Identification" for nameplates and signs.

3.5 FIELD QUALITY CONTROL

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.6 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

**SECTION 15486**  
**FUEL-FIRED WATER HEATERS**

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Residential, power-vent (direct vented), gas-fired, storage, domestic-water heaters.
2. Domestic-water heater accessories.

1.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Commercial domestic-water heaters shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces."

1.3 SUBMITTALS

A. Product Data: For domestic-water heater indicated.

B. Water Heater Accessories

C. Shop Drawings:

1. Wiring Diagrams: For power, signal, and control wiring.

D. Product certificates.

E. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.

F. Source quality-control reports.

G. Field quality-control reports.

H. Operation and maintenance data.

I. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE/IESNA 90.1 Compliance: Fabricate and label fuel-fired, domestic-water heaters to comply with ASHRAE/IESNA 90.1.
- C. ASME Compliance:
  - 1. Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61, "Drinking Water System Components - Health Effects."

1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fuel-fired, domestic-water heaters that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Periods: From date of Substantial Completion.
    - a. Commercial, Gas-Fired, Storage, Domestic-Water Heaters:
      - 1) Storage Tank: Three years.
      - 2) Controls and Other Components: One year.
    - b. Expansion Tank: one year.

PART 2 - PRODUCTS

2.1 COMMERCIAL, GAS-FIRED, STORAGE, DOMESTIC-WATER HEATERS

- A. Commercial, Power-Burner, Gas-Fired, Storage, Domestic-Water Heaters:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 2. Basis-of-Design Product: Subject to compliance with requirements, provide AO Smith BTH150 and per schedule in the drawings, product by one of the following:
    - a. Precision Boilers.
    - b. PVI Industries, LLC.
    - c. RECO USA.
    - d. Sellers Engineering Co.
    - e. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.

3. Standard: ANSI Z21.10.3/CSA 4.3.
4. Storage-Tank Construction: ASME-code steel with 150-psig working-pressure rating.
  - a. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.
    - 1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
    - 2) NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.
  - b. Lining: Glass complying with NSF 61 barrier materials for potable-water tank linings, including extending lining into and through tank fittings and outlets.
5. Factory-Installed Storage-Tank Appurtenances:
  - a. Anode Rod: Replaceable magnesium.
  - b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
  - c. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
  - d. Insulation: Comply with ASHRAE/IESNA 90.1. Surround entire storage tank except connections and controls.
  - e. Jacket: Steel with enameled finish.
  - f. Burner: UL 795 for power-burner, gas-fired, domestic-water heaters and natural-gas fuel.
  - g. Automatic Ignition: ANSI Z21.20/CSA C22.2 No. 199, electric, automatic, gas-ignition system.
  - h. Temperature Control: Adjustable thermostat.
  - i. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
  - j. Combination Temperature-and-Pressure Relief Valves: ANSI Z21.22/CSA 4.4-M. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.
6. Power-Vent System: Exhaust fan, interlocked with burner.

B. Capacity and Characteristics:

1. Capacity: 100 gal.
2. Recovery: 173 gph at 100 deg F temperature rise.
3. Temperature Setting: 120 deg F.
4. Fuel Gas Input: 150 Btu/h
5. Gas Pressure Regulator:
  - a. Capacity: 150 cfh
  - b. Inlet Pressure: 10 inches water column.
  - c. Gas Pressure Required at Burner: 4 inches water column.
6. Electrical Characteristics:

- a. Volts: 120
  - b. Phase: Single
  - c. Hertz: 60.
  - d. Full-Load Amperes: 6.2
7. Minimum Vent Diameter: 3".

## 2.2 DOMESTIC-WATER HEATER ACCESSORIES

### A. Domestic-Water Compression Tanks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  2. Basis-of-Design Product: Subject to compliance with requirements, provide AO Smith PMET-5 comparable product by one of the following:
    - a. AMTROL Inc.
    - b. Flexcon Industries.
    - c. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
    - d. State Industries.
    - e. Taco, Inc.
  3. Description: Steel, pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
  4. Construction:
    - a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
    - b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
    - c. Air-Charging Valve: Factory installed.
    - d. Air separator and relief valve.
  5. Capacity and Characteristics:
    - a. Working-Pressure Rating: 100 psig
    - b. Capacity Acceptable: 4 gal. minimum.
    - c. Air Precharge Pressure: 60 psi.
- B. Heat-Trap Fittings: ASHRAE 90.2.
- C. Gas Shutoff Valves: ANSI Z21.15/CSA 9.1-M, manually operated. Furnish for installation in piping.
- D. Gas Pressure Regulators: ANSI Z21.18/CSA 6.3, appliance type. Include 2-psig pressure rating as required to match gas supply.

- E. Automatic Gas Valves: ANSI Z21.21/CSA 6.5, appliance, electrically operated, on-off automatic valve.
- F. Combination Temperature-and-Pressure Relief Valves: Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.
  - 1. Gas-Fired, Domestic-Water Heaters: ANSI Z21.22/CSA 4.4-M.
- G. Pressure Relief Valves: Include pressure setting less than domestic-water heater working-pressure rating.
  - 1. Gas-Fired, Domestic-Water Heaters: ANSI Z21.22/CSA 4.4-M.
- H. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4-M.
- I. Sealed-combustion direct-vent Optional Concentric Vent Kit -- for roof penetrations.
- J. Water heater(s) shall be suitable for venting with 3" diameter PVC pipe for a total equivalent distance of 50 ft or 4" diameter PVC pipe for a total equivalent distance of 120 ft.
- K. Water heater shall be furnished with Lawler 802 or approved equal thermostatic valve for building discharge temperature adjustment of 110 deg F.  
The Thermostatic master water mixing valve of type with liquid-filled thermal motor. It shall have bronze body construction with replaceable corrosion-resistant components. Valve construction shall employ a sliding piston control mechanism. Sliding piston and liner shall be of stainless steel material. Valve shall come equipped with union end stop and check inlets with removable stainless steel strainers. Valve shall control temperature from a low flow of 2 GPM\* up to a maximum flow rate for a given pressure differential. Valve shall provide protection against hot or cold supply line failure and thermostat failure.  
Unit to include a dial thermometer, shut-off valve and union on tempered water outlet. Unit is completely assembled and tested with necessary fittings, nipples and escutcheons. With surface mounted 16 Ga carbon steel enclosure with baked enamel coating.
- L. Existing domestic hot water return pump shall be reused.

### 2.3 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect assembled domestic-water heaters specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.
- B. Hydrostatically test commercial domestic-water heaters to minimum of one and one-half times pressure rating before shipment.
- C. Domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Division 1 Section "Quality Requirements" for retesting and reinspecting requirements and Division 1 Section "Execution Requirements" for requirements for correcting the Work.

- D. Prepare test and inspection reports.

### PART 3 - EXECUTION

#### 3.1 DOMESTIC-WATER HEATER INSTALLATION

- A. Commercial, Domestic-Water Heater Mounting: Install commercial domestic-water heaters on concrete base. Comply with requirements for concrete base specified in Division 3 Section "Cast-in-Place Concrete."
  - 1. Maintain manufacturer's recommended clearances.
  - 2. Arrange units so controls and devices that require servicing are accessible.
  - 3. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
  - 4. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  - 5. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 6. Install anchor bolts to elevations required for proper attachment to supported equipment.
  - 7. Anchor domestic-water heaters to substrate.
- B. Install domestic-water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
  - 1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Division 15 Section "General-Duty Valves for Plumbing Piping."
- C. Install gas-fired, domestic-water heaters according to NFPA 54.
  - 1. Install gas shutoff valves on gas supply piping to gas-fired, domestic-water heaters without shutoff valves.
  - 2. Install gas pressure regulators on gas supplies to gas-fired, domestic-water heaters without gas pressure regulators if gas pressure regulators are required to reduce gas pressure at burner.
- D. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- E. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Division 15 Section "Domestic Water Piping Specialties."
- F. Install thermometer on outlet piping of domestic-water heaters.

- G. Install piping-type heat traps on inlet and outlet piping of domestic-water heater storage tanks without integral or fitting-type heat traps.
- H. Fill domestic-water heaters with water.
- I. Charge domestic-water compression tanks with air.

### 3.2 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to fuel-fired, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

### 3.3 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Division 15 Section "Mechanical Identification"

### 3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
  - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Division 1 Section "Quality Requirements" for retesting and reinspection requirements and Division 1 Section "Execution Requirements" for requirements for correcting the Work.
- C. Prepare test and inspection reports.

### 3.5 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain commercial, gas-fired, storage, domestic-water heaters.

END OF SECTION

END OF SECTION

## SECTION 15514

### BOILERS

#### 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 gas-fired, direct venting, finned water-tube boilers for heating hydronic hot water system.

##### 1.3 SUBMITTALS

- A. Product Data: Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories for each model indicated.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, required clearances, methods of field assembly, components, and location and size of each field connection.
  - 1. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.
- C. Source Quality Control Tests and Inspection Reports: Indicate and interpret test results for compliance with performance requirements before shipping.
- D. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- E. Maintenance Data: Include in the maintenance manuals specified in Division 1. Include parts list, maintenance guide, and wiring diagrams for each boiler.

##### 1.4 QUALITY ASSURANCE

- A. Listing and Labeling: Provide electrically operated components specified in this Section that are listed and labeled.
  - 1. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.
  - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.
- B. FM Compliance: Control devices and control sequences according to requirements of FM.

## SECTION – 15514 - BOILERS

- C. I=B=R Compliance: Boilers tested and rated according to the Hydronics Institute's "Testing and Rating Standard for Heating Boilers," with I=B=R emblem on a nameplate affixed to the boiler.
  - D. IRI Compliance: Control devices and control sequences according to requirements of IRI.
  - E. Comply with NFPA 70 for electrical components and installation.
- 1.5 COORDINATION
- A. Coordinate size and location of concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete."
  - B. Coordinate boilers' final locations with mechanical room layout, steel supporting rack and roof exhaust and intakes.
- 1.6 WARRANTY
- A. General Warranty: Submit a written warranty, executed by the contractor for the heat exchanger.
    - 1. Warranty Period: Manufacturer's standard, but not less than 5 years from date of Substantial Completion.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide boilers by one of the following:
  - 1. Lochinvar Corp., Model Copper-Fin II (Basis of Design)
  - 2. Raypak, Inc.
  - 3. Patterson Kelly
  - 4. RBI, Model LCD Dominator

## 2.2 COMPONENTS

- A. The Boilers and Water Heaters shall be Lochinvar Copper-Fin II and operated on Natural Gas. The Boilers and Water Heater rating shall be per schedule.
- B. The water containing section shall be of a "Fin Tube" design, with straight copper tubes having extruded integral fins spaced seven (7) fins per inch. The tubes shall terminate into a one piece, glass lined, cast iron header. There shall be no bolts, gaskets or "O" rings in the head configuration. There shall be access to the front header of the heat exchanger for the purposes of inspection,

cleaning or repair. The heat exchanger shall be mounted in a stress free jacket assembly in order to provide a "free floating design" able to withstand the effects of thermal shock. The Boiler shall bear the ASME "H" stamp for 160 psi working pressure and shall be National Board listed. The complete heat exchanger assembly shall carry a ten (10) year limited warranty.

- C. The combustion chamber shall be sealed and completely enclosed with ceramic fiberboard insulation. A burner/flame observation port shall be provided at both ends of the boiler. The burners shall be a premix design, constructed of high temperature stainless steel and fire on a horizontal plane. The Boiler shall have two multi-speed combustion air blowers to precisely control the fuel/air mixture for maximum efficiency.
- D. The Boiler shall be constructed with a heavy gauge galvanized steel jacket assembly, primed and pre-painted on both sides with a minimum dry film thickness of 0.70 mils. The jacket design shall allow single unit venting connection without the use of external draft hood devices.
- E. The Boiler shall be certified and listed by C.S.A. International under the latest edition of the harmonized ANSI Z21.13 test standard for the US. The Boiler shall comply with the energy efficiency requirements of the latest edition of the Ashrae 90.1 standard. The Boiler shall operate at a minimum of 84% thermal efficiency.
- F. Standard operating controls shall include a 3-stage digital temperature controller with an LCD display to control water temperatures and a safety high limit control. The digital temperature control shall display boiler inlet temperature and boiler outlet temperature as well as individual stage set points and differentials. The digital controller shall have a  $\pm 1^\circ$  f accuracy. The control panel shall have a master switch with an indicating light and sequential and diagnostic indicator lights.
- G. The Boiler shall provide 3 stages of control. Each stage shall provide for on/off control of individual valves and increase/decrease control of the combustion air fans to maintain maximum efficiency at all stages of operation.
- H. The standard operating control system shall include redundant proven pilot hot surface ignition systems with full flame monitoring capability. Each ignition system shall be able to function independently in the event of a failure in one system. Multiple main gas valves with redundant valve seats and built in low gas pressure regulators shall be supplied as standard. Gas valves will be referenced to the combustion chamber to ensure proper air/gas mixture for efficient combustion.
- I. Additional standard controls shall include a flow switch, low air/blocked flue pressure switch for each fan, low voltage transformer for the control circuit, 7 amp circuit breaker and an ASME pressure relief valve. All natural gas models will be equipped with an automatic reset low gas pressure switch. The manufacturer shall verify proper operation of the burners, all controls and the heat exchanger by connection to water and venting for a factory fire test prior to shipping. A quality test report shall be shipped with each unit.
- J. A 24 VAC control circuit and components shall be used. All components shall be easily accessed and serviceable. All components shall have multi-pin plug in type connectors to ease service, troubleshooting and lower removal and replacement cost. The Boiler must be able to maintain approximately 50% operating capacity in the event of a failure of any one (1) control component, ie: gas valve, combustion air fan, ignition control, igniter or pressure switch.
- K. The units control panel shall contain the controllers LCD display and diagnostic information center containing 11 individual indicators of current unit status.

- L. The Boiler shall be approved for indoor installation. The Boiler shall be approved for direct venting. Direct vent installations require the use of A129-4C vent materials.
- M. The boiler shall have an independent laboratory rating for oxides of nitrogen (NOx) of less than 30 ppm corrected to 3% O<sub>2</sub>.
- N. CSD-1 note: due to the large discrepancy in CSD-1 requirements from state to state, please confirm to the factory all controls required in this jurisdiction.
- O. Gas Train: The gas train shall include a lubricated manual gas valve, pilot gas pressure regulator, and two-stage hot surface ignition with electronic supervision.
- G. Industry Standard Options shall Include:
  - 1. Factory Mutual (FM)
  - 2. Industrial Risk Insurers (IRI)
  - 3. Improved Risk Mutual (IRM)

### 2.3 BOILER TRIM

- A. Safety-Relief Valve: 10psi above maximum working pressure ASME rated, factory set to protect boiler and piping.
- B. Gage: Combination water pressure and temperature.
- C. Low-Water Cutoff and Inlet Flow Switch: Prevent burner operation when water falls below a safe level or when water flow is low.
- D. Operating Controls: Prewired, factory-assembled electric control including pilot safety and thermocouple transformer, 24-V gas valve, manual main and pilot valves, and junction box.
- E. Operating Temperature Control: Electric indoor/outdoor controller maintains boiler water temperature with outdoor temperature reset.
- F. High Limit: Temperature control with automatic-reset limits boiler water temperature.
- G. Starters and Disconnects.
- H. Boiler stacks combustion and roof vent caps.
- I. IRI Gas Train with Regulator for each boiler.

### 2.4 ACCESSORIES

- A. Circulator: Horizontal shaft, single stage, direct connected, with resiliently mounted motor for in-line mounting, oil lubricated. Circulator to be bronze fitted for domestic water.

- B. Expansion Tank: Welded steel, ASME tested and stamped, rated for working pressure of 125 psig, with flexible diaphragm sealed into tank, pressure gage, and air-charging fitting.

## 2.5 MOTORS

- A. Motor Construction: NEMA MG 1, general purpose, continuous duty, Design B.
- B. Enclosure Type: Open drip-proof motors where satisfactorily housed or remotely located during operation.

## 2.6 SOURCE QUALITY CONTROL

- A. Test and inspect boilers according to the ASME Boiler and Pressure Vessel Code, Section IV.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine area to receive boilers for compliance with requirements for installation tolerances and other conditions affecting boilers' performance. Do not proceed with installation until unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install boilers level and plumb, according to manufacturer's written instructions and referenced standards.
- B. Install gas-fired boilers according to NFPA 54.
- C. Boilers shall be supported on 4-inch thick concrete base 6 inches larger on each side than base of unit.
- D. Install electrical devices furnished with boiler, but not specified to be factory mounted.
- E. The boilers shall be staged to meet building demand. Coordinate with the control contractor on staging sequence and furnish staging controller(s) and/or auxiliary contacts.

### 3.3 CONNECTIONS

- A. Connect gas piping full size to boiler gas-train inlet with union(s) and gas regulator(s).
- B. Connect hot-water piping to supply- and return-boiler connections with shutoff valve and union or flange at each connection.
- C. Install piping from safety-relief valves to nearest floor drain(s).

- D. Venting shall be classified Category I, negative draft, non-condensing, to use type "B" double wall venting materials. The DirectAire venting systems shall allow direct connection of a duct to supply combustion air to the unit from the roof.
- E. Electrical: Comply with applicable requirements in Division 16 Sections.
- F. Ground equipment.
  - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

### 3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to supervise the field assembly of components and installation of boilers, including piping and electrical connections. Report results in writing.
  - 1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Hydrostatically test assembled boiler(s) and piping, according to applicable sections of the ASME Boiler and Pressure Vessel Code.

### 3.5 CLEANING

- A. Flush and clean boilers on completion of installation, according to manufacturer's written instructions.
- B. After completing boilers installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes including chips, scratches, and abrasions with manufacturer's touchup paint.

### 3.6 COMMISSIONING

- A. Engage a factory-authorized service representative to provide startup service.
- B. Verify that installation is as indicated and specified.
  - 1. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements in Division 16 Sections. Do not proceed with boiler startup until wiring installation is acceptable to equipment Installer.
- C. Complete manufacturer's installation and startup checklist and verify the following:
  - 1. Boiler is level on structural steel and/or concrete base.
  - 2. Flue and chimney are installed without visible damage.
  - 3. No damage is visible to boiler jacket, refractory, or combustion chamber.

4. Pressure-reducing valves are checked for correct operation, relief pressure and circuit flow setter are set.
  5. Clearances have been provided and piping is flanged for easy removal and servicing.
  6. Heating circuit pipes have been connected to correct ports.
  7. Labels are clearly visible.
  8. Boiler, burner, and flue are clean and free of construction debris.
  9. Pressure and temperature gages are installed.
  10. Control installations are completed including boiler staging.
- D. Ensure pumps operate properly.
- E. Check operation of pressure-reducing valve on gas train, including venting.
- F. Check that fluid-level, flow-switch, and high-temperature interlocks are in place.
- G. Start pumps and boilers, and adjust burners to maximum operating efficiency.
1. Fill out startup checklist and attach copy with Contractor Startup Report.
  2. Check and record performance of factory-provided boiler protection devices and firing sequences.
  3. Check and record performance of boiler fluid-level, flow-switch, and high-temperature interlocks.
  4. Run-in boilers as recommended or required by manufacturer.
- H. Perform the following tests for each firing rate for high/low burners and for 100, 66, and 33 percent load for modulating burners. Adjust boiler combustion efficiency at each firing rate. Measure and record the following:
1. Gas pressure on manifold.
  2. Combustion-air temperature at inlet to burner.
  3. Flue-gas temperature at boiler discharge.
  4. Flue-gas carbon-dioxide and oxygen concentration.
- I. Measure and record water flow rate, pressure drops, and temperature rise through each boiler.
- J. Inspect expansion tank, makeup water supply, tank pressure, pressure-reducing valve, water level, and backflow preventer.

### 3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel as specified below:
1. Operate boiler, including accessories and controls, to demonstrate compliance with requirements.
  2. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
  3. Review data in the maintenance manuals. Refer to Division 1 Section "Contract Closeout."

**SECTION 15625****REHABILITATION OF EXISTING MCQUAY CHILLER  
& COOLING TOWER****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 inspection and refurbishment of an existing electrically driven, water-cooled chiller and one factory-fabricated, mechanical-draft cooling tower.
- B. Engage a factory-authorized service representative to conduct a complete examination of the units as well as a leak test to discern the condition of the chillers' compressors, oil, refrigerant and internal components. Including purge units, refrigerant alarm and electrical connections. Report results in writing with recommendations made as a result of the inspection for repairs and/or component replacements and maintenance.
- C. Engage factory-authorized service representative to conduct a complete examination of the units to discern the condition of the field-assembled cooling tower and all components. The inspection is to include structural integrity, tower casing, motor, fan, gear reducer, drive shaft, water-flow path to include drift eliminators, hot and cold basin, nozzles, piping and electrical connections. Report results in writing with recommendations for repairs, component replacements and maintenance.

**1.3 SUBMITTALS**

- A. Product Data:
1. For Chiller: Include refrigerant; rated capacities at scheduled flows; furnished specialties; and accessories.
  2. For Cooling Tower: Include rated capacities, pressure drop, fan performance, rating curves with selected points indicated, startup instructions and furnished specialties
  3. Wiring Diagrams: Detail wiring for power, signal, and control systems and manufacturer-installed and field-installed wiring.
- B. Report results in writing with recommendations made as a result of the inspection for repairs and/or component replacements and maintenance.

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- C. Product Certification: Certification of performance after all recommendations have been implemented in according to ARI 550 that the chiller have been started and function properly.
  - D. Product Certification: Certify cooling tower's thermal performance is in according to CTI 201 after all recommendations have been implemented.
  - E. Maintenance Data: For the existing chiller and tower to include in maintenance manuals specified in Division 1.
- 1.4 QUALITY ASSURANCE
- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
  - B. ASHRAE Compliance: Comply with ASHRAE 15 for chiller leak testing.
  - C. UL Compliance: Comply with UL 465.
  - D. Comply with NFPA 70.
- 1.5 WARRANTY
- A. All major assemblies components and/or parts replaced by the factory-authorized service representative shall be guaranteed by the contractor, against defects in material and workmanship for a period of not less than one (1) year, and/or manufacturers warranty from the date of completed installation.
  - B. The Contractor shall, upon replacement of a major assembly/component and/or part, furnish a written warranty for said component.

## PART 2 - PRODUCTS

- 2.1 Manufacturer: McQuay
- A. Existing Chiller  
McQUAY PEH050; Capacity 90 tons
- 2.2 Manufacturer: Marley Towers, SPX Technologies
- A. Existing Marley Towers  
MARLEY # 4862, Capacity 120 tons
- 2.3 BASIN HEATERS

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- A. Basin-Heater Capacity: Maintain basin water temperature at 40 deg F when ambient temperature is 0 deg F and wind velocity is 10 mph. Heater Type shall be Electric immersion heaters with thermostat and low-water cutout switch, enclosed in weatherproof housing suitable for field wiring.
- 2.5 TOWER WATER-LEVEL CONTROL: Manufacturer's standard mechanical makeup water valve bronze float with an adjustable linkage.

## PART 3 - EXECUTION

## 3.1 GENERAL

- A. Perform all repairs, part replacements, tests and lubrication required by the reports generated by the factory-authorized service representatives after a complete examination of the chillers and cooling towers.

## 3.2 INSTALLATION

- A. Check if chiller and Tower are per manufacturer's recommended clearances for service and maintenance.
- B. Electrical Wiring: Install electrical components, devices, and accessories furnished by chiller manufacturer, including remote flow switches and purge unit if required.
- C. Electrical Wiring: Install electrical devices furnished by cooling tower manufacturer including basin heaters.

## 3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties. The following are specific connection requirements:
  - 1. Extend safety-relief valves or rupture-disc discharge piping from chiller and purge condenser receiver to exterior of building.
- B. Electrical: Comply with Division 16 Sections.
- C. Ground equipment.
  - 1. Verify that electrical connectors and terminals are tight in accordance to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

## 3.4 CHILLER PREVENTATIVE MAINTENANCE MINIMUM CHECK LIST

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## A. General:

The following minimum tasks shall be performed in order to properly evaluate the chiller status and prepare the unit for connection to the central plant.

## B. Check the Compressor-Motor Assembly for the following items and performing PM Tasks as indicated:

- Recording voltages
- Meging and recording motor winding resistance
- Checking inlet vane operator and linkage; lubricating where required

## C. Checking the Compressor Oil System for the following items:

- Changing oil, oil filter and dryer
- Conducting analysis on oil at an independent laboratory
- Checking heater and thermostat
- Checking all other oil system components including cooler, strainer and solenoid valve where applicable

## D. Checking Motor Starter and performing the following tasks:

- Running diagnostic check
- Checking all terminals and tightening connections

## E. Review the Control Panel for the following items:

- Running diagnostic check
- Checking safety shutdown operation
- Checking all terminals and tightening connections
- Checking Display Data accuracy and set points

## F. Replace the Purge Units:

- Install the units per manufacturer's recommendation.
- Furnish electrical and control wiring.
- Checking all other components for proper condition and operation; recording pressure control set point

## G. Checking the Condenser for the following items:

- Checking flow switch operation
- Removing condenser head and inspecting end sheets
- Mechanically brush cleaning condenser water tubes

## H. Checking the Cooler for the following items:

- Checking flow switch operation
- Checking refrigerant level

## I. Checking the System for the following items:

- Conducting a leak check
- Recording condition of sight glasses
- Checking the refrigerant cycle to verify the proper operating balance
- Checking condenser water and chilled water heat transfer

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- J. General items included:
- Cleaning equipment and surrounding area upon completion of work
  - Consulting with the operator
  - Report results and any recommendations
- K. Conduct an Eddy current test to provide the owner with a report on the status of the chiller tubes:
1. Remove the evaporator head
  2. Perform Eddy Current Tube Analysis of evaporator and condenser tubes.
  3. Replace evaporator and condenser heads.
  4. Submit a detailed report defining any defects found, and recommend corrective action.

### 3.5 COOLING TOWER PREVENTATIVE MAINTENANCE MINIMUM CHECK LIST

A. General

The following minimum tasks shall be performed in order to properly evaluate the cooling tower status, and prepare the units for connection to the central plant.

B. Motor inspection:

Inspect the mechanical integrity, bearing lubrication and insulation integrity of the cooling towers' motor. Inspect the motor housing for damage or looseness, and remove any oil, dust or scale deposits from the motor. Grease the motor's ball bearings if the bearings feel rough or binds in spots, they should be replaced. Replace the oil regardless of contamination. Check the insulation resistance of the motor using a megohmmeter (with the motor off), apply potential to the winding for one minute before taking a reading.

C. Gear reducer inspection:

Inspect the mechanical integrity and oil level of the cooling tower's gear reducer. Add oil if required. Check that all the assembly bolts and cap screws are tight. Ensure that the oil plugs and pipe connections are free from leaks, verify that their connections are in place and ensure the vent on the gear reducer is clear. Inspect and tighten as required the mechanical equipment anchor bolts, drive shaft coupling bolts and coupling screws. Check the exterior of gear reducer for rust or chipped paint. If needed, touch it up with a coat of epoxy paint.

D. Drive shaft inspection:

Inspect the drive shaft for corrosion, cracking of rubber bushings and couplings, and looseness of hardware. Replace all rubber components showing excessive deterioration, and tighten all loose nuts and screws. If vibration readings indicate an imbalance or misalignment, follow the instructions found in the manufacturer's service manual.

E. Fan inspection:

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Inspect mechanical integrity, blade-pitch angle, torque settings and blade-tip clearance. Inspect the fan guard for damage and missing fasteners, and replace any missing components. Inspect each fan blade carefully for damage and corrosion. Remove any accumulated scale or dirt. Check to see that the drain holes of the blade are clear, and rotate the fan to ensure that the blade tips don't make contact with the fan's cylinder walls. Check the performance of the motor load. The calculated horsepower should equal, but not exceed, the specified contract horsepower. Measurements used in the above calculations must be made with hot water flowing through the tower. To obtain contract horsepower, repitch the blades as required. For specific guidelines on repitching, refer to the manufacturer's service manual.

F. Vibration motor & gearbox survey:

Use an accelerometer observe the frequency domain spectrum of the vibration signal in units of velocity. It is important to use the spectrum chart for proper analysis. To identify the frequencies for the unit model number, refer to the critical vibration frequencies section in the manufacturer's service manual.

G. Check the water-flow path

The water-flow path includes the hot water basin, nozzles, fill/cooling media, cold-water basin, and makeup and flow valves at the tower. For maximum performance, the flow must be equally distributed, unimpeded and near recommended design

H. Splash fill.

It is important to check the condition of the splash bars – look for sagging, fallen, misplaced, broken or decaying splash bars, and excessive buildup of scale. Replace any grids showing excessive deterioration.

I. Drift eliminators.

The cleanliness and effectiveness of drift eliminators are critical in preventing the spread of Legionella pneumophila bacteria. Make certain all air passages are clear of debris and all the components are properly installed. Check the condition of the seals to assure that water can't bypass the eliminators through deteriorated or missing seals.

J. Hot and cold water basin/nozzle inspection.

Inspect the hot and cold water basin and nozzle. Look for deterioration of the basic material, and check for decay and corrosion. Also, look for leaks between adjoining panels to prevent hot water streams from bypassing the fill. Inspect the integrity of the basin support members to ensure their integrity for continued service, including the tightness of bolted joints in steel basins. Check the iron distribution piping for corrosion and loss of coating material. Spot-check for leaks and tightness of bolted joints, and look for signs of deterioration on PVC pipe.

K. Inspect the distribution valve components for corrosion or signs of wear. Operate the valve manually through its full range of travel, and reset the valves to balance the water flow to all basin sections. Temporarily remove the nozzle and disassemble to check for clogging or signs of internal wear. Be sure that all nozzle components such as removable splash plates are in place and working properly. Also, look for any loss of material resulting from corrosion or erosion, and check for adequate connection to the branch pipe or distribution to basin floor. Any debris found in the basin must be removed. Also, check the condition of the sump, sump screen

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and anti-cavitation device (if one is used). The sump screen should be free of trash. Note any corrosion or loss of metal in cold-water basin components. Inspect and repair any signs of leaks or breakdown of sealing material

L. Makeup Valve.

Replace the makeup valves to ensure cooling-system water supply. Operate the float valve or float switch manually to make sure that it opens and closes properly.

M. Tower Casing.

Look for leaks, cracks, holes or general deterioration, including air leaks between adjoining panels. Repair as required. Make sure that the hardware is tight and in good condition, and inspect the steel casing for corrosion or scale buildup. Make sure that access doors are in good working order and that they are shut tightly when the tower is in operation.

### 3.6 ADJUSTING

A. Set and balance condenser-water flow to each tower inlet.

B. Adjust water-level control for proper operating level.

### 3.7 CLEANING

A. After completing installation, including outlet fittings and devices, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

### 3.8 CHILLER COMMISSIONING

A. Verify that installation complies with the Contract Documents.

B. Engage a factory-authorized service representative to perform startup service.

1. Fill out startup checklists and attach copy with Contractor Startup Report.

C. Complete installation and startup checks according to manufacturer's written instructions and check for the following items:

1. No physical damage to unit.
2. Unit is level.
3. Vibration isolation and flexible pipe connections are installed.
4. Clearances have been maintained and piping is installed for easy removal for service and cleaning.
5. Chilled- and condenser-water pipes have been connected to correct ports.
6. Labels and safety instructions are clearly visible.
7. Oil levels are as recommended by manufacturer.